**Department of Economics**

# Three Essays on International Trade

## Davide Sala

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

Florence, June 2007

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# DEDICATION

To my Father and Mother.

# ACKNOWLEDGMENTS

# CONTENTS

# Part I

# Introduction

International trade and trade liberalization is the logical nexus through this thesis.

Not only trade volumes have largely expanded after World War II, but - perhaps less known - also the number of developing and underdeveloped countries opening their markets to international trade has increased sharply in the 80s and the 90s. During the period 1960-1998 the average share of import plus export in total GDP rose from less than 0.55 up to 0.75 and the total volume of merchandise trade rose steadily at a rate of 10.7%. The greater openness of many developing countries is mirrored by the large membership WTO has reached - almost 150 countries. While the number of participating countries at the first round of GATT in 1947 were a bit more than 20, slightly above 100 were sitting in the last GATT round (the Uruguay round).

The number of foreign markets opened to trade - together with the transportation costs and the fixed costs associated to trade - are important elements of a firm's decision to export. As well established in the literature, declining costs associated to trade will push firms to greater exporting. However, recent microeconometric evidence shows that trade liberalization is associated also with productivity increments at the firm level, a fact which can not be accounted by our theoretical trade models.

The first chapter of this thesis (joint with Antonio Navas) focuses on this innovation aspect related to trade liberalization. We introduce into a standard trade framework the possibility of costly process-innovations investments. Firms undertake these investments with the aim of improving the efficiency of their production stage and lowering their unit cost of production. More specifically, firms can decide to costly adopt a more productive available technology than the current in use. Interestingly, we show that trade liberalization matters for process-innovation at the firm-level. The reduction of both variable and fix cost of trade as well as the openness of new markets provide firms with the incentives to adopt the high-productive technology. This, in turn, has positive effects on the productivity level of the industry where such changes occurs.

The cooperation with Antonio Navas is the convergence of my interests for trade and its effects on firms' innovation activities and his interests for the innovation activity as the engine of growth in open and integrated markets.

There is little disagreement that increased volumes of trade and the growing number of participating countries into world trade relations can be ascribed among the major success of multilateral trade liberalization within the GATT/WTO. As a result of subsequent and awkwardly multilateral negotiations, all countries have put a great effort to reduce their tariff-protection, so that tariff rates across goods have considerably declined through the

70s and the 80s. However, multilateral liberalization has proceeded parallel to two other important phenomena. First, as the level of tariffs has fallen, governments have devised other forms of protection - namely quotas and other non-tariff barriers - for sectors facing increased foreign competition. This has brought up substantial consensus upon the gradual but fundamental change in the nature of trade protection from the mid 60s to the mid 80s. Second, countries have liberalized trade on a preferential basis, rather than on a MFN (Multi-favored-Nation) basis as permitted by GATT. Starting from the 90s, regional integration has experienced a spurt and it has represented a major feature of International Relations.

The second chapter aims at reconciling these events looking at the implications that different trade policies have for the formation of Regional Trade Agreements. In particular, it ascertains the proliferation of regionalism in the 90s to the change in the nature of trade protection occurring from the mid 60s to the mid 80s. While the welfare outcome of a Regional Trade Agreements in presence of tariff restricted trade is ambiguous and difficult to sign - as well established in the literature - I prove Regionalism Integration yields welfare gains in presence of quota-restricted trade. This result can provide an explanation for a renewed policy interest for regionalism in the 90s, when trade had become more quota-restricted than in the 70s. Especially in the second best world in which policy makers typically operate, attempting to reduce some distortions while others remaining firmly in place does not necessarily increase welfare. This result may constitute then a simple rule - a rule of thumb - telling them "which way is up".

The third chapter looks at the growth implication of Regional Integration. Indeed, the current regionalism can be distinguished from the regionalism of the 1960s in two important respects. First, the regionalism of the 1960s represented an extension of the import-substitution industrialization strategy from the national to the regional level and was therefore inward-looking. The current regionalism is by contrast taking place in an environment of outward-oriented policies. Second, in the 1960s developing countries pursued regionalism integration (RI) exclusively with other developing countries. Today these countries have their eyes on integration with large developed countries. Interestingly, the fastest growing component of world trade is North-South, and the North-South trade agreements that have flourished in the recent wave of Regional Integration have presumably contributed to stimulate such trade flows.

North-South integration has therefore appeared at many policy makers as a growth-conducive policy. The chapter reviews recent theoretical contributions to emphasize what it can be learnt from endogenous growth theory applied more specifically to regional integration. The predictions from these models are then useful to interpret the mixed empirical

evidence on the growth effect of regional integration. From my survey I conclude that we still know very little about the long run consequences of regional integration and further research on the topic is desirable. However, the actual knowledge seems to suggest that a successful growth conducive regional integration should combine trade liberalization with the promotion of good and stable institutions. In this respect, the European integration represents a unique example and the good economic performance of Ireland, the Mediterranean countries as well as of the Central and Eastern European countries calls for a better understanding of the nexus between growth and trade and institutional integration.

# Part II

# Chapters

# CHAPTER 1

# TECHNOLOGY ADOPTION AND THE SELECTION EFFECT OF TRADE

(Joint with Antonio Navas)

## 1.1   Introduction

Longitudinal micro-data has revealed *i)* the reallocation of output across plants (*between effect*) and *ii)* productivity growth in the individual plants/firms are the two main sources of productivity growth at the industry level (*within effect*).[1]

The first effect is at the heart of the recent literature on heterogenous-firm models pioneered by Melitz (2003) and Bernard et. al. (2003). These models predict heterogenous responses to reduced trade costs across firms, including entry into exporting by some and increased failure by others. As a result, when trade costs fall, industry productivity rises both because low-productive non-exporting firms exit and because high-productive firms are able to expand through exporting. In these models, it is the reallocation of activity across firms - not intra-firms productivity growth - that boosts industry productivity.

In contrast, the aim of our paper is to stress the gains via the second microeconomic channel (*ii*), focusing on endogenous technology adoption within firms, but still building on a heterogenous firms modelling setup. We show that plant productivity actually rises in response to lower trade costs, a result beyond the existing literature and motivated by the empirical relevance that within-plant productivity improvements play in the productivity growth of an industry.

For instance, the right shift of the Canadian productivity distribution of manufacturing firms in 1996 compared to 1988 following the Canada-U.S. FTA documented in Trefler (2005) can be ascribed to both effects. Low productive firms that either exit or downsize following trade liberalization shrink the left tail of the distribution in 1996 relative to 1988, while high productive firms expanding their foreign sales through exporting contribute to the fatter

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[1]See Bartelsman and Doms (2000) for a recent review of the studies using the Longitudinal Research Database (LRD). See Bernard, Eaton, Jensen and Kortum (2003) for evidence on the degree of heterogeneity across firms in productivity as well as in innovation activities and export performances in nearly all industries examined. Finally the role of trade in the success and failure of firms in developing countries is reviewed by Tybout (2000).

right tail of the (size weighted) distribution in 1996 (*between effect*).

This does not exhaust the contribution of trade to aggregate productivity gains at the industry level. As reported in Trefler (2004), U.S. trade concessions to Canada has led to increases in productivity at surviving plants, contributing considerably to the thicker right tail of the distribution in 1996 too (*within effect*).

This effect is what Foster, Haltiwanger and Krizan (FHK, henceforth, 2001) call the "*within*" effect in their decomposition of the aggregate productivity growth and it constitutes the bulk of overall labour productivity growth in industrial economies. Likewise - as studied by Bustos (2005) - Argentinian exporters have adopted more innovative technologies after Argentina's trade liberalization of the 90s and - as reported by Bernard, Jensen and Schott (2006) - plant-productivity improvements are associated to declining industry-level trade costs in the US manufacturing industry.

Moreover, all these studies reveal that within-plant productivity growth was stronger among the group of exporters and among the most export oriented industries. This suggests that there is selection on the basis of innovation status and leads us to model firm's heterogeneity in productivity levels, so that the innovation type can be identified and her responses to trade reforms analyzed. This can not be achieved in the simpler Krugman (1980) setup, as all firms are equally productive and no firm-selection on the innovation status is possible.

We add a technology-adoption choice into the Melitz (2003)'s framework. After entry into the industry, all firms have the option to implement a more productive technology at the expense of higher "implementation" costs or adoption costs.

We think broadly of the adoption of a new technology, including the introduction of a new management, the re-organization of labour, the qualification and training of employees and leading to the reduction of the unit-cost of production. Hence, the intra-firm productivity increase is modeled as a costly investment within the firm to reduce its marginal cost of production and we shall assume there are no technological spillover across firms, as in Cohen and Klepper (1996a) and (1996b). This implies that the return of a process innovation due to a reduction of the variable costs is positively related to the number of internal applications which depends on the firm's scale.

Trade liberalization entails an improved and/or new access to product markets as well as an increased number of competitors. As a result, domestic exporters increase their combined market share, as they conquer part of the exiting firm's market as well as they gain a freer access to foreign markets. Therefore, by raising the scale of production of some exporters, trade strengthens their incentive for vertical innovation. This leads a group of exporters, who ex-ante were not productive enough to perform vertical R&D, to raise their productivity.

This is the new and main result of our model and, mostly important, not only holds true in the transition from autarky to trade (i.e. when a country first opens to trade), but it also applies when transportation costs - a proxy for trade barriers.- are reduced. Hence, it applies to incomplete steps of trade liberalization or partial tariff reforms, of which the Canada-US Free Trade Area (CUSFTA) and Argentinian trade liberalization of the 90s are two examples. This result allows to relate our model to the available evidence in Bernard (2006), Trefler (2004) and Bustos (2005).

The model is closely related to Bustos (2005), although our motivation and aim are different from hers. In common, they have the relation between the engagement of a firm in trade with the adoption of a more productive technology. Indeed, in both models firms are confronted with the option of adopting an alternative technology to the current employed, featuring a lower variable cost, but a higher fixed cost. While in Bustos (2005), the alternative technology is common to all firms, in our framework the alternative technology is firm-specific, matching the evidence on site-to-site variations in the success of implementing new technologies (e.g. Coming (2007) and Bikson et. al. (1987)).

In this respect, our model is similar to Helpam, Melitz and Yeaple (HMY henceforth, 2004) where the *proximity-concentration* trade-off determines whether a firm opts for FDI or exporting as a mode to serve a foreign market. In our framework, the trade off being between *efficiency-implementation costs* and shaping the firm's choice between two its alternative technologies (modes of production).

A second important difference with Bustos (2005) is that we present a general equilibrium set up rather than resting on a partial equilibrium approach. The new insight is that trade can both favour or deter technology-adoption as opposed to always favour it as it occurs in the partial equilibrium analysis. On one hand, trade lowers the cost to benefit ratio of implementing a more productive technology because it increases the access to foreign markets and therefore it increases the total demand for a firm's product. On the other, trade increases competition on the goods market (i.e. lower the demand for the firm's product) and it is a costly activity, putting grater pressure on the scarce input resources. This leads to a higher real wage and, overall, to a higher cost to benefit ratio of technology implementation. The latter effect - which is offsetting the former positive effect of trade - is absent in the partial equilibrium analysis.

We shall show the former can dominate the latter and therefore, when trade costs fall, productivity can increase at the plant level, in particular among the low-productive exporters.

This is one difference with Yeaple (2005) where all exporters adopt necessarily the more

innovative technology and therefore, no selection on the basis of innovation status is possible. In his model, the reduction of transportation costs can only lead the domestic producers to adopt an innovative technology.

This model has some feedback for productivity studies, which are hardly related to trade. Our model suggests that a greater degree of openness in the trading relations can be partly responsible for the importance of the "*within*" component for the productivity growth in industrialized countries, as reported by Bartelsman, Haltiwanger and Scarpetta (BHS henceforth, 2004).

Finally, Baldwin and Nicoud (2005) have recently questioned that the positive effect of trade on aggregate productivity derived in a static model of trade maps into a dynamic growth effect. They highlight a static versus dynamic trade-off in terms of productivity gains: freer trade raises the aggregate productivity level through the selection effect, but at the same time it also rises the cost of creating new varieties since the expected survival probability into the industry is smaller. In turn, productivity growth slows down. Gustafsson and Segerstrom (2006) have shown that this result crucially depends on the strength of knowledge spillover assumed in the R&D technology. Our model suggests that were firms performing vertical innovation, the selection effect could generate productivity growth by forcing the least efficient firms out of the market and reallocating market shares across the most productive firms. Indeed, higher market shares incentive process-innovation leading to productivity growth.

The paper is organized as follows. Section 1.2 presents the model in the closed economy to be compared with the open economy in Section 1.3. This comparison is illustrative of the effects of trade on the aggregate productivity growth to be confronted with the available evidence. Section 1.4 discusses some drawbacks of the model and possible solutions to them. Finally the last section concludes.

## 1.2 The Closed Economy

In this section we extend Melitz (2003) to incorporate technology adoption.

### Preference

Our economy is populated by a continuum of households of measure $L$, whose preferences are given by the standard C.E.S. utility function:

$$U = \left[ \int_{\omega \in \Omega} [q(\omega)]^\rho d\omega \right]^{1/\rho}$$

where the measure of the set $\Omega$ represents the mass of available goods, $0 < \rho < 1$. Each household is endowed with one unit of labour which is inelastically supplied at the given wage $w$. The maximization of utility subject to the total expenditure $R = PQ = \int_{\omega \in \Omega} p(\omega)q(\omega)d\omega$ (where $Q$ is the aggregate good $Q \equiv U$) yields the demand function for every single variety $\omega$:

$$q(\omega) = A\left[p(\omega)\right]^{-\sigma} \tag{1.1}$$

where $A$ represents the demand level which is exogenous from the point of view of the individual supplier and $P$ is the price index of the economy, given by:

$$A = \frac{R}{\int_{\omega \in \Omega} [p(\omega)]^{1-\sigma} d\omega} = \frac{R}{P^{1-\sigma}}$$

$$P = \left[ \int_{\omega \in \Omega} [p(\omega)]^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$$

whereas

$$\sigma = 1/(1-\rho) > 1$$

is the elasticity of substitution across varieties.[2]

**Technology**

Each variety is produced by a single firm according to a technology for which the only input is labour. The total amount of labour required to produce the quantity $q(\omega)$ of the final good or service $\omega$ is given by

$$l(\omega) = f_D + cq(\omega) \tag{1.2}$$

where $f_D$ is the fixed labour requirement and $c \in [0, \bar{c}]$ the firm-specific marginal labour requirement[3].

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[2] $A$ is an endogenous variable to be determined in equilibrium, but it is a constant from the point of view of an individual supplier because of the monopolistic competition assumptions. Indeed, each variety supplier ignores that her behavior can affect the price or the quantity index, and therefore it takes A as given when it maximizes its profits.

[3] Clearly, this technology exhibits increasing return to scale. $f_D$ can be thought as all those activities like marketing or setting up a sales network which are independent of the scale of production. Then, it can be seen as the fixed cost of serving the domestic market. The inverse of $c$ is a measure of a firm's productivity in the production process.

**Entry - Exit**

To enter the industry, a firm must make an initial investment, modeled as a fixed cost of entry $f_E > 0$ measured in labour units, which is thereafter sunk. There is a large (unbounded) pool of prospective entrants into the industry and prior to entry, all firms are identical. An entrant then draws a labour-per-unit-output coefficient $c$ from a known and exogenous distribution with cdf $G(c)$ and density function $g(c)$ on the support $[0, \overline{c}]$. Upon observing this draw, a firm has three options. Like in Melitz (2003), it may decide to exit or to produce. If the firm does not exit and/or produces, it bears the additional fixed overhead labour costs $f_D$. Additionally to Melitz (2003), it can opt for adopting a more productive technology. By investing $f_I$ units of labour, the firm can produce at a lower cost $\gamma c$ ($\gamma < 1$). This is one time investment and, ultimately, it is a choice among a *well established* technology ("*baseline*") - characterized by "implementation" costs $f_D$ and variable costs of production $c$ - and an *innovative one* - featuring lower variable costs ($\gamma c$), but higher fixed cost of adoption ($f_D + f_I$). The trade-off being between *efficiency-implementation costs*, much like of the *proximity-concentration* trade off for horizontal FDI in HMY. Indeed, the technology choice option is formally quite close to the FDI decision in HMY and, therefore, compared to the Melitz model, we add an extra firm-type in the economy, namely the innovating firm, the equivalent of the firm performing FDI in HMY.

We are assuming that technological uncertainty and heterogeneity of the Melitz-type relates to what we have called a "*baseline*" technology. Having found out about their idio-syncratic productivity in the variable cost part of this technology, all firms face the option of adopting an alternative technology, what we have referred to as the "*innovative*" one. While the extra fixed cost is the same for each firm, the reduction in variable cost is proportional to the firm's idiosyncratic "marginal cost draw" given from its own entry. Since the Melitz-type entry leads to heterogeneity in variable cost, the technological option is differently attractive for different firms, relative to their "*baseline*" technologies. In other words, each firm has its own distinct alternative technology option. This could be rationalized as differences in "implementation process" across firms. Adopting a technology requires an active engage-ment of the adopter - namely a series of investments undertaken by the adopter - beyond the selection of which technology to adopt. These investments are often label "technology implementation process" and are empirically the main source of site-to-site variations in the success of implementing new technologies.[4] In turn, better implementation makes new technologies more productive.

Finally, as in Melitz (2003) every incumbent faces a constant (across productivity levels)

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[4]See Comin (2007) and Bikson et. al. (1987).

probability $\delta$ in every period of a bad shock that would force it to exit.

When entrance is successful, a new variety/service is created and introduced into the good market - *product innovation* (or *horizontal innovation*) On top of this, in our model, firms can implement more efficient technologies. The consumers may benefit from this form of innovation in the form of a reduction of good prices. We shall refer sometimes to this reduction of costs in the production stage with an abuse of terminology as *process* or *vertical innovation* .

### Prices and Profits

A producer of variety $\omega$ with labour-output coefficient $c$ faces the demand function (1.1) and charges the profit maximizing price:

$$p(\omega) = \frac{\sigma}{\sigma - 1}wc \equiv p_D(c) \tag{1.3}$$

where $\frac{\sigma}{\sigma-1}$ is the constant markup factor and $w$ is the common wage rate, hereafter taken as the numeraire ($w = 1$). A variety $\omega$ produced with the innovative technology is sold at $p(\omega) = \frac{\sigma}{\sigma-1}\gamma c = \gamma p_D(c) \equiv p_I(c)$. As a result, the effective price (1.3) charged to consumers by non-innovator is higher than the price $p_I(c)$ charged by an innovator. Since demand (1.1) is symmetric and isoelastic, the equilibrium price does not depend on variety-characteristics, but only on the firms specific marginal cost times a constant markup. Therefore, when (1.3) is substitute in (1.1):

$$q(\omega) = A \left[ \frac{\sigma}{\sigma - 1}c \right]^{-\sigma} \equiv q_D(c) \tag{1.4}$$

and likewise the output of an innovating firm producing variety $\omega$ is $q_I(c) = \gamma^{-\sigma}q_D(c)$. It follows the profit of firm type $D$ and firm type $I$ ($D$ for a producer with a "traditional" technology, $I$ for an a firm with innovative technology) are:

$$\pi_D(c) = \frac{r_D(c)}{\sigma} - f_D = Bc^{1-\sigma} - f_D \tag{1.5}$$

$$\pi_I(c) = \frac{r_I(c)}{\sigma} - f_D - \delta f_I = B(\gamma c)^{1-\sigma} - f_D - \delta f_I \tag{1.6}$$

where $r_s(c) = p_s(c)q_s(c)$, $s = D, I$ is the revenue of firm type $s$ and $B = (1/\sigma)A\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma}$ is taken as a constant by a single producer and it represents the level of demand in the country

since it is only a function of $A$ and $\sigma$.[5] The innovation cost $f_I$ into the profit function is weighted by the exogenous probability of exiting . Given that the innovation decision occurs after firms learn about their productivity $c$ and since there is no additional uncertainty or time discounting other than the exogenous probability of exiting, firms are indifferent between paying the one time investment cost $f_I$ or the per-period amortized cost $\delta f_I$. We shall adopt the latter notation for analytical convenience.

Using (1.4) and (1.3), we have the ratio of any two firms's output and revenues only depend on the ratio of their productivity levels:

$$\frac{q(c_1)}{q(c_2)} = \left[\frac{c_1}{c_2}\right]^{-\sigma}, \quad \frac{r(c_1)}{r(c_2)} = \left[\frac{c_1}{c_2}\right]^{1-\sigma} \tag{1.7}$$

(1.7) has some interesting implications. First, dividing numerator and denominator of the quantity ratio by $Q$ and the numerator and the denominator of the revenue ratio by $R$, we can conclude that relative market shares of the firms depends only on the cost ratio and are independent of aggregate variables. Second, $r_I(c)/r_D(c) > 1$, that is rent increases more than proportionally following the introduction of process innovations.[6]

For illustrative purpose, let us consider in figure 1.1 the profit profiles associated to the two possible technology choice. From the prospect of a single firm, (1.5) and (1.6) are linear in $c^{1-\sigma}$ which can be interpreted as a firm's productivity index: the higher it is, the greater the productivity of a firm.[7] An innovator's profit is always steeper than a non-innovator's one, but it has a lower intercept because innovation bears an additional fixed overhead cost of innovation. Thus, process-innovation will be generally more profitable for high-productivity firm and less profitable for low-productivity firms. Moreover, firms have to pay the fixed cost of production ($f_D$), even if they are not producing (inaction is possible - $q = 0$). Therefore, firms with draws below $(c_o)^{1-\sigma}$ make negative profit and have to exit,

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[5] Note that (1.2) is only function of $c$ when (1.4) is substituted in (1.2). It follows $\pi_D(c) = r_D(c) - l(c) = \frac{r_D(c)}{\sigma} - f_D$. The variable costs are $cq_D(c) = A\left[\frac{\sigma}{\sigma-1}\right]^{-\sigma} c^{1-\sigma}$, while revenue is $r_D(c) = p_D(c)q_D(c) = A\left[\frac{c}{\rho}\right]^{1-\sigma} = A\left[\frac{\sigma}{\sigma-1}c\right]^{1-\sigma}$. Therefore operating profits are

$$\pi_D(c) = (1-\rho)A(c/\rho)^{1-\sigma} - f_D = (1/\sigma)A\left(\frac{\sigma}{\sigma-1}c\right)^{1-\sigma} - f_D$$

[6] Note that $r_I(c)/r_D(c) = \gamma^{1-\sigma}r_D(c)/r_D(c) = \gamma^{1-\sigma} > 1$, since $\sigma > 1$ and $\gamma < 1$.

[7] $B$ is an endogenous variable of the model and it is a non linear function of $c$. However, from a single firm's prospect, $B$ is taken as given and therefore, it can be treater as a constant. This graph can not be used for comparative statistic or to pin down equilibrium values, but it is useful to understand the behavior of a firm with a productivity draw $c$.
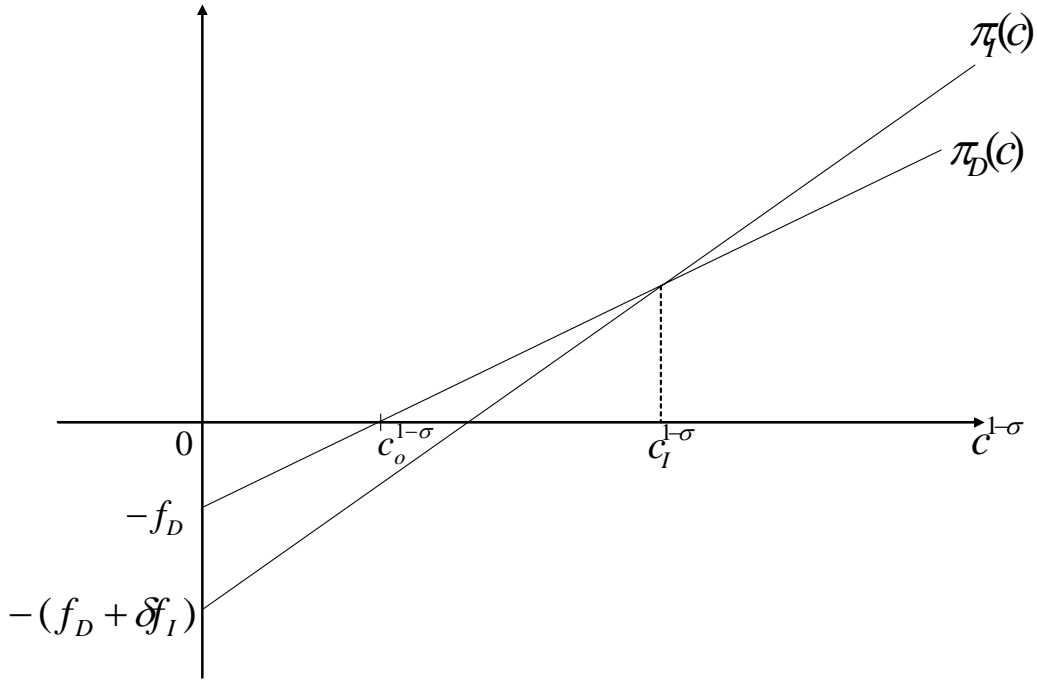
Figure 1.1: Profits from producing and innovating on the domestic market.

while firms with productivity index above $(c_o)^{1-\sigma}$ entry successfully. Only a fraction of these firms $(c^{1-\sigma} \geq (c_I)^{1-\sigma})$, perform also process-innovation. Denote by $M_I$ and $M_D$ respectively the mass of active innovator and domestic (non-innovator) producers, where

$$M_I = \frac{G(c_I)}{G(c_o)} M \tag{1.8}$$

$$M_D = \frac{G(c_o) - G(c_I)}{G(c_o)} M \tag{1.9}$$

and $M$ is the mass of incumbent firms in the economy. $\frac{G(c_I)}{G(c_o)}$ $\left(\frac{G(c_o)-G(c_I)}{G(c_I)}\right)$ is the ex-ante (prior to entry) probability of being an innovator (non innovator). In other words, it represents the probability for a potential entrant to innovate (to entry). By the law of large numbers, it also represents the fraction of innovating (not-innovating) firms in the economy.

$M = M_I + M_D$ is also the total mass of available varieties to the consumers in this closed economy.

## 1.2.1 Equilibrium in a closed economy

We are interested in a stationary equilibrium where the aggregate variables must also remain constant over time. This requires a mass $M_e$ of new entrants in every period, such that the mass of successful entrants, $M_e G(c_o)$, exactly replaces the mass $\delta M$ of incumbents who are hit by the bad shock and exit: $M_e G(c_o) = \delta M$.

The equilibrium entry cost-cutoff $c_o$ and innovation cost-cutoff $c_I$ must satisfy[8]:

$$\pi_D(c_o) = 0 \iff B\left(c_o\right)^{1-\sigma} = f_D \tag{1.10}$$

$$\pi_I(c_I) = \pi_D(c_I) \iff (\gamma^{1-\sigma} - 1)B\left(c_I\right)^{1-\sigma} = \delta f_I \tag{1.11}$$

Firms will learn about their productivity only upon becoming operative into the industry. Therefore, when they take the entry decision their productivity is unrevealed yet and they will compare the expected profit in the industry with the entry cost, taking into account the possibility of being hit by a bad shock. Free entry ensures equality between the expected present discounted value of operating profits of a potential entrant and the entry cost $f_E$:

$$\sum_{t=0}^{\infty}(1 - \delta)^t \left[ \int_0^{c_I} \pi_I(c)dG(c) + \int_{c_I}^{c_o} \pi_D(c)dG(c) \right] = f_E$$

The term in brackets in the LHS is the expected per-period profit for entering into the industry, while $\sum_{t=0}^{\infty}(1 - \delta)^t$ is the surviving probability into the market in the future. The whole expression can be rewritten as the equivalence between the per-period expected profit from entering and the equivalent amortized per-period entry cost:

$$\int_0^{c_I} \pi_I(c)dG(c) + \int_{c_I}^{c_o} \pi_D(c)dG(c) = \delta f_E \tag{1.12}$$

(1.10) to (1.12) characterize the equilibrium cost-cutoffs $c_o$ and $c_I$ as well as $B$.

Combining (1.10) with (1.11) we have the relation between the innovation and the entry cutoff:

$$(c_I)^{1-\sigma} = \frac{\delta f_I}{\gamma^{1-\sigma} - 1}\frac{1}{f_D}\left(c_o\right)^{1-\sigma} = \Psi\left(c_o\right)^{1-\sigma} \tag{1.13}$$

where $\frac{\delta f_I}{\gamma^{1-\sigma}-1}$ is the cost to benefit ratio of innovation. The numerator is the per-period cost of innovation while the denominator represents the revenue differential of innovation per unit of revenue initially earned. It is high when either the innovation cost per se is high or the benefit from innovations are small ($\gamma \to 1$).

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[8] See also figure 1.1.

It follows that a necessary and sufficient condition to have selection into the innovation status is $\Psi > 1$, which measures the cost of innovation relative to the overhead cost of production. The greater the relative cost of innovation $\Psi$, the higher the productivity threshold for innovating. We shall assume that this condition holds throughout since the empirical evidence suggests that only a subset of more productive firms undertakes process innovations[9].

To develop a better intuition of (1.12), let us denote by $\overline{\pi}$ the average industry profit and note that $\int_{0}^{c_I} \pi_I(c)dG(c) + \int_{c_I}^{c_o} \pi_D(c)dG(c) = G(c_o)\overline{\pi}$ - in words, the expected average profit in the industry is the average profit in the industry ($\overline{\pi}$) times the ex-ante probability of entry ($G(c_o)$) (see (1.42) in the appendix), so that (1.12) becomes:

$$\overline{\pi} = \frac{\delta f_E}{G(c_o)} \tag{1.14}$$

It states that firms - upon entry - compare the average industry profit with the per-period cost of entry weighted by the inverse of the probability for a successful entry. The tinier this probability, the higher the "effective" cost of entry since the smaller the chances of recovering it in the future. Therefore, when the per-period entry cost $\delta f_E$ rises, firms are willing to enter if they can expect either a higher per period average profit or greater chances of entry (higher $c_o$).

This can be seen in fig. 1.2 where we show the LHS and the RHS of (1.12).[10] Given (1.13), (1.12) is a function of only $c_o$. We show in the appendix (see (1.43)), the LHS of (1.12) is monotonically increasing from 0 to infinity in $c$, so that its intersection with the constant line $\delta f_E$ determines uniquely $c_o$. It is also clear from the graph that $c_o$ has to rise when the fixed cost of entry increases, for the free entry (FE) condition to hold.

Some important remarks are in order. First, $f_D$, $\delta$, $f_I$ affect the innovation cost cutoff $c_I$ through both $\Psi$ and the entry cost-cutoff $c_o$. More specifically, a greater $f_D$ lowers $\Psi$, but it also shifts up the LHS curve in fig. 1.2, so that it reduces the entry cost-cutoff to $c_o'$.- see(1.43) in the appendix. The intuition is simple and comes from inspecting (1.5) and (1.6). A larger $f_D$ reduces the profits of all firm types in the economy for any given $c$. It follows that $c_o$ and $c_I$ have to adjust for (1.12) to hold in a way that the marginal entering firm can increase its profit and recoup the increased fixed cost of operation. Overall, the effect of an increase in $f_D$ on the innovation productivity cutoff $(c_I)^{1-\sigma}$ is ambiguous since

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[9]See for instance Parisi et. al. (2005) for evidence on Italian firms and Baldwin et al. (2004) for evidence on Canada.

[10]The curves are dipicted as a parabola for convenience. We do not know the exact shape of them, but that are monotonically increasing on $[o, \overline{c}]$.
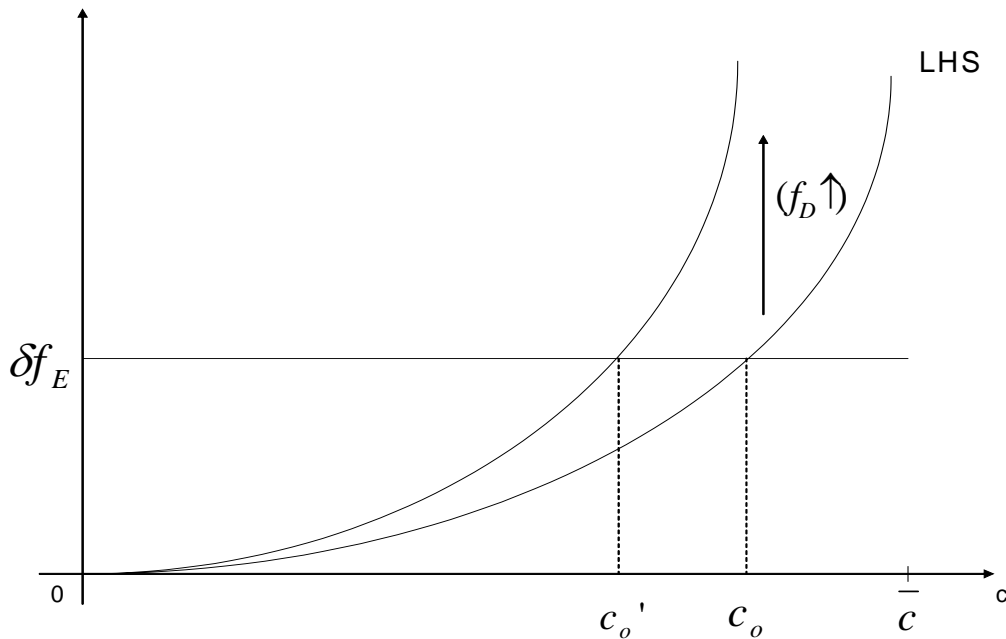
Figure 1.2: Determination of the equilibrium entry cost cutoff as given by the Free Entry Condition

$\Psi$ is lower, but $(c_o)^{1-\sigma}$ is larger. This ambiguity is a specific-feature of a general equilibrium model and its source is the entry decision of firms. In absence of an entry decision - like in Bustos (2005) - the effect of $f_D$ would be well determined and would affect the economy only through $\Psi$.

Second, this thought experiment in which the fixed costs of operation $f_D$ rises (stronger increasing return to scale) is illustrative of the basic mechanism through which trade openness will affect vertical innovation in the open economy of the next section. As for $f_D$, trade will have contrasting effects on the innovation cost cutoff. On the one hand, trade offers new market opportunities to the exporters. Exporting firms that compensate some market share loss on the domestic market due to import competition with market shares gains on foreign markets, will increase their total sales and revenue. Therefore, it will be easier for them to recoup the fixed cost of innovation and the benefits associated to the cost-reducing innovations will be spread on a greater output. This means that trade liberalization will lower the cost to benefit ratio of innovation $\Psi$. On the other one, more competition from foreigner exporters will force the least productive domestic firms out of the market - *extensive-margin*

*adjustment* or *selection effect of trade*. As described in Melitz (2003) this translates in a lower entry cost cutoff $c_o$.

This ambiguous effect of $f_D$ on the innovation cost cutoff carries on to the number of varieties in the economy, whereas in Melitz (2003) increasing $f_D$ unambiguously reduces the number of firms in the the industry. As shown in the appendix, the number of varieties is:

$$M = \frac{R}{\overline{r}} = \frac{L}{\sigma(\overline{\pi} + f_D + \frac{G(c_I)}{G(c_o)}\delta f_I)} \tag{1.15}$$

so that when $f_D$ rises, a larger $\overline{\pi}$ and $G(c_o)$ contribute to reduce the number of varieties[11]. However, only when $c_I$ rises, the total number of firms unambiguously declines. In the other case - when $c_I$ is reduced - the effect of $f_D$ on $M$ remains ambiguous.[12]

There is an other difference between our economy and the economy in Melitz (2003), namely the entry productivity cutoff level is higher in this setting.[13] The possibility to innovate allows the most efficient firms that perform process innovation to "steal" market shares to the least efficient firms for which is harder to survive into the market. Consequently, our economy is more efficient, because some varieties are produced at a lower cost, but less varied because some varieties have disappeared. This trade-off has been well emphasized in the literature (see Peretto (1998)).

## 1.2.2 The Innovation Decision

Before turning to the open economy we look more closely at the firm's decision to innovate. Firms will introduce process innovation if the adoption of the innovative technology yields higher profits than the traditional one, namely whenever (1.6) is greater than (1.5) or:

$$(\gamma^{1-\sigma} - 1)r_D(c) \geqslant \sigma\delta f_I$$

where we used $r_I(c) = \gamma^{1-\sigma}r_D(c)$. Note that in equilibrium, $R = L$ - that is, the aggregate revenue coincides with labour income ($w = 1$) - as shown in the appendix. Dividing the expression above by $R$, the firm's decision to innovate can be evaluated also in terms of its market share by:

$$(\gamma^{1-\sigma} - 1)s(c) \geqslant \frac{\sigma\delta f_I}{L} \tag{1.16}$$

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[11]Recall that a larger $f_D$ entails a lower $c_o$. A lower $c_o$ translates into higher $\overline{\pi}$ - by (1.14) - and lower $G(c_o)$.

[12]Given that such effect should offset the other negative effects through $f_D$, $\overline{\pi}$ and $G(c_o^A)$, we think of this possibility as implausible. Indeed, assuming $G(c)$ as in (1.30), the innovation cost cutoff would increase and the number of firms decreases when $f_D$ is larger.

[13]The proof of this result has been left to the appendix.

where $s(c) = r_D(c)/R$ is the firm's market share. Accordingly, a firm evaluates the expected changes in market share when it takes its innovation decision and it will innovate if the increment in its market share is at least as big as the RHS of (1.16). It is interesting to note that $f_D$ affects the firm's innovation decision only through $R$ (taken as given by a single firm), since the fixed cost of production has to be incurred regardless of the technology choice. In other words, the degree of increasing return to scale (IRS) determines the size of the market share each single firm can have and, in turn influences the innovation decision. Since the benefits from innovation are proportional to the firm's cost level, the innovation decision can also be related to the firm's current market share by:

$$s(c) \geqslant \frac{\sigma \Psi f_D}{L} \tag{1.17}$$

The higher the present market share of a firm, the higher the likelihood for this firm to be an innovator. The intuition is simple: the greater the market share, the greater the firm's sales and its profits from a cost-reduction innovation. The larger the market ($L$), the greater the market power (low $\sigma$), the lower the relative cost of innovation ($\Psi$), the more likely is process-innovation.

## 1.3 The Open Economy

Let us assume that the economy under study can trade with other $n \geq 1$ symmetric countries. We will assume that trade is not free, but it involves both fixed and variable costs, since free trade could simply be analyzed by doubling $L$ in the closed economy. One can think of the fixed cost associated to trade as the cost of customizing its own variety to the regulations and tastes of foreign countries as well as of creating sale-networks. The variable trade costs are trade barriers such as transportation costs imposed by distance. We follow a long tradition in the trade literature and model these variable costs in the iceberg formulation: $\tau > 1$ units of a good must be shipped in order for 1 unit to arrive at destination.

Finally, the symmetry of countries is required to ensure that factor price equalization holds and countries have indeed a common wage which can be still taken as the numeraire. Alternatively, a freely traded homogenous good produced under constant return to scale could be introduced to pin down its price and thus the wage to unit in all countries. The symmetry assumptions also ensures that all countries share the same aggregate variables.

**Prices,Profits and Firm-Types**

The variable costs of trade are naturally reflected into the price charged by the domestic exporters into foreign markets. By symmetry, the imported products are more expensive

than domestically produced goods due to transportation costs. As a result, the effective consumer price for imported products from any of the $n$ countries is:

$$p_X(c) = \tau p_D(c) \tag{1.18}$$

while an exporter who has opted for process innovation charges:

$$p_{XI}(c) = \gamma p_X(c) \tag{1.19}$$

Analogously, the profits of an exporter and an innovator-exporter in a foreign market are[14]:

$$\pi_X(c) = \tau^{1-\sigma} B c^{1-\sigma} - \delta f_X \tag{1.20}$$

$$\pi_{XI}(c) = (\gamma\tau)^{1-\sigma} B c^{1-\sigma} - \delta f_X \tag{1.21}$$

where $\delta f_X$ is the amortized per-period fixed cost of the overhead fixed cost $f_X$ that firms have to pay (in units of labour) to export to foreign markets.

The following table summarizes the profit function for all possible firm-types with productivity $c$.

| type | Domestic Producer | Exporter |
|---|---|---|
| Non Innovator | $\pi_D(c)$ | $\pi_D(c) + n\pi_X(c)$ |
| Innovator | $\pi_I(c)$ | $\pi_I(c) + n\pi_{XI}(c)$ |

No firm will ever export and not also produce for its domestic market. Indeed, any firm would earn strictly higher profits by also producing for its domestic market since the associated variable profit $r_D(c)/\sigma$ is always positive and the overhead production cost $f_D$ is already incurred. Then, all exporters' profits can be separated into the portion earned domestically ($\pi_D(c)$ or $\pi_I(c)$) and on each of the foreign market ($\pi_X(c)$ or $\pi_{XI}(c)$). Moreover, since the export cost is assumed equal across countries, a firm will either export to all $n$ countries in every period or never export.

Finally, not all four types can coexist simultaneously in the economy, but which firm type is active will depend on the kind of selection. The empirical evidence suggests that

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[14]$r_S(c) = p_S(c)q_S(c)$, $S = X, XI$ . Note that $r_{XI}(c) = \gamma^{1-\sigma} r_X(c) = \tau^{1-\sigma} r_I(c)$ as well as $r_X(c) = \tau^{1-\sigma} r_D(c)$. So, $\pi_X(c) = \frac{r_X(c)}{\sigma} - \delta f_X = \frac{\tau^{1-\sigma} r_D(c)}{\sigma} - \delta f_X = \tau^{1-\sigma} B c^{1-\sigma} - \delta f_X$ and $\pi_{XI}(c) = \frac{r_{XI}(c)}{\sigma} - \delta f_X = \frac{(\gamma\tau)^{1-\sigma} r_D(c)}{\sigma} - \delta f_X = (\gamma\tau)^{1-\sigma} B c^{1-\sigma} - \delta f_X$.

Note we account for the entire overhead production cost in the domestic profit (see (1.5) and (1.6)). This choice is uninfluential for the equilibrium as all firms (domestic producers and exporters) will produce also for the domestic market and incur $f_D$ upon staying into the industry.

exporting and innovation are performed by the most productive firms (lowest cost levels), while domestic producers are typically smaller, less innovative and less productive. Accordingly, we shall focus on the selections with the exporters or the innovators being the most productive types. In selection $BW$ in figure 1.3, exporting is relatively cheaper than innovating and therefore only the more productive exporters can undertake vertical innovation: an innovating firm is necessarily an exporter ($XI$-type), but there are exporters that are not innovators ($X$-type).[15] Indeed, from (1.20) and (1.21) it easy to check that if the X-type is making positive profit from exporting, then also the XI-type does necessarily so. However, no innovator would produce and innovate just for the domestic market (no $I$-type) because given her high productivity she would give up positive profits from not meeting the foreign demand.

BW) 

$c_I$  $c_x$  $c_o$

B) 

$c_x$  $c_I$  $c_o$
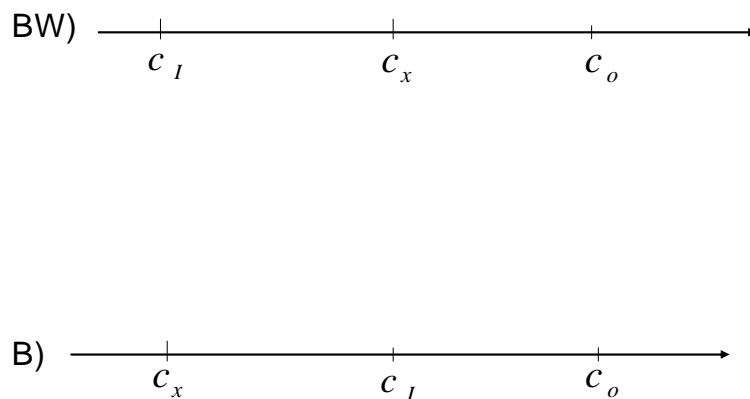
Figure 1.3: Plausible selections

On the contrary, in selection $B$ only a fraction of incumbents innovate ($I$-type) and only a subset of innovators become exporters ($XI$-type). No firm will ever export without innovating (no $X$- type). Indeed, firms that can take advantage of profit opportunity abroad are already innovating on the domestic market. Therefore they will exploit their innovative technology to serve the foreign market as well.

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[15]This is different from Yeaple (2005) where the firm type adopting the innovative technology is also necessary an exporter. In other words, the exporting firms coincides with the innovative types and therefore, no selection on the basis of innovation status is possible.

$BW$ is interesting because the marginal innovating firm is an exporter and trade is likely going to affect its innovation decision. $B$ represents the other side of the same coin: the marginal innovating firm is a domestic producer and therefore, innovation is mostly determined by domestic factors and will less likely respond to trade liberalization.

Given the aim of the paper, we focus closely on selection $BW$ where trade induces within-plant productivity changes besides allocative effects of market shares. Roughly stated, trade will have "*between*" and "*within*" effects on productivity growth (from here $BW$). Then, we turn to discuss briefly selection $B$ and highlight why trade is not influential on plants' innovation activity. In this equilibrium, trade affects productivity only through allocative effects - *between* effect (form here $B$).

### 1.3.1   Selection $BW$

Let us denote by $M_D$ the mass of active incumbent firms with a local dimension only, by $M_X$ the mass of exporting not innovating firms and by $M_{XI}$ the mass of exporting and innovating firms. The sum of all these firms ($M_D + M_X + M_{XI} = M$) gives the mass of incumbent firms in any country. The mass of non-innovating incumbent firms in any country is $M_{NI} = M_D + M_X$, while $M_T = M_D + n(M_X + M_{XI})$ gives the total mass of varieties available to consumers in any country. Let $p_{rD} = [G(c_o) - G(c_X)]/G(c_o)$, $p_{rX} = [G(c_X) - G(c_I)]/G(c_o)$, $p_{rXI} = [G(c_I)]/G(c_o)$ be the probability of becoming each type conditional on being an incumbent.

**The equilibrium - BW**

We are again interested only in a stationary equilibrium where all aggregate variables are constant over time. The stability condition imposes the entrants into the industry replaces exactly exiting firms, i.e. $\delta M = M_e G(c_o)$. Note that the equilibrium value of the aggregate variable $Q$, $R$, and therefore $A$ and $B$ as well as of the entry cutoff $c_o$ is different in this equilibrium from the closed economy one. Nevertheless we stick to same notation as they are defined in the same way.

Cutoffs in **equilibrium BW** must satisfy the following conditions:

$$\pi_D(c_o) = 0 \Leftrightarrow \frac{r_D(c_o)}{\sigma} = B(c_o)^{1-\sigma} = f_D \tag{1.22}$$

$$\pi_X(c_X) = 0 \Leftrightarrow \frac{r_D(c_x)}{\sigma} = Bc_X^{1-\sigma} = \frac{\delta f_X}{\tau^{1-\sigma}} \tag{1.23}$$

$$\pi_I(c_I) + n\pi_{XI}(c_I) = \pi_D(c_I) + n\pi_X(c_I) \Leftrightarrow \frac{r_D(c_I)}{\sigma} = B(c_I)^{1-\sigma} = \frac{\delta f_I}{(\gamma^{1-\sigma} - 1)(1 + n\tau^{1-\sigma})} \tag{1.24}$$

Thus the parameter restriction that sustains this equilibrium ($c_I \leq c_X \leq c_o$) where only exporters perform process innovation must satisfy:

$$\frac{\delta f_I}{(\gamma^{1-\sigma} - 1)} \frac{1}{(1 + n\tau^{1-\sigma})} \geq \delta f_X \tau^{\sigma-1} \geq f_D \tag{1.25}$$

This condition requires that the innovating is relatively more expensive than exporting. That is, the foreign markets should be fairly accessible, otherwise serving them would result extremely costly and it could be afforded exclusively by the most productive firms.

$\frac{\delta f_I}{(\gamma^{1-\sigma}-1)}$ is equivalent to the cutoff for innovation for the closed economy: the same assumptions that guarantees selection on the basis of innovation status in the closed economy (i.e., $\Psi \geq 1$) ensures that this term is positive and bounded away from zero in the open economy. Recall that this term represents the cost to benefit ratio of innovation. Importantly, in the open economy we have an extra term given by $\frac{1}{(1+n\tau^{1-\sigma})}$ which is unity in the closed economy (set $n = 0$ or $\tau \to \infty$). The denominator represents precisely the further revenue differential associated to innovation on each of the foreign markets that become available with trade.

We like to think of $n$ as the number of countries into the trading network sharing a common code of rules as it could be for the WTO membership. Then, it represents a measure of the world's openness to trade, as for a low $n$ very few countries have trading relations. $\phi = \tau^{1-\sigma} \in [0, 1]$ is commonly referred in the literature as an index of the freeness of trade with values closer to 1 indexing freer trade.

Clearly, trade liberalization that come in the form of either freer trade (greater $\phi$) or greater world openness (larger $n$) can affect process innovation weighing upon the return of innovation.

(1.22) to (1.24) give a system of 3 equations in 4 unknowns ($c_o$,$c_X$,$c_I$,$B$). We can use the FE condition to close this system and uniquely determine the entry cutoff. The FE condition ensures the equivalence between expected entry profit and entry cost:

$$\int_{c_X}^{c_o} \pi_D(c)dG(c) + \int_{c_I}^{c_X} (\pi_D(c) + n\pi_X(c))dG(c) + \int_0^{c_I}(\pi_I(c) + n\pi_{XI}(c))dG(c) = \delta f_E \tag{1.26}$$

Combining appropriately the three conditions for the cutoff points ((1.22) to (1.24)), the relation between the cutoffs can be written explicitly as:

$$(c_I)^{1-\sigma} = \frac{\delta f_I}{(\gamma^{1-\sigma} - 1)(1 + n\tau^{1-\sigma})} \frac{1}{f_D} (c_o)^{1-\sigma} = \Psi^f (c_o)^{1-\sigma} \tag{1.27}$$

$$(c_I)^{1-\sigma} = \frac{\delta f_I}{(\gamma^{1-\sigma} - 1)(1 + n\tau^{1-\sigma})} \frac{1}{\delta f_X \tau^{\sigma-1}} c_X^{1-\sigma} = (\Psi_X^f) c_X^{1-\sigma} \tag{1.28}$$

$$c_X^{1-\sigma} = \frac{\delta f_X \tau^{\sigma-1}}{f_D} (c_o)^{1-\sigma} \tag{1.29}$$

Note that $\Psi = \Psi^f(1 + n\tau^{1-\sigma})$ and $\Psi_X^f = \Psi^f f_D/\delta f_X \tau^{\sigma-1}$. $\Psi \geq \Psi^f$ - namely, the cost to benefit ratio is smaller in the trading equilibrium than in autarky - reflects that trade and vertical innovation are related: new market opportunities abroad induce exporters to expand their scale of operation and the benefits of cost-reducing innovation are spread on a greater number of units sold, while the up-front cost of innovation is unchanged.[16] Comparing (1.27) with (1.13) shows that the distance between the entry productivity index cutoff and the innovation productivity index cutoff is always smaller in the trading equilibrium than in autarky ($\Psi^f < \Psi$), as trade reduces the relative cost of innovation. Hence, trade (for positive $n$ and non-prohibitive transportation cost $\tau$) reduces, *ceteris paribus,*the innovation productivity cutoff $(c_I)^{1-\sigma}$and therefore it boosts *within-plant innovation*. This is the partial equilibrium effect described also in Bustos (2005).[17]

However, this is not enough for concluding the proportion of incumbents undertaking productivity innovation will be larger after trade. In general equilibrium, trade affects also the entry productivity cutoff $(c_o)^{1-\sigma}$ which results higher in the trading equilibrium than in autarky, as it is shown in the appendix. Trade increases competition on the domestic market and forces the least productive producers out of the market (selection effect). The most hurt are obviously the domestic firms that produce exclusively for the national market whose product demand is reduced without being compensated by the expansion of their product demand on the foreign markets, as it is for some of the exporters.

In this equilibrium, two forces are affecting the innovation cost cutoff when the economy opens to trade:

i) the selection effect of trade reduces the incentive to perform process innovation because entry is less likely and survival more difficult in a more competitive environment - lower $c_o$;

ii) conditional on being an incumbent, the benefit of cost-reducing innovation is higher after trade because the selection effect and the scale effect together increase exporters' total market shares. Thus, some incumbent will start performing vertical innovation - $\Psi^f < \Psi$.

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[16] Only for prohibitive trade barriers ($\phi = 0$) or a close world ($n = 0$), $\Psi = \Psi^f$.
[17] This situation would describe an industry within the economy which is small enough to affect the equilibrium price index of the economy, and therefore, real wages and where no entry and exit takes place.

The overall effect of trade on innovation is ambiguous and depends on the relative strength of these pushing and deterring factors of process innovation. Although, the proportion of incumbents is reduced (lower $c_o$), the proportion of innovating firms among them will raise (higher $c_I$) if the *ii)* dominates *i)*, namely if the adjustments through the extensive margin of innovation dominate those through the extensive margin of trade.

In order to shed some light on which effect dominates, we use a specific parametrization for $G(c)$. We shall show that the net outcome of these two offsetting forces is a higher proportion of firms performing process innovation with freer trade.

Assuming that the productivity draws $(1/c)$ are distributed according to a Pareto distribution with low productivity bound $(1/\bar{c})$ and $k \geq 1$, the c.d.f of cost draws $c$ is given by:

$$G(c) = \left(\frac{c}{\bar{c}}\right)^k, \ \ k > \sigma - 1, \ \ k > 2. \tag{1.30}$$

This formulation has been used widely in many extensions of Melitz (2003) because it allows to derive closed form solutions for the cutoff levels[18]. $k$ is a shape parameter indexing the dispersion of cost draws. $k = 1$, corresponds to the uniform distribution. As $k$ increases, the distribution is more concentrated at higher cost level and firms' heterogeneity is reduced. $k > 2$ ensures that the second moment of the distribution is well defined, while $k > \sigma - 1$ ensures the first moment of the truncated distribution ((1.33) and (1.34) in the Appendix) exists and is well defined. With this assumption, we are able to prove the following proposition on technology adoption.

**Proposition 1.1** *Denote with $c_I^A$ ($c_I^f$) the equilibrium innovation cost cutoff in autarky (in the open economy). If (1.30) and (1.25) hold, then the innovation cost cutoff in the open economy is larger than in autarky (i.e $c_I^A < c_I^f$)*

**Proof.** *See appendix.* ■

An intuition for this result is the following. The market shares of the domestic exiting firms are reallocated to the more productive surviving incumbents, and thus, also to some domestic exporters (*extensive margin effect* or *selection effect*). This effect adds up to the *intensive-margin effect* or *scale effect* - that following trade liberalization, some exporters will increase their market share abroad. As a result, their combined market share enlarges.

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[18]See for example Melitz and Ottaviano (2005).

Since to a larger scale of operation corresponds a greater return from "vertical innovation", a larger fraction of them finds profitable to introduce "process-innovation". In other words, trade affects the extensive margin of innovation inducing exporting firms that are not as productive as former innovators, to introduce more productive technologies.

Interestingly the reallocation of output across plants induced by trade - *between effect* - is playing a key role and is related to $f_X$, the fixed cost of trade. In absence of it and with CES preferences, all firms exports and therefore all firms perfectly compensates for the loss in the domestic market shares with gains in foreign market shares. Differently expressed, the increase in each firm's market size after trade is exactly offset by the rise in the number of competitors. This can be easily checked inspecting the equilibrium conditions. (1.22) becomes $(1+n\tau^{1-\sigma})Bc_o^{1-\sigma} = f_D$ which together with (1.24) and (1.26) characterize the equilibrium with $f_X = 0$, $c_o \equiv c_X$ and $\pi(c_o) = \pi(c_X)$. It is easy to show that such equilibrium is equivalent to the autarky one described by (1.10)-(1.12). In other words, no firms using the baseline technology opts to implement the innovative technology after engaging in trade. However, when $f_X > 0$, an increase in the revenue from sales abroad does not map into a greater profit for all firms, determining selection into exports by a subset of incumbents. This means that the increase in market size for the exporting firms is not longer exactly compensated for the augment of competitors. Indeed, some domestic exporter are enjoying a larger slice of the foreign market (and higher revenues from foreign market) as they are not facing the competition from their actual domestic producers (previously exporting) and, at the same time (by symmetry) are confronted with less competitors on the national market since the number of foreign competitors on the national market has analogously decreased. This is the basic economic intuition behind *ii)* it is strictly related to the existence of fixed trade costs.

Nevertheless, firms willing to engage in trade and incurring $f_X$, exacerbates the competition for the scarce labour input pushing up the real wage, making survival tougher, and exporting and innovating more costly (*i*, above). Still, trade translates into net gains for the most productive exporting non-innovating firms, inducing them to implement the innovative technology, as we can conclude from showing that *ii* is dominating *i*.

We would expect that the reduction of transportation costs which lead to trade creation in this model have similar effects on innovation. This is established in the following Lemma.

**Lemma 1.2** *Assume (1.30) and (1.25) hold, $dc_I/d\tau \leq 0$.*

   **Proof.** *See in the appendix* ∎

Its relevance is that trade liberalization taking the form of partial tariff reform, as often it is in practice, induce similar positive effect on process innovation. For instance, we can evaluate the effects of Canada-US FTA (CUSFTA) on within firm performances. $\tau$ in (1.27) is the transportation cost faced by Canadian manufacturing firms exporting to US. The model predicts US tariff concessions granted to Canada - a reduction of $\tau$ - after the FTA would induce some Canadian exporters to innovate, as they can take advantage of a lower cost to benefit ratio. This is consistent with the evidence shown in Trefler (2004). The numbers are quite substantial: "*U.S. tariff concessions raised labor productivity by 14 percent or 1.9 percent annually in the most impacted, export-oriented group of industries*". Bustos (2005) find evidence of adoption of innovative technology by Argentinean manufacturing exporting firms following the substantial trade liberalization of the country in the 90s. Interestingly, firms adopting the innovative technology are the high productive non-innovating exporters, so that she concludes that the change in technology spending has an inverted U shape after trade liberalization. It is highest for firms in the middle range of the productivity distribution, consistently with the predictions of our model. Indeed, the firms incurring the fixed cost of innovation after trade liberalization are neither the most productive ones which have already incurred this cost, nor the least productive ones which have never paid this cost, but rather firms with productivity in the range between the old and the new innovation cost cutoff. Only these firms are innovating and therefore, copping with the fixed adaptation cost $f_I$.

Interestingly, Bustos finds also the some exporters keep the "traditional" technology even after trade liberalization, providing empirical support for the relevance of selection BW analyzed here.[19]

Summing up, by increasing the scale of production of some of the exporters, trade increases what Cohen and Klepper (1996) call the "ex ante" output - the firm's output when it conducts process innovation. This, in turn, raises firms' incentive to innovate and triggers process-innovation, productivity increments and market share growth at firm level (see (1.7)). This is consistent with Baldwin and Gu (2003) and Trefler (2004) who find that within-firm productivity increments have occurred mostly among exporters. Moreover, Baldwin (2004) finds empirical support for such casual link: vertical innovation is a main determinant of productivity growth and productivity growth induces market share growth[20].

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[19] Also in Yeaple (2005), lower transportation costs induce a greater adoption of the innovative technology. However, no exporters retain the old technology as found in Bustos (2005).

[20] Baldwin (2004) finds Canadian process-innovators had productivity growth that was 3.6 percentage points higher than Canadian non-process innovators (table 9). Moreover, a within-firm productivity increment of 10% relative to the industry average translate into almost 2% gain in the firm's market share (table 12).

Finally, the reduction of transportation costs has contrasting effect on $c_X$ too. A reduction of trade barriers have a direct effect and lowers the exporting productivity cutoff $c_X^{1-\sigma}$ (see (1.29)), but also an indirect effect through $(c_o)^{1-\sigma}$ which rises this threshold. The following lemma shows that the direct effect dominates the indirect one.

**Lemma 1.3** *Assume (1.30) holds, $dc_X/d\tau \leq 0$.*
   **Proof.** *See the appendix* ■

In the context of CUSFTA, this lemma predicts that some Canadian manufacturing firms which are not as productive as established exporters, will also start to serve the US market in virtue of the American preferential tariff reform. Interestingly, Baldwin et al. (2003) find evidence of this.

## 1.3.2   Selection B

We shall just show that trade in this equilibria can not affect the extensive margin of innovation as for selection BW. The non-innovating firms are only the $D$-type, while the innovating firms are the $I$-type and the $XI$-type, but only the latter are present on international market. There is no $X$-type.

The cutoff conditions for **equilibrium B** are:

$$\pi_D(c_o) = 0 \tag{1.31}$$

$$\pi_I(c_I) = \pi_D(c_I) \tag{1.32}$$

$$\pi_{XI}(c_X) = 0 \Leftrightarrow Bc_X^{1-\sigma} = (\tau\gamma)^{\sigma-1}\delta f_X$$

which imply that the necessary and sufficient condition for $c_X \leq c_I \leq c_o$ is:

$$\delta f_X \tau^{\sigma-1} \geq \frac{\delta f_I}{(\gamma^{1-\sigma} - 1)}\gamma^{1-\sigma} \geq f_D\gamma^{1-\sigma}$$

This equilibrium is characterized by a trading cost relatively higher than the innovating one. High variable and fixed cost of exporting make trading a very expensive activity performed only by the most productive firms.

Note also that (1.31) and (1.32) imply the same relation among the innovation and the entry cutoff as in the closed economy given by (1.13). Indeed, the marginal innovating firm is not an exporter and the transition from autarky to trade leaves the cost to benefit ratio of innovation unchanged. That is, trade liberalization can not affect and stimulate firms' innovation investments because it has no impact on $\Psi$. In other words, the extensive margin of innovation responds to lower trade barriers uniquely through the selection effect; consequently, a raise in $c_o^{1-\sigma}$ raises $c_I^{1-\sigma}$ as well and depresses vertical innovation.

### 1.3.3  Final Remarks

The model has implications on the aggregate productivity level. As in Melitz (2003), the industry average productivity will be rising in the long run by means of the selection effect which spells the least efficient firms out of the market - *between effect* . Moreover, in our model trade will rise the average industry productivity through a further channel, namely the *within effect* (Proposition 1.1 and Lemma 1.2). Following trade liberalization, some of the exporters opt for implementing a more efficient technology, improving their productivity level. The right shift of the Canadian productivity distribution of manufacturing firms in 1996 compared to 1988 following the Canada-U.S. FTA documented in Trefler (2005) can be interpreted as the combination of the *between effect* and of the *within effect.* Low productive firms - below the industry average - that either exit or downsize following trade liberalization - *between component* - determine a thinner left tail of the distribution in 1996 relative to 1988. Analogously, the reallocation of market shares favouring high productive firms has contributed to a fatter right tail of the distribution of 1996.

The exporters who have raised their plant productivity (within component) significantly determine the increased mass on medium and high productivity levels for the distribution in 1996 relative to the one in 1988.

Moreover, such liberalization encourages also new Canadian exporters that are less productive than old Canadian exporters to enter the US market (Lemma 1.3). This must reduce the industry average productivity as the expansion in the US market increases the market share of lower productivity new exporters.

Finally the model suggests that trade liberalization and the geography of a country can interact each other: the same trade liberalization may induce different innovation outcomes depending on the location of a country.

Moving from $B$ to $BW$, the cost of exporting relative to the cost of innovating decreases. This means that the effect trade has on the process innovation will be differentiated according to the level of transportation cost. We shall interpret high transportation cost as a proxy for the remoteness of the Home economy from the main exporting markets or, more generally, as the level of trade barriers faced by the Home country.

If in the transition from autarky to trade, the country is fairly remote and faces selection $B$, then process innovation performed will be reduced, as discussed above. On the contrary, if the country is close to the exporting markets and selection $BW$ is possible, process innovation increases.

## 1.4  Caveats and Further Research

We have modeled the process innovation very simply as a binary decision - adopt/not adopt the new productive technology. The benefit and the cost of innovation are known and exogenously given. This introduces two major limitations.

First, more innovation in this economy is measured by the changes in the proportion of firms innovating and therefore is related uniquely to the extensive margin of innovation. In other words, the intensity of innovation is out of the model as firms do not decide upon their productivity target.

Second, all innovators improve their productivity in the same proportion. This means that the mass of firm with cost levels in the range $[\gamma c_I, c_I]$ has measure zero and the ex-post innovation cost distribution of incumbent-firms has a hole.

One way around the latter problem which preserves the innovation decision as exogenous would be introducing $\gamma$ as a continuous random variable. Firms would pay the cost of innovation to draw a $\gamma$.

Instead, we are currently working to make the innovation decision endogenous: firms that opt for vertical innovation, choose optimally their $\gamma$ balancing the benefits with the costs of innovation. Not only this avenue would solve the problem of the hole in the distribution, but it also allows to analyze how both the intensive and the extensive margin of innovation respond to trade liberalization.

Indeed, trade would affect both who is innovating and how much each firm is innovating. In equilibrium *BW*, the *within* effect would not be comprised of only the new innovators, but also of the former innovators investing more intensively in productivity increments. Interestingly, in equilibrium *B*, trade may continue to be unrelated to the extensive margin on innovation, but it still could affect the intensive margin inducing some of the innovators to innovate more. Thus, the dichotomy *within* and *no-within* effect proper of equilibrium *BW* and *B* is a specific feature of our setup and would not survive under this modification. Trade would affect the industry productivity growth through both the *within* and the *between* effect in both equilibrium. However, the degree of importance of the within effect would be different across the two equilibrium and only in equilibrium BW trade can likely weigh upon the extensive margin of innovation.

In spite of all these limitations, this set up highlight in a simple way the trade forces related to the within-firm productivity changes. Moreover, it is able to generate some predictions that are consistent with the available empirical evidence.

## 1.5  Conclusion

The paper introduces process innovation into the Melitz (2003) framework. As in Melitz (2003), trade has a selection effect on firms forcing the least productive ones out of the market and reallocating market shares to the more productive ones. Although this contributes to the aggregate productivity growth, it is not exhaustive of the effects of trade on productivity. We showed trade can favour the adoption of an innovative technology, especially among exporters.

One could think that fiercer competition implied by trade can reduce the incentive for innovation. This is certainly true for low productive domestic firms whose survival possibilities have decreased together with their market shares. Instead, exporters compensate the loss of market shares in the domestic market with gains in market shares in foreign markets. As they expand their scale of production, their incentive for process innovation strengthens and some of them introduce a more productive technology. Moreover, if the reallocation of output from exiting firms to incumbents firms is consistent, also relatively low productive exporters can take advantage of a greater market share and benefit from vertical innovation.

In productivity studies, this is the so called *within* effect - some of the incumbent firms update their productivity - and it is a main source of labour productivity growth in industrialized countries. This is the new insight of the model: trade contributes to the industry productivity growth through the *within* effect besides through the *between* effect. More generally, a greater openness in the trading relations can justify the finding of the great importance of the within component for the industry productivity growth, as recently documented.

This seems consistent with some recent micro evidence. For instance, the productivity distribution of Canadian manufacturing firms has shifted to the right decreasing considerably the mass on low productivity values (*between effect*) and at the same time increasing its mass on the upper-tail of the distribution (*within effect*) after the US-Canada Free Trade Agreement was signed. The latter has also brought some new Canadian firms - not quite as productive as old exporters - into exporting to the US market in virtue of these lower trade barriers. This is consistent with the prediction of the model that a reduction of transportation costs leads to an increase of the proportion of firms exporting to foreign markets, as firms not as productive as well established exporters can also afford to serve some markets abroad.

Furthermore, geography plays an important role. Trade liberalization can depress vertical innovation (equilibrium $B$) for remote countries, while it can boost process-innovation (equilibrium $BW$) for countries closely located to the core of the exporting markets.

## 1.6 Appendix

### 1.6.1 Appendix A - Closed Economy

We first proceed with the aggregation to define the aggregate variables of the economy that firms take as given in their decisions (see (1.5) and (1.6)). Then, we turn to the analysis of the equilibrium and determine the entry cost-cutoff and the number of varieties.

#### 1.6.1.1 Aggregation

Let us denote by $\mu_D(c)$ and $\mu_I(c)$ respectively, the cost distribution of domestic producers and active innovator prior to innovation. These "ex-ante"-innovation cost distributions are truncated distribution of $g(c)$:

$$\mu_D(c) = \begin{array}{cc} \frac{g(c)}{G(c_o)-G(c_I)} & , \quad c_I < c < c_o \\ o & otherwise \end{array} \tag{1.33}$$

$$\mu_I(c) = \begin{array}{cc} \frac{g(c)}{G(c_I)} & , \quad 0 < c < c_I \\ o & otherwise \end{array} \tag{1.34}$$

and will be used repeatedly in the aggregation. They are not affected by the exogenous productivity $\delta$ which affects all firms equally and it is independent of the productivity level. Finally, in order to derive the aggregated variable, it is useful to introduce some synthetic measures of the productivity index as the following averages:

$$\widetilde{c_D}^{1-\sigma} = \int_{c_I}^{c_o} c\mu_D(c)dc \tag{1.35}$$

$$\widetilde{c_I}^{1-\sigma} = \frac{1}{G(c_I)} \int_0^{c_I} c^{1-\sigma}\mu_I(c)dc \tag{1.36}$$

$$\widetilde{c}^{1-\sigma} = \frac{1}{M} \left[ M_I(\gamma\widetilde{c_I})^{1-\sigma} + M_D\widetilde{c_D}^{1-\sigma} \right] \tag{1.37}$$

(1.35) is the weighted average productivity index within the subgroup domestic producers, while (1.36) is the "ex ante"-innovating weighted average productivity index among the subgroup of inventors[21]. Given that process innovation is simply modeled as a fixed proportional reduction in the cost level, the "ex-post" innovation weighted average productivity index will also be increased proportionally and be $(\gamma\widetilde{c_I})^{1-\sigma}$. Therefore, (1.37) is the weighted average

---

[21] Given that domestic (non-innovators) domestic producers do not increment their productivity level, the ex-ante and ex-post innovation cost distribution of domestic producers coincide.

productivity index of the economy which is an opportunely weighted average of the averages prevailing in each subgroup. All these measures are independent of the number of firms. $\widetilde{c}$ is the most aggregated productivity-index and completely summarizes all aggregate variables of the model derived below.

Using (1.3) for both a domestic and an innovator producer and the definition of the price index for CES utility function in footnote **??**, it is possible to define the price index for this economy as:

$$
\begin{aligned}
P^{1-\sigma} &= \int_0^{c_I} M_I[p_I(c)]^{1-\sigma}\mu_I(c)dc + \int_{c_I}^{c_o} M_D\left[p_D(c)\right]^{1-\sigma}\mu_D(c)dc \\
&= (1/\rho)^{1-\sigma}\left[M_I\gamma^{1-\sigma}\widetilde{c}_I^{\,1-\sigma} + M_D\widetilde{c_D}^{1-\sigma}\right] \\
&= M\left[\frac{\widetilde{c}}{\rho}\right]^{1-\sigma} = M\left[p_D(\widetilde{c})\right]^{1-\sigma}
\end{aligned}
\tag{1.38}
$$

Similarly,

$$
\begin{aligned}
R &= \int_0^{c_I} M_I r_I(c)\mu_I(c)dc + \int_{c_I}^{c_o} M_D r_D(c)\mu_D(c)dc \\
&= M_I r_I(\widetilde{c}_I) + M_{NI}r_D(\widetilde{c_D}) \\
&= M_I\gamma^{1-\sigma}r_D(\widetilde{c}_I) + M_{NI}r(\widetilde{c_D}) \\
&= M\left[\frac{M_I}{M}\gamma^{1-\sigma}r_D(\widetilde{c}_I) + \frac{M_{NI}}{M}r(\widetilde{c_D})\right] = Mr_D(\widetilde{c}) = M\overline{r}
\end{aligned}
\tag{1.39}
$$

and

$$
\begin{aligned}
\Pi &= \int_0^{c_I} M_I\pi_I(c)\mu_I(c)dc + \int_{c_I}^{c_o} M_D\pi_D(c)\mu_D(c)dc \\
&= \frac{1}{\sigma}\left[\int_0^{c_I} M_I r_I(c)\mu_I(c)dc + \int_{c_I}^{c_o} M_D r_D(c)\mu_D(c)dc\right] - Mf_D - M_I\delta f_I \\
&= M\frac{r_D(\widetilde{c})}{\sigma} - Mf_D - M_I\delta f_I = M\underbrace{\left[\frac{r_D(\widetilde{c})}{\sigma} - f_D - \frac{M_I}{M}\delta f_I\right]}_{\pi_D(\widetilde{c})} = M\underbrace{\left[\frac{\overline{r}}{\sigma} - f_D - \frac{M_I}{M}\delta f_I\right]}_{\overline{\pi}}
\end{aligned}
\tag{1.40}
$$

where $\overline{r}$ and $\overline{\pi}$ are the average revenue and profit in the economy.

In a proof below, we shall use the average profit in autarky and we shall use the convention that the variable with superscript $A$ denote the equilibrium variables in the closed economy

equilibrium. For example the average profit in autarky will be:

$$\overline{\pi}^A = \frac{\overline{r}^A}{\sigma} - f_D - \frac{M_I^A}{M^A}\delta f_I \tag{1.41}$$

where $\overline{r}^A$ is (1.39) evaluated at the equilibrium cost cutoff $c_o^A$ and $c_I^A$.

Note we can use the first line of (1.40) together with (1.8), (1.9), (1.33) and (1.34) to rewrite (1.12) as:

$$\int_0^{c_I^A} \pi_I(c)dG(c) + \int_{c_I^A}^{c_o^A} \pi_D(c)dG(c) = G(c_o^A)\overline{\pi}^A \tag{1.42}$$

which is (1.14).

### 1.6.1.2   Determination of the equilibrium

$\mu_I(c)$ and $\mu_D(c)$ are not affected by the simultaneous entry and exit since the successful entrants and failing incumbents draw their productivity level from a common distribution and $\delta$ is independent of the innovation status. These distributions depend exclusively on the cutoffs points for entry and innovation.

Using (1.40) together with (1.8) and (1.9), it is possible to express (1.12) as (1.14), which can be further refined and express in terms of solely $c_o$. Insert (1.10) and (1.11) into (1.12), replace $\delta f_I = \Psi(\gamma^{1-\sigma} - 1)f_D$ and rearrange terms to get:

$$\begin{aligned}
\delta f_E &= B\left[\gamma^{1-\sigma}G(c_I)\widetilde{c_I}^{1-\sigma} + (G(c_o) - G(c_I))\widetilde{c_D}^{1-\sigma}\right] - f_D G(c_o) - \delta f_I G(c_I) \\
&= G(c_I)\gamma^{1-\sigma}\left(\frac{\widetilde{c_I}}{c_o}\right)^{1-\sigma} f_D - G(c_I)\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} f_D - G(c_I)\Psi(\gamma^{1-\sigma} - 1)f_D + \\
&\quad + G(c_o)\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} f_D - G(c_o)f_D \tag{1.43} \\
&= f_D\left[j_D(c_o) + \gamma^{1-\sigma}j_I(c_o)\right]
\end{aligned}$$

where

$$j_D(c_o) = G(c_o)\left[\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} - 1\right] - G(c_I)\left[\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} - \Psi\right] \tag{1.44}$$

$$j_I(c_o) = G(c_I)\left[\left(\frac{\widetilde{c_I}}{c_o}\right)^{1-\sigma} - \Psi\right] \tag{1.45}$$

1.6.1.3 Existence and Uniqueness of the equilibrium in the closed economy

**Proposition 1.4** *Under autarky, the equilibrium exists and is unique.*

    **Proof.** *We shall prove that the RHS of (1.43) is monotonically increasing in $c_o$ on the domain $[0, \overline{c}]$, so that $c_o$ is uniquely determined by the intersection of the latter curve with the flat line $\delta f_e$ in the $[0, \overline{c}]$ space. Recall that $\widetilde{c}_I$ is a function of $c_I$ (see (1.36)), which, in turn, is a function of $c_o$ by (1.13). Let us define $\Lambda = \Psi^{1/1-\sigma}$. Note that (1.13) implies:*

$$\frac{\partial c_I}{\partial c_o} = \Psi^{1/1-\sigma} = \Lambda$$

*and (1.36) implies:*

$$\frac{\partial}{\partial c_o}\left(\frac{\widetilde{c}_I^{1-\sigma}}{c_o^{1-\sigma}}\right) = \frac{\frac{\Psi^{1/1-\sigma}g(c_I)\left[(c_I)^{1-\sigma}-\widetilde{c}_I^{1-\sigma}\right](c_o)^{1-\sigma}}{G(c_I)} - \widetilde{c}_I^{1-\sigma}(1-\sigma)(c_o)^{-\sigma}}{(c_o)^{2(1-\sigma)}}$$

$$= \Lambda\frac{g(c_I)}{G(c_I)}\left[\left(\frac{c_I}{c_o}\right)^{1-\sigma} - \left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\right] - \frac{\widetilde{c}_I^{1-\sigma}(1-\sigma)}{(c_o)^{1-\sigma}c_o}$$

$$= \Lambda\frac{g(c_I)}{G(c_I)}\left[\Psi - \left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\right] - \left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\frac{1-\sigma}{c_o}$$

*It follows:*

$$\frac{\partial j_I(c_o)}{\partial c_o} = \frac{\partial}{\partial c}\left\{G(c_I)\left[\left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma} - \Psi\right]\right\} \tag{1.46}$$

$$= g(c_I)(\frac{\partial c_I}{\partial c})\left[\left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma} - \Psi\right] + G(c_I)\left[\frac{\partial}{\partial c}\left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\right]$$

$$= g(c_I)\Lambda\left[\left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma} - \Psi\right] + G(c_I)\left\{\Lambda\frac{g(c_I)}{G(c_I)}\left[\Psi - \left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\right] - \left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma}\frac{1-\sigma}{c_o}\right\}$$

$$= -\frac{1-\sigma}{c_o}G(c_I)\left(\frac{\widetilde{c}_I}{c_o}\right)^{1-\sigma} \geq 0$$

*Using (1.35) and following similar steps we get:*

$$\frac{\partial}{\partial c}\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} = \frac{g(c_o)}{G(c_o)-G(c_I)}\left[1 - \left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma}\right] + \frac{g(c_o)\Lambda}{G(c_o)-G(c_I)}\left[\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} - \Psi\right] - \left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma}\frac{1-\sigma}{c_o}$$

$$\frac{\partial j_D(c_o)}{\partial c_o} = \frac{\partial j_D(c_o)}{\partial c_o}\left\{G(c_o)\left[\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} - 1\right] - G(c_I)\left[\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} - \Psi\right]\right\} \tag{1.47}$$

$$= -\frac{1-\sigma}{c_o}[G(c_o)-G(c_I)]\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma} \geq 0$$

*(1.46) and (1.47) ensure that the RHS of (1.43) is an increasing function of $c_o$. Furthermore,* $\lim_{c_o \to \overline{c}} j_I(c_o) = \infty$, *and* $\lim_{c_o \to \overline{c}} j_D(c_o) = a < \infty$, *so that* $\lim_{c_o \to \overline{c}} [j_D(c_o) + \gamma^{1-\sigma} j_I(c_o)] = \infty$. *In order to show that the RHS of (1.43) goes to 0 as $c_o$ goes to 0, I will follow Melitz (2003) and show that the elasticities of $j_I(c_o)$ and $j_D(c_o)$ are positive and $j_I(c_o)$ is always bounded away from 0.*

$$\frac{\partial j_I(c_o)}{\partial c_o} \frac{c_o}{j_I(c_o)} = -(1-\sigma)\left[1 + \frac{\Lambda}{j_I(c_o)}\right] \geq -(1-\sigma)$$

$$\frac{\partial j_D(c_o)}{\partial c_o} \frac{c_o}{j_D(c_o)} = -(1-\sigma)\left[\frac{(G(c_o) - G(c_I))\left(\frac{\widetilde{c_D}}{c_o}\right)^{1-\sigma}}{j_D(c_o)}\right] \geq 0$$

*Therefore the RHS of (1.43) is monotonically increasing in the space $(0, \overline{c})$ and it must cross the horizontal curve $\delta f_E$ only once. The equilibrium $c_o$ exists and it is unique.* ∎

Once the unique $c_o$ is determined, (1.33) and (1.34) can be determined as well as (1.35) to (1.37). By (1.13) follows $c_I$, while by (1.14) follows $\overline{\pi}$. However, to determine the aggregate variables, we have to compute the number of varieties.

### 1.6.1.4   Determination of the number of varieties

Labour can be employed in three activities: product innovation, process innovation and production. The labour used for product innovation is the labour used by new entrants for investment purposes and amounts to $L_e$ units. $L_p$ is the labour devoted to produce a variety or make its productive process more efficient. By full employment $L = L_e + L_p$. The market clearing condition for product innovation is $L_e = M_e f_e$, since each of the new $M_e$ entrants pays $f_e$ units of labour. Domestic producers and Innovators pay their workers out of revenues. Thus, the aggregate payment to production workers must match the difference between aggregate revenue and profit:

$$wL_p = L_p = R - \Pi$$

The stability condition $M_e G(c_o) = \delta M$ together with (1.14) imply:

$$L_e = M_e f_e = \frac{\delta M f_e}{G(c_o)} = M\overline{\pi} = \Pi$$

Then, the labour market clearing conditions implies $L = L_e + L_p = \Pi + R - \Pi = R$, that is the aggregate revenue consists of the aggregate consumers' expenditure and it is exogenously limited by the country size. Then, from (1.39) follows (1.15), with the understanding that the

superscript $A$ denotes the autarky equilibrium value of these variables. The cutoffs and the number of varieties pin down all other aggregate variables and complete the characterization of the unique stationary equilibrium in the closed economy.

### 1.6.2 Appendix B - Comparison of our entry cutoff with Melitz's (2003) in the closed economy

**Proposition 1.5** *Let denote $c_M^*$ as the cutoff level of marginal cost found in Melitz (2003) for the closed economy. Then we have that:*

$c_0 < c_M^*$

**Proof.** *Since (1.10) and $R = L$ are common to both models, the ratio of the entry cost-cutoff is given by:*

$$\frac{c_M^*}{c_0} = \frac{P_M^*}{P}$$

*where*

$$P_M^* = \left( \int_0^{c_I} (p(c))^{1-\sigma} g(c)dc + \int_{c_I}^{c_M^*} (p(c))^{1-\sigma} g(c)dc \right)^{\frac{1}{1-\sigma}}$$

$$P = \left( \int_0^{c_I} (\gamma p(c))^{1-\sigma} g(c)dc + \int_{c_I}^{c_0} (p(c))^{1-\sigma} g(c)dc \right)^{\frac{1}{1-\sigma}}$$

*Assume that:*

$c_0 > c_M^*$

*This implies that :*

$$\left( \int_0^{c_I} (p(c))^{1-\sigma} g(c)dc + \int_{c_I}^{c_M^*} (p(c))^{1-\sigma} g(c)dc \right)^{\frac{1}{1-\sigma}} < \left( \int_0^{c_I} (\gamma p(c))^{1-\sigma} g(c)dc + \int_{c_I}^{c_0} (p(c))^{1-\sigma} g(c)dc. \right)^{\frac{1}{1-\sigma}}$$

*and, rearranging terms, we have:*

$$(1 - \gamma^{1-\sigma}) \int_0^{c_I} (p(c))^{1-\sigma} g(c)dc > \int_{c_I}^{c_0} (p(c))^{1-\sigma} g(c)dc. - \int_{c_I}^{c_M^*} (p(c))^{1-\sigma} g(c)dc.$$

*which is not possible since, $\gamma < 1, \sigma > 1, c_0 > c_M^*$.*

*Q.E.D* ∎

### 1.6.3 Appendix C - Open economy - selection BW

#### 1.6.3.1 Aggregation

Let $\mu_D(c) = g(c)/[G(c_o) - G(c_X)]$, $\mu_X(c) = g(c)/[G(c_X) - G(c_I)]$, $\mu_{XI}(c) = g(c)/[G(c_I)]$ denote the distribution of cost level in each subgroup prior to innovation.

Defining $\widetilde{c_D}^{1-\sigma}$ and $\widetilde{c_I}^{1-\sigma}$ similarly as above and letting $\widetilde{c_X}^{1-\sigma} = \int_{c_I}^{c_X} c^{1-\sigma}\mu_X(c)dc$ and $M_D\widetilde{c_D}^{1-\sigma} + M_X\widetilde{c_X}^{1-\sigma} = M_{NI}\widetilde{c_{NI}}^{1-\sigma}$, the price index is a weighted average of within-group average productivity indexes given by:

$$P^{1-\sigma} = \frac{M_T}{\rho^{1-\sigma}} \underbrace{\left\{ \frac{1}{M_T} \left[ M_{NI}\widetilde{c_{NI}}^{1-\sigma} + M_{XI}\gamma^{1-\sigma}\widetilde{c_I}^{1-\sigma} + n\tau^{1-\sigma}(M_X\widetilde{c_X}^{1-\sigma} + M_{XI}\gamma^{1-\sigma}\widetilde{c_I}^{1-\sigma}) \right] \right\}}_{\widetilde{c}^{1-\sigma}}$$

$$(1.48)$$

where $\widetilde{c}^{1-\sigma}$ is again the weighted average productivity index of the economy.

Similarly,

$$\begin{aligned}
R &= M_{NI}r_D(\widetilde{c_{NI}}) + M_{XI}\gamma^{1-\sigma}r_D(\widetilde{c_I}) + n(M_X r_X(\widetilde{c_X}) + M_{XI}\gamma^{1-\sigma}r_X(\widetilde{c_I})) && (1.49) \\
&= M\underbrace{\left[ (1 - p_{rXI})r_D(\widetilde{c_{NI}}) + p_{rXI}\gamma^{1-\sigma}r_D(\widetilde{c_I}) + n(p_{rX}r_X(\widetilde{c_X}) + p_{rXI}\gamma^{1-\sigma}r_X(\widetilde{c_I})) \right]}_{\overline{r}} \\
&= M_T r_D(\widetilde{c})
\end{aligned}$$

where $M_S = Mp_{rS}$, $S = NI, X, XI$ was used.

Finally, the overall average - across all domestic firms - of combined profit is very similar and given by:

$$\begin{aligned}
\overline{\pi} &= \Pi/M = (1 - p_{rXI})\pi_D(\widetilde{c_{NI}}) + p_{rXI}\gamma^{1-\sigma}\pi_I(\widetilde{c_I}) + n(p_{rX}\pi_X(\widetilde{c_X}) + p_{rXI}\gamma^{1-\sigma}\pi_{XI}(\widetilde{c_I})) && (1.50) \\
&= \frac{\overline{r}}{\sigma} - f_D - \frac{G(c_I)}{G(c_o)}\delta f_I - \frac{G(c_X)}{G(c_o)}n\delta f_X
\end{aligned}$$

where the last equality follows from substituting for the $\pi$'s in the first line and using the expression for $\overline{r}$.

In a proof below, we shall use the average profit in the $BW$ equilibrium and we shall use the convention that the variable with superscript $f$ denote the equilibrium variables in the open economy equilibrium. For example the average profit in the trading equilibrium will be:

$$\begin{aligned}
\overline{\pi}^f &= \Pi/M = (1 - p_{rXI})\pi_D(\widetilde{c_{NI}}) + p_{rXI}\gamma^{1-\sigma}\pi_I(\widetilde{c_I}) + n(p_{rX}\pi_X(\widetilde{c_X}) + p_{rXI}\gamma^{1-\sigma}\pi_{XI}(\widetilde{c_I})) && (1.51) \\
&= \frac{\overline{r}^f}{\sigma} - f_D - \frac{G(c_I^f)}{G(c_o^f)}\delta f_I - \frac{G(c_X)}{G(c_o^f)}n\delta f_X
\end{aligned}$$

with $\widetilde{c_D}^{1-\sigma}$, $\widetilde{c_I}^{1-\sigma}$, $\widetilde{c_X}^{1-\sigma}$, $\widetilde{c_{NI}}^{1-\sigma}$ as well $p_{rD}$, $p_{rX}$, and $p_{rXI}$ are evaluated at the equilibrium cost cutoff $c_o^f, c_I^f$.

### 1.6.3.2  Existence and Uniqueness of the trading equilibrium

(1.22) to (1.24) as well as (1.27) and (1.28) allow us to rearrange the FE conveniently for the characterizing the equilibrium as a function of only $c_o$ and $c_X$:

$$\frac{\delta f_E}{G(c_o)} = \left\{ (1 - p_{rXI}) \left[ \frac{\widetilde{c_{NI}}}{c_o} \right]^{1-\sigma} + p_{rXI}\gamma^{1-\sigma} \left[ \frac{\widetilde{c_I}}{c_o} \right]^{1-\sigma} - 1 \right\} f_D - \delta f_I p_{rXI} + \quad (1.52)$$

$$+ \left\{ \frac{p_{rX}}{p_{rEXP}} \left[ \frac{\widetilde{c_X}}{c_X} \right]^{1-\sigma} + \frac{p_{rXI}}{p_{rEXP}}\gamma^{1-\sigma} \left[ \frac{\widetilde{c_I}}{c_X} \right]^{1-\sigma} - 1 \right\} p_{rEXP} n \delta f_X$$

$$\delta f_E = \left[ l_{NI}(c_o) + \gamma^{1-\sigma} l_I(c_o) \right] f_D + \left[ l_{NI}(c_X) + \gamma^{1-\sigma} l_I(c_X) \right] n \delta f_X$$

where $p_{rEXP} = G(c_X)/G(c_o)$ and

$$l_{NI}(c_o) = G(c_o) \left[ \left[ \frac{\widetilde{c_{NI}}}{c_o} \right]^{1-\sigma} - 1 \right] - G(c_I) \left[ \left[ \frac{\widetilde{c_{NI}}}{c_o} \right]^{1-\sigma} - \Psi^f \right]$$

$$l_I(c_o) = G(c_I) \left[ \left[ \frac{\widetilde{c_I}}{c_o} \right]^{1-\sigma} - \Psi^f \right]$$

$$l_{NI}(c_X) = G(c_X) \left[ \left[ \frac{\widetilde{c_X}}{c_X} \right]^{1-\sigma} - 1 \right] - G(c_I) \left[ \left[ \frac{\widetilde{c_X}}{c_X} \right]^{1-\sigma} - \Psi_X^f \right]$$

$$l_I(c_X) = G(c_I) \left[ \left[ \frac{\widetilde{c_I}}{c_X} \right]^{1-\sigma} - \Psi_X^f \right]$$

**Proposition 1.6** *Assume (1.25) holds. In the open economy, the equilibrium arising under selection BW exists and is unique.*

**Proof.** We proceed similarly as in the proof for the closed economy and we shall prove that the RHS of (1.52) is monotonically increasing in $c_o$ on the interval $[0, \overline{c}]$. By (1.46), $l_I(c_o)$ is monotonically increasing in $c_o$ and $l_I(c_X)$ is monotonically increasing in $c_X$ from zero to infinity on $c \in [0, \overline{c}]$. In turn, $c_X$ is increasing in $c_o$ from (1.29). Similarly by (1.47), $l_{NI}(c_o)$ and $l_{NI}(c_X)$ are monotonically increasing from 0 to infinity respectively in $c_o$ and $c_X$ belonging to $[0, \overline{c}]$. Hence, the RHS of (1.52) is a monotonic increasing function from 0 to $\infty$ in the $[0, \overline{c}]$ space, while the LHS is a flat line. The equilibrium cost-cutoff level $c_o$ must then be unique. ∎

### 1.6.3.3 Comparison of the entry cost-cutoff in autarky and in trade

To compare the equilibrium entry cost-cutoff of autarky $c_o^A$ with the one arising in the $BW$-equilibrium $c_o^f$, it is useful to re-arrange (1.52) in a more convenient way as:

$$\delta f_E = \left[ j_D(c_o^f) + \gamma^{1-\sigma} j_I(c_o^f) \right] f_D + \Gamma \tag{1.53}$$

where

$$\Gamma = \left\{ \left[ \frac{\widetilde{c_X}}{c_X} \right]^{1-\sigma} - \frac{G(c_I^f)}{G(c_X)} \left[ \frac{\widetilde{c_X}}{c_X} \right]^{1-\sigma} + \gamma^{1-\sigma} \frac{G(c_I^f)}{G(c_X)} \left[ \frac{\widetilde{c_I}}{c_X} \right]^{1-\sigma} - 1 \right\} G(c_X) n \delta f_X \geq 0$$

The first term of the RHS in (1.53) is exactly the same as in the closed economy. If $\Gamma$ were 0, (1.43) and (1.53) would yield the same solution, i.e. $c_o^f = c_o^A$. Since $\Gamma$ is positive the curve representing the RHS of (1.53) must lie above the curve representing the RHS of (1.43), implying a lower entry cost-cutoff in the trading equilibrium than in the autarky equilibrium. That is, $c_o^f \leq c_o^A$.

### 1.6.3.4 Proposition 1.1 - In $BW$, trade increases the proportion of firms performing process-innovation

**Proposition** *1.1. If (1.30) and (1.25) hold, then the innovation cutoff in the open economy is lower than in autarky (i.e $c_I^f < c_I^A$).*
**Proof.** First, use the expressions for $\mu_D, \mu_X, \mu_{XI}, p_{rX}, p_{rXI}$ to rewrite (1.26) as:

$$\bar{\pi}^f = \frac{\delta f_E}{G(c_o^f)} \tag{1.54}$$

where $\bar{\pi}^f$ is (1.51).

Using (1.14) and (1.54) combined with (1.30) it is possible to write the ratio of the average profit in the trading equilibrium to the average profit in autarky as:

$$\frac{\bar{\pi}^f}{\bar{\pi}^A} = \left( \frac{c_o^A}{c_o^f} \right)^k$$

Use (1.13) and (1.27) to get:

$$\left( \frac{c_I^A}{c_I^f} \right)^k = (1 + n\tau^{1-\sigma})^{\frac{k}{1-\sigma}} \left( \frac{\bar{\pi}^f}{\bar{\pi}^A} \right)$$

Let us make some convenient transformations. Recalling that:

$$\Psi^f = \frac{\delta f_I}{(\gamma^{1-\sigma} - 1)(1 + n\tau^{1-\sigma}) f_D} \tag{1.55}$$

we define $\Lambda = \Psi^{\frac{1}{1-\sigma}}$, $\Lambda^* = \Psi^{f\frac{1}{1-\sigma}}$, and $\Lambda^* = \alpha\beta$ where:

$$\alpha = \left(\frac{\tau^{1-\sigma}f_I}{(\gamma^{1-\sigma}-1)(1+n\tau^{1-\sigma})f_X}\right)^{\frac{1}{1-\sigma}}$$

$$\beta = \left(\frac{\delta f_X}{f_D}\tau^{\sigma-1}\right)^{\frac{1}{1-\sigma}} \tag{1.56}$$

(1.52) can then be expressed as a function of the parameters of the model:

$$\bar{\pi}^f = \left[\frac{k}{k+1-\sigma}\left[(1-\Lambda^{k+1-\sigma})+\gamma^{1-\sigma}\Lambda^{k+1-\sigma}\right]-1\right]f_D - \delta f_I\Lambda^k +$$

$$\left[\frac{k}{k+1-\sigma}\left[(1-\alpha^{k+1-\sigma})+\gamma^{1-\sigma}\alpha^{k+1-\sigma}\right]-1\right]\beta^k n\delta f_X$$

Using the definition of $\Lambda$ and rearranging terms we get:

$$\bar{\pi}^f = \frac{k}{k+1-\sigma}\left[(\gamma^{1-\sigma}-1)\Lambda^{k+1-\sigma}\right]f_D - \delta f_I\Lambda^k + \frac{\sigma-1}{k+1-\sigma}f_D +$$

$$\frac{k}{k+1-\sigma}\left[(\gamma^{1-\sigma}-1)\Lambda^{k+1-\sigma}\right]\beta^{\sigma-1}n\delta f_X + \frac{\sigma-1}{k+1-\sigma}\beta^k n\delta f_X$$

Using (1.56) and the fact that $\Lambda^* = (1+n\tau^{1-\sigma})^{\frac{1}{\sigma-1}}\Lambda$:

$$\bar{\pi}^f = \left[\frac{k}{k+1-\sigma}\left[\Lambda^{1-\sigma}(\gamma^{1-\sigma}-1)\right]f_D - \delta f_I\right]\Lambda^{*k} + \frac{\sigma-1}{k+1-\sigma}f_D \tag{1.57}$$

$$+\frac{\sigma-1}{k+1-\sigma}\beta^k n\delta f_X$$

and expanding (1.43):

$$\bar{\pi}^A = \left[\frac{k}{k+1-\sigma}\left[\Lambda^{1-\sigma}(\gamma^{1-\sigma}-1)\right]f_D - \delta f_I\right]\Lambda^k +$$

$$\frac{\sigma-1}{k+1-\sigma}f_D$$

Then,

$$\left(\frac{c_I^A}{c_I^f}\right)^k = \frac{(1+n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}A+B+C}{(1+n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}A+(1+n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}B} \tag{1.58}$$

where

$$A = [\frac{k}{k+1-\sigma}\left[\Lambda^{1-\sigma}(\gamma^{1-\sigma}-1)\right]f_D - \delta f_I\Lambda^k \tag{1.59}$$

$$B = \frac{\sigma-1}{k+1-\sigma}f_D \tag{1.60}$$

$$C = \frac{\sigma - 1}{k + 1 - \sigma}\beta^k n\delta f_X \qquad (1.61)$$

We have to show that :

$$\frac{c_I^A}{c_I^f} < 1$$

which implies:

$$((1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}} - 1)B > C$$

Substituting (1.60),(1.61), the inequality becomes:

$$(1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}} > 1 + \left(\frac{\delta f_X}{f_D}\right)^{\frac{k+1-\sigma}{1-\sigma}}\tau^{-k}n$$

To show that this inequality holds true, note that $\beta < 1$ implies:

$$\left(\frac{\delta f_X}{f_D}\right)^{\frac{k+1-\sigma}{1-\sigma}}\tau^{-k}n < n\tau^{1-\sigma} \Rightarrow 1 + \left(\frac{\delta f_X}{f_D}\right)^{\frac{k+1-\sigma}{1-\sigma}}\tau^{-k}n < 1 + n\tau^{1-\sigma}$$

It follows:

$$(1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}} > (1 + n\tau^{1-\sigma}) > 1 + \left(\frac{\delta f_X}{f_D}\right)^{\frac{k+1-\sigma}{1-\sigma}}\tau^{-k}n$$

since $k > \sigma - 1$ is assumed. ■

### 1.6.3.5 Lemma 1.2

**Lemma** *1.2. Assume (1.30) and (1.25) hold. Trade liberalization will have positive effects in innovation, i.e. $dc_I/d\tau \leq 0$.*

**Proof.** Combining (1.27) with (1.30), we get that:

$$G(c_I) = \Psi^{\frac{k}{1-\sigma}}G(c_o^f)$$

Substitute (1.54) and (1.55) into this expression to get:

$$(G(c_I))^{-1} = (1 + n\tau^{1-\sigma})^{\frac{k}{1-\sigma}}\bar{\pi}^f\Theta = f$$

where $\Theta$ is a constant independent of $\tau$, so that we shall ignore it because it does not affect the derivative. Totally differentiating both sides of this expression w.r.t. $\tau$, we obtain the following:

$$\frac{dc_I}{d\tau} = \frac{\frac{df}{d\tau}}{\frac{d(G(c_I))^{-1}}{dc_I}}$$

Since the denominator is negative, it is enough to show $\frac{df}{d\tau} > 0$ for $\frac{dc_I}{d\tau} < 0$. Use (1.57), (1.59) to (1.61) and recall $\Lambda^* = (1 + n\tau^{1-\sigma})^{\frac{1}{\sigma-1}}\Lambda$ to expand $f$ in the following way:

$$f = A + \frac{B}{(1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}} + \frac{C}{(1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}}$$

where $A, B, C$ are defined as in (1.59) to (1.61) and $A$ is independent of $\tau$. Using (1.56) and (1.61), it is convenient to express $C = \lambda\phi^{\frac{k}{\sigma-1}}$, with $\phi \equiv \tau^{1-\sigma}$, so that:

$$\frac{df}{d\phi} = \frac{\lambda\phi^{\frac{k+1-\sigma}{\sigma-1}}(1+n\phi)^{\frac{k}{\sigma-1}} - (1+n\phi)^{\frac{k+1-\sigma}{\sigma-1}}\phi^{\frac{k}{\sigma-1}}\lambda n - Bn(1+n\phi)^{\frac{k+1-\sigma}{\sigma-1}}}{(1+n\phi)^{\frac{2k}{\sigma-1}}}$$

Rearranging terms:

$$\frac{df}{d\phi} = \frac{\left[\lambda\phi^{\frac{k}{\sigma-1}}\frac{1}{\phi(1+n\phi)} - B\frac{n}{1+n\phi}\right]}{(1+n\phi)^{\frac{k}{\sigma-1}}}$$

Since we are deriving $f$ with respect to $\phi$ (instead of $\tau$) and $\sigma > 1$, the numerator is negative (i.e. $\frac{df}{d\tau} > 0$) iff:

$$\phi^{\frac{k+1-\sigma}{\sigma-1}} < \frac{B}{\lambda}n$$

and substituting for the values of $B$ and $\lambda$, we get:

$$\phi = \frac{f_D}{\delta f_X}$$

and:

$$\tau \leq \left(\frac{\delta f_X}{f_D}\right)^{\frac{1}{1-\sigma}}$$

which satisfies our parameter restrictions (1.25). ∎

#### 1.6.3.6    Lemma 1.3

**Lemma** *1.3. Assume (1.30) holds. $c_x$ is monotonically decreasing in $\tau$ and $f_x$.*
**Proof.** Combining (1.29) with (1.30) gives the following equality:

$$G(c_X) = \beta^k G(c_o)$$

Substitute (1.54) and (1.56) into this expression to get:

$$(G(c_X))^{-1} = \zeta\tau^k\bar{\pi}^f = g \tag{1.62}$$

where $\zeta = \left(\frac{\delta f_X}{f_D}\right)^{\frac{k}{\sigma-1}}$ is constant with respect to tariffs.

Proceeding similarly to the proof above, we take the total differential of both sides of (1.62) w.r.t. $\tau$, so that the response of the exporting cost cutoff to changes in the transportation costs is given by:

$$\frac{dc_X}{d\tau} = \frac{\frac{dg}{d\tau}}{\frac{d(G(c_X))^{-1}}{dc_X}}$$

Since the denominator is negative, we need to prove $\frac{dg}{d\tau} > 0$ for $\frac{dc_X}{d\tau} < 0$. Substituting (1.57),(1.59),(1.60),(1.61) into (1.62), $g$ is a function given by:

$$g = \zeta\tau^k(1 + n\tau^{1-\sigma})^{\frac{k}{\sigma-1}}A + \zeta\tau^k B + \zeta\tau^k C$$

or, substituting for the value of $C$, $g$ can be conveniently expanded as:

$$g = \zeta(\tau^{k(\sigma-1)} + n\tau^{(k-1)(\sigma-1)})^{\frac{k}{\sigma-1}}A + \zeta\tau^k B + \Phi$$

where $\Phi = \frac{(\sigma-1)n}{k+1-\sigma}(\delta f_X)$. It follows $\frac{dg}{d\tau} > 0$.

To prove that $dc_X/df_X \le 0$ we totally differentiate both sides of (1.62) w.r.t. $f_X$ and obtain the following:

$$\frac{dc_X}{df_X} = \frac{\frac{dg}{df_X}}{\frac{d(G(c_X))^{-1}}{dc_X}}$$

Note that $\frac{dg}{df_X} > 0$ as $\frac{d\zeta}{df_X} > 0, \frac{d\omega}{df_X} > 0$ and $A, B$ are independent of $f_X$. Recalling that the denominator is negative, it follows that $\frac{dc_X}{df_X} \le 0$ - Q.E.D. ■

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# CHAPTER 2

# RTAS FORMATION AND TRADE POLICY

## 2.1 Introduction

Starting from the 90s, regional integration has experienced a spurt and it has represented a major feature of International Relations. Starting in 1948, some 200 RIAs have been notified to GATT/WTO, but about one-half of all notifications have occurred in the last decade.

This recent proliferation of preferential trade agreements (PTAs) was often attributed to the unsatisfactory progress of multilateral trade negotiations and therefore, to issues related to the efficiency of multilateral trade liberalization to achieve free trade.[1] This view has shifted the economic debate from the traditional concern about the welfare implications of preferential trade *per se*, to the highly controversial issue on whether regionalism or multilateralism is the most effective strategy for achieving global free trade.[2]

A common feature of this literature is that trade policy has been represented mostly by tariff measures and their reductions, mirroring probably that the major effort of GATT rounds was the reduction of tariff barriers.[3]

However, this at odd with the striking empirical observation that numerous other instruments of trade policy - such as global and country specific volume quotas, value quotas, voluntary export restraint (VER), local content schemes - have become more and more popular throughout out all countries. The relevance of this is that Corden and Falvey (1985) and Falvey (1988) have shown that these instruments have specific implications - not shared with tariffs - in the context of piecemeal tariff reform which are likely to be relevant for regional

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[1]See for example Bhagwati (1993). The first wave of regionalism took place in the 1960s, but it failed to spread because the U.S. supported a multilateral approach. But the U.S. changed positions, and – starting with the 1980s – has favored regional trade agreements. See also Fernandez (1997) for a broad and extensive review on the "traditional" and "non-traditional" gains of regionalism .

[2]Some view PTAs as antithetical to the GATT, inevitably leading to a world of warring trade blocs - *stumbling blocs* in Bhagwati's definition - while others view them as supplemental, being just one more path by which global free trade can be approached - *building blocs.* See Summers (1991), Krugman (1993) and Frankel et. al (1997). For a traditional approach to custom unions (CUs) focusing on its welfare outcome, refer to Viner (1950).

[3]In this literature, alternative measures to tariff protection such as quota restrictions have been analyzed in terms of their tariff-equivalent. Note that uniform tariff measures are also analytically convenient.

integration too, but have not been - to the best of my knowledge - explored so far. Going back to a more traditional welfare approach, the aim of this paper is to show that, differently from tariffs, such non tariff barriers have positive implications for the welfare consequence of a regional integration agreement.

Starting from this standpoint, this paper relates the policy interest in preferential trade among nations to a well known feature of international trade relations - the gradual but fundamental change in the nature of trade protection over the past thirty years. As international negotiation has succeeded in reducing tariffs to low levels, national governments have resorted to a range of increasingly intricate policies to protect their domestic industries from foreign competition. As Laird and Yeats (1990) note "*while a major effort was made in multilateral trade negotiations to reduce tariffs, protectionism in the form of NTBs (non tariff barriers) greatly expanded, and may have even offset or exceeded the effects of liberalized import duties*". Estimates relating to the post WWII period indicate that the average tariff on manufactures in developed countries was approximately 40 percent, whereas nowadays it is lower than 5 percent. The declining proportion of imported industrial products that do not receive duty free treatment in developed countries, and the reduced fraction of imports into developed countries from all sources facing tariff rates more than 15%, point to the same evidence of falling tariffs protection over the same period. On the contrary, in 1966 NTBs affected 25 per cent of developed countries' imports, while in 1986 this share had increased to 48 percent, a symptom of an increasing trend of non-tariff trade restrictions.

In spite of GATT prohibitions, these quantitative restriction have been widely used, partly because GATT rules do permit countries to recourse to instruments such as quota to protect domestic agriculture as anti-dumping measures and as temporary "safeguard" actions. Moreover, most developing economies are exonerated from these rules and trade in textile and apparel and agriculture commodities has been largely exempted from GATT disciplines for decades. In addition, VER, being voluntary, are negotiated on a bilateral basis outside the GATT framework.[4] The consequence being that such direct quantitative restrictions (QRs) on international trade have greatly expanded their coverage: from $ 30 billion of imports from OECD countries affected by NTBs in 1966 ($ 100 billion in 1986 prices) to the $356 billion of 1986.

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[4]For instance, The Long-Term Textile Agreement (LTA) and the Multi-Fiber Arrangement (MFA) are a series of bilateral trade quotas covering textiles and apparel that have been negotiated outside the GATT. Many countries have kept their programs of support for agricultural apart from GATT rules. The USA, for example, have being using import quotas to support domestic farm price, and similarly the European Community supports its farmers with its Common Agricultural Policy which relies on a series of variable tariffs that act very much like quotas.

In the context of regional integration (RI), non tariff barriers have different implications from tariffs on trade flows and therefore, they lead to a different welfare outcome. Prior to a regional agreement, it may be presumed that a country had the same tariffs on all countries, but it purchased from outside the union because that price was lowest. After the union, the country switches its purchases from the lowest-price to a higher-price country. However, if imports had been limited by volume quotas, a member-country could still have imported the good from the lowest cost supplier, as long as the quantity of imports did not exceed the quota limits. Trade diversion occurs at a less extent under quota restricted trade than under tariff-restricted trade. In particular, if quotas vis-á-vis countries outside the union result binding even after the implementation of a RTA, the volumes of trade with the rest of the world will be clearly preserved - which is the "*efficient rule*" for welfare-enhancing custom unions and FTAs as proposed by Kemp and Wan (1976) and Krishna and Panagariya (2002). In other words, the Kemp-Wan and Krishna-Panagariya results have important implications in the presence of QRs. This is the main result of the paper and suggests welfare gains from a trade agreement may turn to be more likely under NTBs than under tariff-barriers. In turn, this may have led government to a renewed policy interest in the formation of RTAs after 1990.

The intuition for this result is simple: binding quotas, differently from tariffs, succeed to preserve the trade volumes with the rest of the world. When purchases from the rest of the world are fixed, countries in a CU and in a FTA move closer to free trade which is welfare improvement. Indeed, in this specific case the FTA does not reduce trade with the outside world and expands trade between the partners.

Krishna and Panagariya (2002) do not provide a general existence result for a tariff vector ensuring that the criterion they propose for welfare enhancing FTA holds - namely, every FTA member imports and exports the same quantity with the rest of the world as they did before the FTA. This paper shows that the presence of binding NTBs vis-à-vis non member countries leads to a FTA formation that naturally implements this "efficiency rule", whereas the same agreement implemented in presence of tariff restricted trade could not lead to such outcome. The intuition for the latter result is related to Bagwell and Staiger (2004) who shows that any bilateral agreement on tariff-reduction can preserve the pre-existing volumes of trade if only satisfies the principles of reciprocity and Most Favoured Nation (MFN) treatment, which is necessarily violated by a FTA.[5]

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[5]This principle states that all countries belonging to GATT should be treated equally. So if Japan reduces its tariffs on goods coming from Europe, it must do the same for those goods coming from any other member country of GATT.

Furthermore, Kemp and Wan (1976) and Krishna and Panagariya (2002) allow us to conclude that welfare improving CUs and FTAs exist, while this paper emphasizes that the desirability of such reforms has increased through time, by relating the existence of welfare enhancing FTAs to the systematic change in the type of trade policy instruments adopted by most countries over the past twenty-five years. As countries have reduced tariff protection in the fulfilment of GATT regulations and substitute it with non-tariff trade restrictions, policy maker's interest for joining into a RTAs has also increased, resulting in a greater formation of RTAs.

Chang and Winters (2002) have shown that Mercosur has brought significant terms of trade appreciation for Brazil and loss for the external countries exporting into the area, including US, Japan, Germany, South Korea and Chile. Interestingly, the model shows that such effects could be driven by agreements upon the abolition of existing VERs (possibly arising also in the context of regional integration) and that such agreements may turn to be welfare-enhancing. This is especially important, given the extensive use of VERs in the mid-80s for which later on countries have rescinded their requests in the 90s.[6]

Finally, in their survey De Melo et. al. (1993), they briefly discuss the possibility of a welfare improving FTA in presence of QRs, but their underline assumption is that partner countries are small relative to the rest of the world. I consider the large country setting, but like them, I assess the benefits of RI from the view point of participating countries rather than the world as a whole.

The basic insights are developed in a three-countries, two-goods general equilibrium trade model presented in section 2.2. I shall follow closely Bagwell and Staiger (1999), (2002) and (2004), and extend their framework to include global quotas, country-specific quotas and VERs besides tariffs, as instruments of trade policy available to countries. Then, the model is used in section 2.3 to analyze the different welfare consequence of a RTA in presence of quota-restricted from tariff-restricted trade. The small open economy case is illustrative of the different adjustment mechanisms implied by NTBs and tariffs after the implementation of an agreement. Such mechanisms will still be operative in the large economy case, but they will be either reinforced or offset by terms of trade effects. Given the empirical relevance of VERs, section 2.4 shows that they can also lead to a favorable welfare outcome of regionalism

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Under the principle of reciprocity, negotiations result in tariff adjustments that generate for each participant an equal change in the volume of its imports and exports.

[6]For example Laird and Yeat (1990) have documented that the incidence of VERs on import volumes has greatly increased between 1981 and 1986 for all developed economies.

in spite of the terms of trade effects induced. In section (2.5), I turn to the possibility of comparing the gains arising from RIAs under two different trade policies, namely quotas and tariffs. The last section concludes.

## 2.2 The model

The basic insights for the different outcome of regional integration in presence of two different instruments of trade policy - namely tariffs and volume quota restrictions - can be developed in a three country $\{A, B, C\}$, two goods $\{x, y\}$ general equilibrium model.[7] All countries share the same preferences over $x, y$ which are normal goods in consumption and are produced in each country with a non-increasing return to scale technology. All markets are perfectly competitive.

*Trade-Patterns*

Trade patterns reflect comparative advantages: without loss of generality, country $A$ (home country- no *) exports good $y$ to foreign countries $^*B$ and $^*C$ and imports good $x$ from them. For simplicity, suppose further that the two foreign countries do not trade with one another[8]. This is the easiest and minimal structure to confront, in the next section, the home country with the option of a trade agreement with $^*B$ (e.g. a FTA) when trade is restricted either by NTBs or by tariff measures.

*Trade Policy*

The trade policy conducted by each country is exogenously given, as its political determination is beyond the aim of the present paper. Among several types of NTBs, direct quantitative restrictions on international trade have become particularly widespread. Thus, I shall restrict my attention here to volume import quotas and VERs. The volume quota imposed by the home country on imports of $x$ from foreign country $i$ is denoted as $\overline{m}^i$, and $\overline{m}^{*i}$ is likewise the quantity restriction imposed by foreign country $i$ on imports of good $y$. Note that, more broadly, $\overline{m}^i$ may be re-interpreted as the VER imposed (possibly on request or threat) by foreign country $i$ to $A$, and likewise, $\overline{m}^{*i}$ may be the VER levied by A against foreign country $i$.

When trade protection is achieved through tariffs, the ad valorem tariff that the home government places on imports of $x$ from foreign country $i$ is denoted as $t^i$, and $t^{*i}$ likewise denotes the ad valorem tariff levied by the government of foreign country $i$ on imports of $y$

---

[7]This model is developed in greater detail in Bagwell and Staiger (1999), (2002) and (2004).

[8]This is the simplest way to ensure A can set a discriminatory trade policy (e.g. a trade agreement) against its two foreign trading partners without prohibiting trade with the less favored partner.

from the home country. When $t^B = t^C$, $A$ is implementing a non-discriminatory trade policy complying with the Most Favoured Nation (MFN) principle of GATT. On the other hand, $t^B \neq t^C$ is a descriminatory trade policy. Note that $t$ $(t^{*i})$ can also the implicit trade tax associated with a quantitative restriction $\overline{m}^i$ $(\overline{m}^{*i})$.

Assume that the revenue collected by each country from trade protection is disbursed to the consumers by costless non-distortionary means. Throughout, I shall assume the market for import quota licenses is competitive. That is, quota are allocated so as to ensure perfect competition among quota holders.[9]

*International Transaction, and Terms of Trade*

Let $p \equiv p_x/p_y$ denotes $A$'s local relative price and similarly $p^{*i} = p_x^{*i}/p_y^{*i}$, the local relative price in foreign country $i$. Letting $\tau^i \equiv (1 + t^i)$ and $\tau^{*i} = (1 + t^{*i})$, the local prices can be represented in terms of world prices and tariffs by $p = \tau^i p^{wi} \equiv p(\tau^i, p^{wi})$ and $p^{*i} = p^{wi}/\tau^{*i} \equiv p^{*i}(\tau^{*i}, p^{wi})$. $p^{wi} = p_x^{*i}/p_y$, $i = B, C$ is the "world" (i.e. untaxed) relative price or, equivalently, the ratio of exporter/producer prices for trade between the home country and foreign country $i$. It represents foreign country $i$'s terms of trade while its inverse is $A$'s bilateral terms of trade with each trading partner.[10]

Foreign country $i$ buys good $y$ internationally from country $A$ at $p_y$, but its local price is $p_y^{*i} = \tau^{*i} p_y$, whereas the local price of good $x$ coincides with the producer or the exporter price $p_x^{*i}$, as no export taxes or subsidies are in place. $A$ has two possible source countries from which to buy good $x$ at either $p_x^{*B}$ or $p_x^{*C}$. It is natural to assume that consumers in the home country are indifferent between an homogenous good $x$ coming from the two locations $B$ and $C$.[11] Due to this perfect substitutability, $A$ will be trading with both partners provided that consumer prices of goods coming from different locations are equalized:

$$p_x = (1 + t^B)p_x^{*B} = (1 + t^C)p_x^{*C} \tag{2.1}$$

or in terms of relative price:

---

[9]This assumption ensures that in equilibrium there will no be unexploited profit opportunities so that each quota-license holder uses entirely its license.

Moreover, as Krueger (1974) notes quota-induced scarcity rents are economically valuable and may push some firms to engage in some "rent seeking" activities such as lobbying, red-tape, and other resource-using activities. I disregard this possibility here and assume that there is no diversion of economic resources from their most efficient use.

[10]The terms of trade of a country is defined as the price of its exports relative to the price of its imports.

[11]This preference could be represented by $U(C_x^{*i}, C_y^{*i})$ in foreign country $i$ and $U(C_x, C_y)$ in the home country with $C_x = c_{xA} + c_{xB} + c_{xC}$ being a linear subutility function. $C_x$ is a quantity index giving the total amount of good x consumed regardless of its origin. $c_{xk}, k = A, B, C$ is the units of good x manufactured in country $k$ and consumed in country A. The linearity makes good $xk$ from the different source countries perfect substitutes, or equivalently, the indifference curves between these locations are linear.

$$p = \tau^B p^{wB} = \tau^C p^{wC} \tag{2.2}$$

which states that world prices are linked across bilateral trading relationships. (2.2) implies that under MFN tariffs ($\tau^B = \tau^C$) a single world price $p^w = p^{wB} = p^{wC}$ arises, whereas when A discriminates with its tariff policy ($\tau^B \neq \tau^C$) - like in the case of a regional integration agreements - there are different world prices: $p^{wB} \neq p^{wC}$. (2.1) like (2.2) is the condition for an interior solution - that is, A trades simultaneously with both its trading partners. Otherwise A would be just trading with the source-country whose good can be offered at a cheaper local price, as it is the only good for which demand is positive.

Note that when A is a small country, its volume of trade are too limited to affect $p_x^{*B}$ and $p_x^{*C}$ which are taken as given. Assuming C is the lowest cost supplier ($p_x^{*C} < p_x^{*B}$), (2.1) can not possibly hold with a MFN tariff, leading only to bilateral trade between the home country and the cheapest source country.

When A is a large country, $p_x^{*B}$ and $p_x^{*C}$ are endogenously determined and depend on the volume exchanged. In this context, C being the lowest cost supplier just means that it has a grater comparative advantage relative to B and can therefore supply more quantities at the same price. A allocates optimally its imports between the two foreign countries so that the premium per good $x$ (the excess of the tariff-distorted domestic price over the world price) is the same across locations. If this is not the case (e.g. $p_x - p_x^{*B} < p_x - p_x^{*C}$), the tariff revenue per unit of good $x$ will be greater from importing additional units of good $x$ from C and fewer from B. Such reallocation will continue until either the premia is driven to equality or until all imports come necessarily from a single source.

An MFN tariff further implies that import mix from the two possible sources have to equalize producer prices.

*Production*

Let $Q_k = Q_k(p)$ and $Q_k^{*i} = Q_k^{*i}(p^{*i})$, $k = x, y$ and $i = B, C$ denote the optimal production quantities of good $k$ respectively in the home country and in foreign country $i$.[12] The optimal production quantity in each country is determined by the tangency point on the production possibility frontier between the marginal rate of transformation between $x$ and $y$ and the local relative price.

*Consumption, Tariff Revenue and GDP*

---

[12] Think of the production quantities as the result of profit maximization of the representative firm in each sector $k$. With the assumption of perfect competition, the amounts produced in each industry will maximize the value of GDP at the local prices. That is, $Q_k(p) = \arg\max_{Q_k} \{pQ_x(p) + Q_y(p) \ s.t. \ PPF\}$ where PPF is the production possibility frontier. Analogously, $Q_k^{*i}(p) = \arg\max_{Q_k} \{Q_x(p^{*i}) + Q_y(p^{*i})/p^{*i} \ s.t. \ PPF\}$

Consumption in each country is a function of the local relative price and income. Given that the tariff/quota revenue is redistributed back to the consumers, national income for the home country (foreign country $i$) will be the sum of the value of domestic production (GDP) and tariff revenue $R$ $(R^{*i})$ expressed in units of the local export good at local prices:[13]

$$I(p, R) = pQ_x(p) + Q_y(p) + R \tag{2.3}$$

$$I^{*i}(p^{*i}, R^{*i}) = Q_x(p^{*i}) + Q_y(p^{*i})/p^{*i} + R^{*i} \tag{2.4}$$

Given that each country's income is a function of local relative prices and revenue from protection, consumption of good $k$ can be represented by $C_k^{*i} = C_k^{*i}(p^{*i}, R^{*i})$ for foreign country $i$ and by $C_k = C_k(p, R)$ for the domestic economy for $k = x, y$. The tariff revenue in foreign country $i$ in units of the local export good at local prices is defined implicitly by:

$$
\begin{aligned}
R^{*i} &= (t^{*i}/p^{wi})[C_y^{*i}(p^{*i}, R^{*i}) - Q_y^{*i}(p^{*i})] \\
&= [1/p^{*i} - 1/p^{wi}][C_y^{*i}(p^{*i}, R^{*i}) - Q_y^{*i}(p^{*i})] \\
&\equiv R^{*i}(p^{*i}, p^{wi})
\end{aligned}
$$

Denoting by $M^{*i}(p^{*i}, p^{wi}) \equiv C_y^{*i}(p^{*i}, R^{*i}(p^{*i}, p^{wi})) - Q_y^{*i}(p^{*i})$ the imports of good $y$ for foreign country $i$ and, similarly by $E_x^{*i}(p^{*i}, p^{wi}) \equiv Q_x^{*i}(p^{*i}) - C_x^{*i}(p^{*i}, R^{*i}(p^{*i}, p^{wi}))$ foreign country $i$'s exports of good $x$, the expression for tariff revenue simplifies to:

$$R^{*i} = (t^{*i}/p^{wi})M^{*i}(p^{*i}, p^{wi}) = [1/p^{*i} - 1/p^{wi}]M^{*i}(p^{*i}, p^{wi}) \tag{2.5}$$

Consumption in the domestic country is affected by $R$ which originates from trading with both trading partners. Moreover, if A imposes a discriminatory trade policy, its tariff revenue will depend upon the total volume of $x$ that it imports and the composition of this volume across the foreign trading partners. Defining bilateral trade shares by:

$$s^{*i} = \frac{E^{*i}(p^{*i}, p^{wi})}{\displaystyle\sum_{j \in \{B,C\}} E^{*j}(p^{*j}, p^{wj})} \equiv s^{*i}(p^{*B}, p^{*C}, p^{wB}, p^{wC}) \tag{2.6}$$

and country $A$'s multilateral terms of trade as:

---

[13] Think of the consumed quantities in each country as derived from the maximizing of the representative consumer's preferences subject to the budget constraint. For instance, the representative consumer of foreign country $i$ solves:

$\max_{C_x^{*i} \geq 0, C_y^{*i} \geq 0} U(C_x^{*i}, C_y^{*i})$

$s.t. \quad p_x C_x^{*i} + p_y C^{*i} = p_x Q_x^{*i} + p_y Q_y^{*i} + R^{*i}$

$$T = \sum_{i \in \{B,C\}} s^{*i} p^{wi} \equiv T(p^{*B}, p^{*C}, p^{wB}, p^{wC}) \qquad (2.7)$$

the revenue from trade protection in units of the local export good at local prices can be defined implicitly by:

$$
\begin{aligned}
R &= \sum_{i \in \{B,C\}} [C_x(p,R) - Q_x(p)] s^{*i} t^i p^{wi} \\
&= \sum_{i \in \{B,C\}} [C_x(p,R) - Q_x(p)] s^{*i} (p - p^{wi}) \\
&= [C_x(p,R) - Q_x(p)](p - \sum_{i \in \{B,C\}} s^{*i} p^{wi}) = [C_x(p,R) - Q_x(p)](p - T) \\
&\equiv R(p,T)
\end{aligned}
$$

$s^{*i}$ is country $A$'s share of imports from foreign country $i$ and $T$ is an import share-weighted average of the bilateral terms of trade. A reduction in $T$ represents an improvement in $A$'s multilateral terms of trade as much as a reduction in $p^{wi}$ represents an improvement in its bilateral terms of trade with foreign country $i$. (2.2) implies $T = p^w$ under MFN tariffs. Letting $M(p,T) \equiv C_x(p, R(p,T)) - Q_x(p)$ and $E(p,T) \equiv Q_y(p) - C_y(p, R(p,T))$ be respectively $A$'s total imports (of good $x$) and total exports (of good $y$), the budget constraint of each country implies that trade is balanced, so that:

$$M^{*i}(p^{*i}, p^{wi}) = p^{wi} E^{*i}(p^{*i}, p^{wi}) \qquad i = B, C \qquad (2.8)$$

$$TM(p,T) = E(p,T) \qquad (2.9)$$

Note that for each foreign country, the production, consumption, import and export quantities depend exclusively on the tariffs and the world prices. Indeed, once the latter are determined, local prices can be determined too. Analogously, each quantity at home can be expressed ultimately as a function of the local relative price $p$ and the multilateral terms of trade $T$.

*Equilibrium with tariffs*

Given a set of tariff $\boldsymbol{\tau} = (\tau^B, \tau^C, \tau^{*B}, \tau^{*C})$ the equilibrium world prices $p^{wB}$ and $p^{wC}$ can be pinned down by (2.2) together with the following condition:

$$M(p,T) = \sum_{i \in \{B,C\}} E^{*i}(p^{*i}, p^{wi}) \qquad (2.10)$$

(2.10) is the market clearing condition for good $x$ stating that the world demand for good $x$ is equal to its world supply and recall (2.2) is the condition for an interior solution. By Walras law, (2.10), (2.8) and (2.9) ensure the market for good $y$ clears as well[14]. (2.10) and (2.2) determine the two unknown world prices which together with the tariffs determine the equilibrium values of all local prices. In turn, all other quantities (domestic consumption and production, import and export volumes, tariff revenue) and the multilateral terms of trade can be derived.

Given the general form of the functions assumed, it is possible that anomalous but not impossible cases - such as the Metzler and the Lerner paradox - arise. The Metzler paradox comprises a situation in which the domestic price of an imported good fall after a country levies a tariff on that good. This means that the sector which recieves a greater protection is worse off after the introduction of the tariff, so that resources move away from the protected sector since it becomes less profitable. The Lerner paradox refers to the situation in which the terms of trade moves against the tariff-imposing country. In other words, the shortage of demand (excess of supply) that a country induces by imposing a tariff on the imported good does not yield a fall in the international price of that good and consequently an improvement of the country's terms of trade. Technically, this cases can arise because the offer curve is not necessarily well behaved (namely, monotonically increasing and concave to its import axis) even if we assume underlying well behaved supply and demand schedules.[15] I shall restrict my focus to an equilibrium which lies on the upward-sloping segment of the offer curve - the so called "elastic" region.[16]

Therefore, I shall assume *i)* $\partial p^{wi}/\partial \tau^i \leq 0 \leq \partial p^{wi}/\partial \tau^{*i}$ which ensures the terms of trade are always an increasing function of each country's own tariffs (no Lerner paradox). In case of MFN tariffs ($\tau^C = \tau^B = \tau$), these restrictions are simply $\partial p^w/\partial \tau \leq 0 \leq \partial p^w/\partial \tau^{*i}$.

---

[14]The market clearing condition for market y is $E(p,T) = \sum\limits_{i \in \{B,C\}} M^{*i}(p^{*i}, p^{wi})$.

[15]For instance, an offer curve for foreign country $i$ can be derived solving:
$\max_{M^{*i}, E^{*i}} B(M^{*i}, E^{*i}) \quad s.t. \ (2.8)$
where
$B(M^{*i}, E^{*i}) \equiv \max_{C_x^{*i}, C_y^{*i}, Q_x^{*i}, Q_y^{*i}} [U(C_x^{*i}, C_y^{*i}) : M^{*i} = C_y^{*i} - Q_y^{*i}, \ E_x^{*i} = Q_x^{*i} - C_x^{*i}, \ PPF]$
and PPF is the production possibility frontier.

[16]The "elasticity" terminology comes from the fact that the offer curve has a positive slope if and only if the home country's elasticity of demand for imports (with respect to the relative price of the importable) exceeds unity. When the price of a good increases (say because a tariff on this good is levied), it produces three effects: *i)* a production effect (resources move in the sector whose good price has increased) *ii)* a substitution effect (consumer switch demand toward less expensive goods) *iii)* an income effect (due to the improved real income of a country associated to higher terms of trade). Effects *i)* and *ii)* both contribute to decrease imports of this good and increase exports of other goods. On the contrary, effect *iii)* contributes to raise imports of all goods. Restricting to the upward sloping segment of the offer curve means focusing on a situation where the income effect *iii)* is dominated by *i)* and *ii)*, so that an increase of the price of the imported good leads to a reduction of its imported quantity.

Moreover, I shall assume that when other countries raise tariffs on one another, foreign country $i$'s terms of trade improve - i.e. *ii)* $\partial p^{wi}/\partial \tau^j \geq 0$ $(i \neq j)$ and *iii)* $\partial p^{wi}/\partial \tau^{*j} \geq 0$ $(i \neq j)$. Finally *iv)* $dp/d\tau^i > 0$ and *v)* $dp^{*i}/d\tau^{*i} \leq 0$, rule out the Metzler paradox and imply a restrictive trade policy always raise local prices. Recall that $p = \tau^i p^{wi}$, so that the total differential of this expression yields the change in the domestic price induced by a tariff change, namely $dp/d\tau^i = p^{wi} + \tau^i dp^{wi}/d\tau^i$. Given that the last term is negative (since an increase in $\tau^i$ improves $A$'s terms of trade), ruling out the Metzler pardox (i.e. $dp/d\tau^i \geq 0$) is equivalent to assume that the terms of trade effect induced by the tariff are not so strong to offset the increment that a tariff has on the domestic price of the good.

Note that the balanced trade conditions together with the market clearing conditions allow to rewrite the domestic tariff revenue as:

$$
\begin{aligned}
R &= \sum_{i \in \{B,C\}} t^i p^{wi} E^{*i}(p^{*i}, p^{wi}) = \sum_{i \in \{B,C\}} (p - p^{wi}) E^{*i}(p^{*i}, p^{wi}) \qquad (2.11) \\
&= (p - T) M(p, T)
\end{aligned}
$$

where the intuition for the first equality follows from the bilateral nature of the trading relations which make foreign country $i$'s exports necessarily the home's imports from $i$. Note $R^{*i}$ and $R$ are an increasing function of foreign country $i$'s terms of trade, under our assumption that goods are normal.

Furthermore, given that tariff revenues are only functions of local relative prices and world relative prices, also national incomes (2.3) and (2.4) are only functions of local and world relative prices.

### Equilibrium with volume quotas

The bilateral nature of exchanges between $A$ and each foreign country $i$ fixes $B$'s and $C$'s exports of good $x$ at the quantity level set by $A$'s import quota of $m^B$ units of good $x$ from $B$ and of $m^C$ units from $C$. Thus, the equilibrium world prices are determined by

$$
E^{*i}(p^{*i}, p^{wi}) = \overline{m}^i \qquad\qquad i = B, C. \qquad\qquad (2.12)
$$

(2.10) becomes a tautology because $A$'s total imports are necessarily the sum of the two binding volume quota restrictions. In addition, if foreign country $i$ imposes a volume quota of $\overline{m}^{*i}$ on its imports, world price $p^{wi}$ can be be explicitly determined by (2.8) as the ratio $\overline{m}^{*i}/\overline{m}^i$.

When the only restrictions in place are $A$'s import quotas on imports from country $C$, $E^{*C}(p^{*C}, p^{wC}) = \overline{m}^C$ still determines $p^{wC}$ and (2.10) determines the remaining unknown $p^{wB}$.

This highlight a specificity of a quota with respect to a tariff which is worth mentioning as it will play a crucial role in the welfare analysis. If a quantitative restriction on imports from $C$ remains binding even after a reform that abolishes a formerly existing quota $m^B$ imposed on imports from $B$, $E^{*C}(p^{*C}, p^{wC}) = \overline{m}^C$ will still fix the level of imports from $C$ and the terms of trade at the pre-reform level. Thus, all the adjustments induced by the reform affect only the bilateral relations among $B$ and $A$. On the contrary, a reform that alters a pre-existing $A$'s MFN tariffs lowering only the tariff risen on imports from $B$ will lead to world price adjustments (see (2.2) and *i)* and *ii)* above).[17] Intuitively, if the home government taxes more heavily the exports of foreign country $C$, then the home demand for exports from $C$ is reduced whereas the home demand for exports from $B$ is increased, resulting in a terms of trade loss for $C$ and a terms of trade gain for $B$. In this sense, the tariff protection is more likely to induce cross market effects than quota protection.

This insight gives the intuition for a potentially more severe trade diversion in tariff protected than in quota restricted markets. Note, however, it is a feature of country-specific volume quota. Were $A$ restricting only its total imports of good $x$ to $\overline{M} = \overline{m}^B + \overline{m}^C$ units (global quota), the outcome would be similar to the tariff case. Imports from each source country would be allocated such that the quota premium is equalized across source country ( $p_x - p_x^{*B} = p_x - p_x^{*C}$) or all imports come from the single source that maximizes the quota premia. Indeed, there are several combinations of import-mixes from the two source countries that can satisfy (2.10) with $M$ held fixed at $\overline{M}$ and the one chosen is maximizing the quota premium. Thus, country-specific direct quantitative restrictions are more restrictive than an equivalent global quota because they restrict the import mix to a specific one which is not necessarily the optimal one.[18]

## 2.3 Regional Integration with different trade policies

I shall consider now the welfare outcome of a regional integration (RI) policy under alternative trade policies. Without loss of generality, country $A$ has the option to sign a trade agreement with $B$ reducing preferentially trade barriers to the member country ($B$), but leaving unaltered those raised vis-à-vis non-member countries ($C$).

The desirability of a RIA has to be evaluated according to some welfare measure and I

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[17]An example would be a reform that lowers $\tau^B$ to 1 and leaves $\tau^C$ unaltered at $\tau$.

[18]Country-specific quotas are widely employed. The United States, for instance, imposes limitations on imports of sugar on a country-by-country basis, with each specific exporting country having its own quota allotment of sugar exports. Trade in textiles and apparel is managed in much the same way; importing nations negotiate country-specific import targets with each significant exporter. See Markunsen et. al (1995).

shall assume national governments maximize national income. This choice corresponds to national governments maximizing the indirect utility function $v$ of the representative consumer. Therefore, $V(p, T) = v(p, I(p, T))$ measures $A$'s welfare and, similarly $V^{*i}(p^{*i}, p^{wi}) = v(p^{*i}, I^{*i}(p^{*i}, p^{wi}))$ represents the welfare of foreign country $i$.[19]

Countries may trade in two different policy regimes. In the first one, all countries are making use of tariff measures to protect national industries - as in the 70s. The initial tariff vector is $\boldsymbol{\tau}_I = (\tau_I^B, \tau_I^C, \tau_I^{*B}, \tau_I^{*C})$, $I$ for *initial*. Then, A and B join into a FTA which gives free access to the internal market only to member countries, leaving trade barriers against non member countries unaltered (reform $t$ hereafter). Thus, the post reform tariff vector (indexed by $t$) is $\boldsymbol{\tau}_t = (1, \tau_I^C, 1, \tau_I^{*C})$. That is, $A$ and $B$ trade freely one another. Given that $C$ is not part of the agreement and its tariff level is unchanged after the reform, for simplicity I shall set $\tau^{*C} = 1$, meaning it is trading freely before and after the reform. Therefore, $\boldsymbol{\tau}_I = (\tau_I^B, \tau_I^C, \tau_I^{*B}, 1)$ and $\boldsymbol{\tau}_t = (1, \tau_I^C, 1, 1)$.

Consequently, let me denote as $V_I$ the welfare associated to the pre-agreement equilibrium and likewise, $V_t$ the welfare associated to the post-agreement equilibrium when trade is restricted by tariffs.

In the second one - as in the 90s -trade is initially restricted by direct quantitative restrictions and countries $A$ and $B$ undergo through the same kind of piecemeal reform which liberalizes the internal market to member countries while it leaves unchanged the quantity restrictions vis-à-vis non-member countries (reform $q$ hereafter). Therefore $\overline{m}_s = (\overline{m}_s^B, \overline{m}_s^C, \overline{m}_s^{*B}, \overline{m}_s^{*C})$ ($s$ for *start*) is the pre-agreement quota vector and $\overline{m}_q = (no, \overline{m}_s^C, no, \overline{m}_s^{*C})$ is the post-reform quota vector. *no* in the first element of this vector means that no volume quota is in place in country $A$ for imports of good $x$ from $B$. As above, I shall assume for simplicity that $C$ is in a free trade regime. We have, $\overline{m}_s = (\overline{m}_s^B, \overline{m}_s^C, \overline{m}_s^{*B}, no)$ and $\overline{m}_q = (no, \overline{m}_s^C, no, no)$. Thus, the volume quota faced by $C$ remains the only restriction in place after the FTA is signed. Obviously, $V_s$ denotes the welfare associated to the pre-agreement equilibrium and likewise, $V_q$ the welfare associated to the post-agreement equilibrium when trade is restricted by volume quota.

As well established in the literature, such partial reforms should be evaluated in terms of terms of trade and efficiency effects. As shown in Grinols and Wong (1991) and Ju and Krishna (2000a), reform $q$ can ensure Pareto gains (s0, $V_q \geq V_s$) through a system of

---

[19]Bagwell and Staiger (2002) show that government preferences can be generalized to allow for a wide range of economic and political motivations.

self-financing lump sum transfers provided that the following condition holds:[20]

$$
\begin{aligned}
(p_s^{wB} - p_q^{wB})E^{*B}(p_s^{*B}, p_s^{wB}) + (p_s^{wC} - p_q^{wC})E^{*C}(p_s^{*C}, p_s^{wC}) & \\
+ (p_q - p_q^{wB})[E^{*B}(p_q^{*B}, p_q^{wB}) - E^{*B}(p_s^{*B}, p_s^{wB})] & \quad (2.13) \\
+ (p_q - p_q^{wC})[E^{*C}(p_q^{*C}, p_q^{wC}) - E^{*C}(p_s^{*C}, p_s^{wC})] & \geq 0
\end{aligned}
$$

that is, regionalism integration must avoid adverse terms of trade or efficiency effects to ensure Pareto gains. The first line in (2.13) indicates the impact of the reform on the terms of trade: if the RTA reduces (increases) the price of imports (exports), it will contribute positively to raise welfare. The last two lines are the change in tariff revenue evaluated at the post-reform tariff vector (see (2.11)) and represent efficiency gains.[21] Trade diversion means that $A$ switches the supplier from outside the FTA (where tariff revenue is collected) to another within the FTA (with no tariff revenue), so that tariff revenue falls. The last two lines would then be negative. Thus, RTAs should reduce trade diversion as much as possible to be welfare enhancing. It is worth mentioning that (2.13) is a sufficient condition, so that its violation does not mean the reform under evaluation is a failure a priori, but it just needs a careful examination.

It is instructive to consider first the small open economy, first. It allows to abstract from terms of trade and focus closely only on the different degree of trade diversion implied by the two different instruments of trade policy. Then, I shall analyze the large country case where the same mechanisms of trade diversion interact with terms of trade effects, making the analysis more cumbersome.

Given that the literature on regional integration has found trade diversion theoretically and empirically relevant, the interesting case is represented by a potential trade diverting agreement.

Therefore, I shall consider $C$ - the outside union member - as the lowest cost supplier or the cheapest source country in the small open economy. In the large economy, $C$ has a comparative advantage in good $x$ relative to $B$, translating in greater export supply for

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[20]This formula is derived in the appendix. See also Feenstra(2004). The intuition is that the revenue $R$ collected after the implementation of the reform can be used to finance a system of lump sum transfers which compensates losers and taxes gainers. This redistributive policy aims at equilibrating the uneven benefit distribution arising with the trade reform and therefore can achieve Pareto gains for all consumers.

[21]See Feenstra (2004). The tariff reflects the difference between domestic and international prices: if positive, that indicates that marginal costs at home exceed international prices, so it would be more efficient for the country to import the good. Therefore the term $(p_q - p_q^{wi})[E^{*i}(p_q^{*i}, p_q^{wi}) - E^{*i}(p_s^{*i}, p_s^{wi})]$ gives a measure of the efficiency gain by attracting imports towards the highest-tariff sectors after the implementation of a reform.

any given world price. Note that trade diverting agreements do not need to be necessarily welfare decremental, but they can be welfare enhancing.[22] In particular, I am interested in whether such agreements are welfare enhancing when trade protection is achieved through NTBs, so that the formation of RIAs in the 90s can be related to the observed change in the nature of trade protection.

## 2.3.1 The small open economy case

The small open economy is illustrative of how a volume quota has different effects from tariff when a country undergoes a piecemeal tariff reforms.

The assumption of a small open economy ensures that:

- $A$'s trade policy does not affect the terms of trade with the two possible suppliers, $B$ and $C$, but only the relative domestic prices $p \equiv p_x/p_y$. As world prices do not change in response of a trade reform, I shall denote them as $p^{wB}$ and $p^{wC}$ without any subindex $(I, s, t, q)$.

- $B$'s and $C$'s supply is infinitely elastic at the world relative price $p^{wi}$, $i = B, C$ for trade with A, with $p^{wC} < p^{wB}$, as $C$ is assumed to be the lowest cost supplier,. Assume further that $p^{wC} \leq p^{wB} \leq \tau_I^C p^{wC} = p$, that is that $B$'s terms of trade with $A$ is lower than the tariff-distorted domestic price of good $x$ coming from $C$.[23]

To see how the two types of instruments lead to different adjustment mechanisms when a RIA is joined, suppose country $A$ is initially protecting its industries by a MFN ad valorem tariff $t_I = t_I^B = t_I^C$. Imports from $B$ would be more expensive than imports from $C$ (by assumption $p^{wB} \geq p^{wC}$), and could be sold domestically only at a higher price ($\tau_{Ip}^{wB} \geq \tau_{Ip}^{wC}$) - so that (2.2) is violated and A will be only trading with $C$. Indeed, given that $C$ is willing to supply all $M(p_I, p_I^{wC})$ at the world price $p^{wC}$, all imports of $x$ come from $C$.[24] Thus, in equilibrium there are only bilateral relations among $A$ and $C$, but the tariff revenue is positive and given by (2.11).[25]

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[22] Trade diverting preferential agreement are necessarily welfare reducing under two specific assumptions: i) no substitution in consumption and ii) a linear production possibility frontier. See Markunsen et. al. (1995).

[23] This assumption puts A into the situation of a trade diverting agreement.

[24] In other words, (2.10) is $M(p_I, p_I^{wC}) = E^{*C}(p_I^{*C}, p_I^{wC})$ and $E^{*B}(p_I^{*B}, p_I^{wB}) = 0$. As shown in section (2.2), (2.2) can not possible hold in the small open economy with MFN tariff. The equilibrium is necessarily a corner solution where $A$ trades only with partner $C$.

[25] Obviously $E^{*B}(p_I, p_I^{wB}) = 0$ in (??), as the equilibrium is in the corner solution where $A$ trades only with $C$.

However, when $A$ grants preferential access to its market only to country $B$ and retains the same tariff on imports from $C$, the relative domestic price of good $x$ imported from $B$ becomes $p_t = p^{wB}$, lower than the price $\tau_I p^{wC}$ at which each unit imported from $C$ could possibly be sold in $A$. Given that $A$'s total import demand at $p^{wB}$ is completely satisfied, trade is completely diverted from country $C$ to country $B$. In this case, in equilibrium only $A$ and $B$ trade each other and the tariff revenue is lost because all imports come from a union-members to which no tariff is applied.

The outcome differs under the NTBs regime. Suppose that $A$ initially sets a global quota $\overline{M}_s$ on the total number of units of $x$ imported. Assume that it is binding and, for expositional simplicity, it is the tariff-equivalent quota (i.e. $\overline{M}_s = E^{*C}(p_I^{wC})$), that is the implicit ad valorem tariff associated to it is $t_I$.[26] Therefore, the initial equilibrium is formally identical to the the initial tariff-ridden equilibrium with all units imported exclusively from $C$ and sold domestically at the tariff-distorted domestic price $p_s = p_I = \tau_I p^{wC}$. Therefore, the tariff revenue collected is the same too.

After $A$ joins into a RIA with $B$, $A$ will be trading freely with $B$, but it can also keep trading with $C$ within the limits imposed by the volume quota $\overline{M}_s$, now imposed exclusively on imports from $C$. Note that $C$ faces an import restriction as high as it was before the agreement, while $B$ benefits from the removal of all trade barriers. Since the international prices at which country $A$ can make international transactions are not affected by this policy, a quota-license holder can make positive profit by buying $x$ from the lowest cost supplier $C$ at $p^{wC}$ and re-sell it at the higher domestic price $p_q = p^{wB}$. All license holders will have an incentive to use entirely their license and the amount of $x$ imported from $C$ is therefore $\overline{M}_s$. This is an equilibrium because $C$ is willing to supply all the $\overline{M}_s$ units at $p^{wC}$, whereas $B$ serves the residual import demand $(M_q - \overline{M}_s)$ at $p^{wB}$.[27] All three countries end up trading simultaneously and therefore some revenue $R_q = (p^{wB} - p^{wC})\overline{M}_s$ from industry protection can be maintained even after the implementation of the agreement. The part of the original revenue that is given up $(p_I - p^{wB})\overline{M}_s$ reflects exactly the reduced economic value of the quota which is not as stringent as it was before the integration.[28] Indeed, those units of imports desired by country $A$ in excess of the quota limit that could not be imported before the agreement, can now be imported from Country $B$.

Although the partial reform implemented under the two different types of protection has

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[26] The equivalence result between a tariff and a quota due to Bhagwati (1965) holds - in the sense that a tariff rate will produce an import level which, if alternatively set as a quota, will produce an identical discrepancy between foreign and domestic prices.

[27] The binding quota ensures the desired imports of good $x$ necessarily exceed the $\overline{M}_s$ units after the agreement is in place.

[28] The pre-agreement quota rent is $R_I = (p_I - p^{wC})\overline{M}_s = [(p_I - p^{wB}) - (p^{wB} - p^{wC})]\overline{M}_s$.

identical effects on A's relative domestic prices (i.e. $p_q = p_t = p^{wB}$), the composition of the volume of trade across the two supplier is rather different as trade diversion does not occur under quantitative restrictions to trade. With quota protection, $A$ expands its volume of trade with $B$ (trade creation), but trades with $C$ ex-post as much as it did ex-ante the agreement, whereas with tariff protection, trade diversion alters the pre-union trade patterns between $A$ and $C$. Only the FTA implemented in presence of quota restrictions preserves the imports and the exports with the rest of the world and results therefore welfare improving as shown by Krishna and Panagariya (2002). This observation is the essence of the different welfare consequence of a trade agreement under the two types of trade policy instruments.

This different degree of trade diversion implied by the two types of trade barriers will extend naturally to the large country case. Therefore I shall defer the formal proof of this result till later in the more general case of large countries.

Note that such conclusion would still hold if $A$ were initially setting country specific import restrictions $\overline{m}^B$ and $\overline{m}^C$. After a RTA that abolishes just $\overline{m}^B$, but it leaves unchanged the quota raised on imports from $C$ at $\overline{m}^C$, $A$'s post-agreement purchases from $C$ are unchanged provided that this quota is still binding.

## 2.3.2 The large economy case

Although a small country always gain from reform $q$, a large country may not do so if such reform leads to adverse terms of trade effects. Let $p_s^{wB}$ and $p_s^{wC}$ the world price in the pre-agreement equilibrium determined by (2.12). Note that $E^{*C}$ is an increasing function of only $p^{wC}$ as $C$ does not protect its imports (i.e. $p_s^{*C} = p_s^{wC}$). Supposing $\overline{m}_s^C$ keeps be binding after the reform, (2.12) implies that the terms of trade with $C$ are unchanged (i.e. $p_q^{wC} = p_s^{wC}$) and, in turn, $M^{*C}(p_q^{wC}) = M^{*C}(p_s^{wC})$ by (2.8). (2.10) implies that also the terms of trade with $B$ are fixed at their initial value (i.e. $p_q^{wB} = p_s^{wB}$), as proved in the appendix.[29] Therefore, after the reform is implemented, $A$ is trading with partner $C$ as much as it was doing before the reform was approved, importing and exporting the same quantities. This is the criteria for welfare enhancing Free Trade Areas proposed by Krishna and Panagariya (2002). The preservation of trade volumes with non-members countries guarantees that their terms of trade and, in turn, their welfare is preserved (i.e. $V_s^{*C} = V_q^{*C}$) too. To see that it also

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[29]To see this point, note that (2.10) implies that $M(p_q, T_q) - E^{*B}(p_q^{*B}, p_q^{wB}) = E^{*C}(p_q^{wC}) = \overline{m}_s^C = M(p_s, T_s) - E^{*B}(p_s^{*B}, p_s^{wB})$. Given market $x$ is intially clearing at $(p_s^{wC}, p_s^{wB})$, it necessarily keeps clearing at these world prices after reform $q$. That is, $p_s^{wC} = p_q^{wC}, p_s^{wB} = p_q^{wB}$. Indeed, the increase in $B$'s export supply matches exactly with $A$'s greater total import demand (i.e. $M(p_q, T_q) - M(p_s, T_s) = E^{*B}(p_q^{*B}, p_q^{wB}) - E^{*B}(p_s^{*B}, p_s^{wB})$), so that market $x$ necessarily clears at the same pre-reform world prices.

improves the welfare of participating government, it is easy to verify that (2.13) is satisfied being equal to zero. The first line is 0 because the world price vector is unchanged and, therefore countries in the FTA do not experience terms of trade gains or loss. The second line is 0 as no quota premium arises from FTA members $(p_q^{*B} - p_q^{wB} = 0)$. Finally, the last line is 0, as trade diversion does not occur and import volumes with third countries are preserved (i.e. $E^{*C}(p_q^{*C}, p_q^{wC}) = \overline{m}_s^C = E^{*C}(p_s^{*C}, p_s^{wC})$). Clearly, this agreement increases $B$'s volume of trade, contributing to raise its welfare too - see the appendix (2.7.1).[30] Henceforth, the agreement is mutually favorable. We have the following proposition.

**Proposition 2.1** *A RIA between the home country and foreign country i that abolishes volume quota one another leaving unaltered former volume import restrictions vis-á-vis non-member country j is welfare enhancing, provided that such import restrictions keep being binding after the agreement is implemented.*

A FTA implemented in presence of quota restricted trade does not yield terms of trade gains, but it also avoids any trade diversion. This is enough to ensure the possibility to achieve Pareto gains through a system of transfers among consumers and, more importantly, among countries. The intuition for this result is suggested by the literature on piecemeal tariff reform.[31] Since following reform $q$, some binding quota are relaxed with others remained fixed and there are no other distorted markets, the welfare change is positive because the relaxation in any quota unambiguously enlarges the economy's consumption set. Importantly, these gains from consumption are not offset by adverse terms of trade effects.

I think of this proposition as an indication of the desirability of regionalism in presence of quota-restricted trade. This is known as the "*compensation principle*" due to Chipman (1987) - in the sense that if regional integration agreements combined with lump-sum transfers could make everyone better off, then we accept such reform itself as a worthwhile policy, even when the transfers are not made. Indeed, the knowledge required to implement the long list of lump sum compensatory payments, some of them international in nature, make the practical implementation of these transfers very difficult.

Obviously, proposition (2.1) holds for a small country too, as (2.13) is satisfied by the small country above.

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[30]It can be directly verified that (2.24) in the appendix - a formula like (2.13) for foreign country $*B$ - holds. The first term is 0 since reform $q$ has no terms of trade effect. The second term is 0 as no quota is risen on imports from member countries (i.e. the implicit tariff is $t^{*B} = 0$). If $B$ had multiple partners too, trade patterns would be symmetric to $A$, exporting $x$ to both the union country $A$ and a third country outside the FTA and importing $y$ from a union country $A$ and the third country outside the union. Thus, the question of whether union formation is welfare improving for each member country could be analyzed in the same way for both members of the union. Since the FTA results welfare-enhancing for $A$, it would be so for $B$ too.

[31]See Vousden (1990), chapter 9 pag pag 217.

On the contrary, reform $t$ is not necessarily welfare improving because the trade diversion induces terms of trade movements as well. The initial equilibrium world prices $p_I^{wC}$, $p_I^{wB}$ solve (2.10) and (2.2). After the reform $t$, the elimination of tariff within the FTA reduces the local price of the imported good in the two member countries, so that $[1/\tau_I^{*B} \leq p_t^{wB}/p_I^{wB} \leq \tau_I^B]$, whereas by (2.2), $C$'s terms of trade worsen $(p_t^{wC} \leq p_I^{wC})$ to preserve competitiveness in the union market.[32] This appreciation of $A$'s terms of trade against $C$ originates from the trade diversion of imports formerly coming from the outside member country in favor of intra-union imports (i.e. $E^{*C}(p_t^{wC}) \leq E^{*C}(p_I^{wC})$). The elimination of tariff on union trade shifts out both $A$'s import demand and $B$'s export supply. Depending on this relative shifts, $B$'s terms of trade may appreciate or depreciates. First, suppose it appreciates $(1 \leq p_t^{wB}/p_I^{wB} \leq \tau_I^B)$ - for instance because at the initial world price there is an excess demand of good $x$ by $A$ to be cleared out. Replacing $q$ with $t$ and $s$ with $I$, (2.13) is not necessarily positive: the second line is 0 as no tariff is levied on member's imports, whereas the third line is negative as trade diversion reduces tariff revenue from non-members countries. Finally, the first term in the first line is negative while the second term is positive. For welfare to raise, favorable terms of trade effects against non-member countries have to be strong enough to compensate for both terms of trade loss vis-à-vis member countries and efficiency loss.

Supposing instead that $(p_t^{wB} \leq p_I^{wB})$, welfare gains are more likely as $A$ experiences favorable terms of trade effects with both member and non-member trading partners which can offset the efficiency loss associated to trade diversion (the negative term in the last line of (2.13).

Note for the small open economy above, Pareto gains can not be ensured either, since (2.13) is violated. The first two lines are clearly 0, whereas the last line is negative because of trade diversion. The intuition is again that trade diversion associated to the preferential reduction of tariffs may not necessarily translates into the enlargement of the economy's consumption set, especially when imports are just diverted from one source to another. Moreover, adverse terms of trade plausibly associated to trade diversion make imports more expensive and reduce welfare.

It is worth pointing out a number of interesting features of this result.

First, the desirability of reform $t$ has to be evaluated empirically case by case, as widely recognized in the literature. For instance, Grinols (1984) finds that Great Britain incurred in a welfare loss when it joined the European Economic Community in 1973 and (2.13) was

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[32]$[1/\tau_I^{*B} \leq p_t^{wB}/p_I^{wB} \leq \tau_I^B]$ follows from $p_t = p_t^{wB} \leq \tau_I^B p_I^{wB} = p_I$ and $p_t^{wB} = p_t^{*B} \geq p_I^{*B} = p_I^{wB}/\tau_I^{*B}$. $p_t^{wC} \leq p_I^{wC}$ follows from $\tau_I^C p_t^{wC} = p_t \leq p_I = \tau_I^C p_I^{wC}$. This is fully consistent with price restriction *i)* and *ii)*.

evaluated to be negative. In contrast, proposition (2.1) suggests a general desirability of reform $q$ which can provide an explanation for a renewed interest in RIAs policy in the 90s. Indeed, policy makers are usually working in a second best world, attempting to reduce some distortions while others remaining firmly in place. As we know from the theory of second best, such changes do not necessarily increase welfare. However, it would be helpful to have some simple rules - a rule of thumb - telling them "which way is up". Then, Proposition (2.1) suggests reform $q$ can be readily understood and implemented by policy makers with some confidence that a welfare improvement will be the outcome.[33]

Second, because "the way up" is so clear when all trade barriers consists of quantitative restrictions, it would appear that the difficulty of identifying welfare-enhancing FTA can be resolved simply by converting all explicit taxes or subsidies to quotas and then gradually relaxing the quotas. Such an approach runs counter to the view of reform which is popular to most policy makers and adopted by the WTO in 1995, that is change quotas to tariffs and then set about reducing the tariffs - so called "tariffication" process. However, quotas have many other disadvantages relative to tariffs, particularly in the presence of monopoly and/or foreign retaliation, and such considerations presumably are what motivate the popular view.[34]

Third, the welfare outcome of reform $q$ and reform $t$ is different, though both reforms leave unaltered former trade barriers against non-member countries. This is the criteria established by GATT-WTO regulations to permit preferential trade agreements. Article XXIV of GATT explicitly imposes "the duties (with outside parties) shall not on the whole be higher or more restrictive than the general incidence of the duties...prior to the formation". This criteria naturally implements the efficient rule for welfare-enhancing FTA in case of NTBs, as it helps to keep purchases from the rest of the world fixed. In contrast, in case of tariff protection (reform $t$), it is unable to lead to welfare improving FTA as this principle does not suffice, on its own, to preserve trade volumes with non-member countries. As shown by Bagwell and Staiger (2004), the FTA would do so if only complies with two other principles of GATT-WTO - namely reciprocity and MFN. However a FTA could not possibly respect MFN as, by definition, it is a legal recognized exception to it.

Fourth, the model suggests that when a RTA is implemented in presence of NTBs, the terms of trade vis-à-vis non member countries should be preserved. This seems at odd with the empirical findings by Chang and Winters (2002) of favourable terms of trade effects of

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[33]This has some analogies with the large literature on piecemeal tariff reforms. A number of economists have looked for simple piecemeal reform rules that could be leading to welfare enhancing outcomes with some confidence. Examples of such rule of thumb rules are proportional reduction of all trade taxes or reduction of the highest tariff rate first. See Vousden (1990), Chapter 9 for a review.

[34]See Vousden (1990), chapter 4, 5 and 6.

MERCOSUR for Brazil vis-à-vis US, Japan, Germany, South Korea and Chile, who are all exporting into the union-area. However, Mercosur entailed also tariff reductions which can lead to terms of trade effects as predicted by the model (reform $t$). Moreover, it is important to note that the preservation of trade volumes with non-member countries is a specificity of country-specific volume quotas. Consequently, terms of trade effects can also occur in presence of only quantitative restrictions, when, for instance, a RTA provides that countries relax a global import volume quota or a formerly employed VERs. Given the empirical relevance of VERs in trade policies, next section will consider them specifically and show that, indeed, may lead to favourable terms of trade improvements for member countries and loss for non member countries as for Brazil after Mercosur.[35]

## 2.4 RIAs and VERs

A VER is a quota imposed by an exporting country on its exports to another country in response to pressure by the importing country. In my framework, the initial VERs vector $\overline{m}_o = (\overline{m}_s^{*B}, no, \overline{m}_s^B, \overline{m}_s^C)$ where foreign country $i$ imposes a VER of $\overline{m}_s^i$ units of good $x$, whereas $A$ restricts its exports to $\overline{m}_s^{*B}$ units of good $y$ toward $B$, mirrors the protection achieved by the initial import-volume quota vector $\overline{m}_s$. The equivalent of reform $q$ in terms of VERs relaxation (hereafter denoted as reform $v$) implemented by a bilateral agreement yields the post-reform VER-vector $\overline{m}_v = (no, no, no, \overline{m}_s^C)$. For an exporter in foreign country $i$, a unit of the exported good $x$ is more valuable on the international market than on the domestic market (i.e. $p_x \geq p_x^{*i}$) due to the artificial scarcity created by a VER. Analogously, for a home exporter, the international price of the exported good $y$ benefits from such artificial restrain and results above its domestic price (i.e. $p_y^{*i} \geq p_y$). Then, the untaxed or "world" relative price at which international transactions are made is given by $\widetilde{p}^i = p_x/p_y^{*i}$ which still represents foreign country $i$'s terms of trade and the ratio of exporter prices. With this definition, relative domestic prices are in the same relation with world prices as above (i.e. $p^{*i} \leq \widetilde{p}^i \leq p$) and (2.8) is still foreign country $i$ budget constrain with $p^{wi}$ replaced by $\widetilde{p}^i$.

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[35]VERs have become most pervasive in the textiles and clothing area, applying to 80% of the world trade in these industries through the various bilateral agreement which constitutes the Multifibre Arrangement (MFA). They are also particularly in evidence in the steel industry, in which they limit steel exports from Japan and the EEC to the USA. They were employed in the automobile industry, in which they restricted exports from Japan to the USA, Germany, France, UK and Italy. For example, after 1981, the Japanese Ministry of International Trade and Industry (MITI) told each auto manufacturer in Japan how much it could export to the U.S. In the late 1980s, US and the European countries rescinded their request to Japan for restricted automobile exports. Later on, they have begun to be applied to a range of electronic consumer goods. As documented by Laird and Yeats (1990), over the period 1981-1986 a major shift has occurred in the use of VERs on import volumes as opposed to other forms of NTBs.

One major difference with the import quota case analyzed above, is that both $E^{*C}$ and $E^{*B}$ are vertical at $\overline{m}_s^C$ and $\overline{m}_s^B$ when VERs are binding and do not pin down world prices. These are determined by:

$$M(p_o, \widetilde{T}_o) = \overline{m}_s^B + \overline{m}_s^C \tag{2.14}$$

$$M^{*B}(p_o^{*B}, \widetilde{p}_o^B) = \overline{m}_s^{*B} \tag{2.15}$$

with $\widetilde{T} = \sum_{i \in B,C} \widetilde{s}^i / \widetilde{p}^i$ and $\widetilde{s}^i = M^{*i}(p^{*i}, \widetilde{p}^i) / M^{*B}(p^{*B}, \widetilde{p}^B) + M^{*C}(p^{*C}, \widetilde{p}^C)$.[36] Note that, differently from above, an increase in $\widetilde{T}$ represents an improvement in $A$'s multilateral terms of trade. (2.15) determines $\widetilde{p}_o^B$ while (2.14) pins down $\widetilde{T}_o$ and, in turn, $\widetilde{p}_o^C$.[37] Generally, $\widetilde{p}_o^i$ will result different from the terms of trade $p_s^{wi}$ because $C$ and $B$ are moving the terms of trade in their favour by imposing a VER whereas, in the import quota case, was $A$ to benefit from the terms of trade appreciation with the imposition of a country-specific quota to each of its trading partners. Moreover, revenue formerly collected with the imposition of such import quotas, accrues under the VER scheme to foreign country $i$, implying quite different lump sum transfers for consumers of country $A$. In turn, in general equilibrium models, also relative domestic prices will be generally different in the two situations ($p_s \neq p_o$ and $p_s^{*i} \neq p_o^{*i}$) because of income effects associated with changes in the terms of trade.

After the implementation of the RTA between $A$ and $B$, only the VER imposed by $C$ on its exports is firmly in place and assumed to be binding, which implies that $E^{*C}$ is still vertical at $\overline{m}_s^C$. Clearly, the export quantities toward $A$ are preserved, but, differently from the import quota case, the terms of trade are not necessarily preserved because, under a binding VER only this quantity is supplied regardless of its price. By (2.8), the terms of trade would be unchanged if only the quantity imported by $C$ were also unchanged.

The market of good $y$ results free of protection and country $A$ has two potential buyers, namely $B$ and $C$. Of course, $A$ would maximize its export revenue by selling to the best buyer and will allocate to it all its exports unless the price per unit of good exported is not driven to equality by such allocation (i.e. $p_y^{*B} = p_y^{*C}$). Therefore, the post-agreement equilibrium in which $A$ is trading with both partners is characterized by the following market $x$ clearing condition and arbitrage condition:

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[36] To develop an intuition it is useful to think of VERs in terms of implicit export taxes. $t^{*i}$ is the export tax levied by foreign government $i$ on its exports of good $x$ - so that an exporter receives $p_x^{*i} = (1 - t^{*i})p_x$. $t^B$ is the export tax imposed by $A$ on exports directed to $B$, while $t^C = 0$ - so that an exporter in the home country receives $p_y = (1 - t^B)p_y^{*B}$ when it sells the good in market $B$ and $p_y = p_y^{*C}$ when it sells its good in market $C$. Export taxes and import tariffs have qualitatively the same effects because they distort domestic prices in the same manner favouring the import-competitive sector.

[37] Actually $\widetilde{p}_o^B$ can be derived more explicitly and it is $\widetilde{p}_o^B = \overline{m}_s^{*B} / \overline{m}_s^B$.

$$M(\widetilde{T}_v) = E^{*B}(\widetilde{p}_v^B) + \overline{m}_s^C \tag{2.16}$$

$$\widetilde{p}_v^B = \widetilde{p}_v^C \tag{2.17}$$

The $y$ market clearing condition $E(\widetilde{T}_v) = M^{*B}(\widetilde{p}_v) + M^{*C}(p_v^{*C}, \widetilde{p}_v)$ implied by (2.16) and (2.8) provides us with an intuition for the effects of the RTA. Initially, the allocation of A's exports to its partners is constrained by the A's VER of $\overline{m}_s^{*B}$ units of good $y$ (see (2.15)). Following the trade liberalization, $A$ will wish to export more units and its allocation among its trading partners is driven by revenue maximization. Very likely, such optimal export mix toward its trading partners is different from the original export mix and leads to terms of trade movements. In particular, it can be shown (see the appendix) that the effect on $\widetilde{p}_v^B$ is ambiguous, while $\widetilde{p}_v^C$ and $M^{*C}$ are smaller than initially. The preserved exchanges of good $x$ between $A$ and $C$ does not longer suffice to preserve the volumes traded of good $y$ as well as the terms of trade. Therefore, negotiated bilateral agreements for the elimination of VERs also have favourable terms of trade effects for the the negotiating parties vis-à-vis third parties.

As shown in the appendix, it is possible to express the sufficient condition for Pareto gains for the home country as:

$$\sum_{i \in B,C} \left( \frac{1}{\widetilde{p}_v^i} - \frac{1}{p_v} \right) \left[ M^{*i}(p_v^{*i}, \widetilde{p}_v^i) - M^{*i}(p_o^{*i}, \widetilde{p}_o^i) \right] + \tag{2.18}$$

$$\left( \frac{1}{\widetilde{p}_v^B} - \frac{1}{\widetilde{p}_o^B} \right) M^{*B}(p_o^{*B}, \widetilde{p}_o^B) + \left( \frac{1}{\widetilde{p}_v^C} - \frac{1}{\widetilde{p}_o^C} \right) M^{*C}(p_o^{*C}, \widetilde{p}_o^C) \; \geq \; 0$$

where the first line is 0 in my framework because $A$ does not employ any VER after reform $v$ is implemented. Therefore, Pareto gains only depend on terms of trade movements. In particular, when both $\widetilde{p}_v^B \leq \widetilde{p}_o^B$ and $\widetilde{p}_v^C \leq \widetilde{p}_o^C$, Pareto gains can be ensured, otherwise possible adverse terms of trade with member countries have to be offset by gains vis-à-vis non member countries. Most remarkably, Pareto gains for country $A$ under a VER reform are more likely than under reform $t$, although both reforms $t$ and $v$ entail similar terms of trade effects. The reason is that country $A$ had already given up its tariff revenue when it negotiated a VER protection and regionalism (reform $v$) has no consequences for the loss of such revenue in this case. In contrast, (2.13) showed that favourable terms of trade induced by reform $t$ had in any case to compensate for tariff revenue loss (the negative term in the third line) to ensure Pareto gains.[38]

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[38] Note that if $A$ were imposing initially a VER to both its trading partner and leaving its VER unaltered

## 2.5 Comparison of the different strategies to RIAs

We have shown that policy makers may be quite confident about pursuing regional integration policies to rise the well being of countries in a context where trade is restricted by NTBs, while the outcome of this strategy is quite case-specific and needs more careful evaluation in a context of tariff restricted trade. However, in many cases, the option for such preferential reforms may still represent an improvement relative to pre-existent tariff-ridden trade relations. In spite of a more generalized desirable welfare outcome of RTAs in presence of NTBs, it would be interesting to be able to compare the size of the gains associated to piecemeal reforms with either type of instruments. In terms of the notation of my model, I am interested in comparing gains from a reform $q$ relative to those arising under reform $t$ (i.e. $V_q - V_s$ vs. $V_t - V_I$). This enables us to construct useful counterfactuals. Would a country joining into a regional trade agreement in the 70s have gained at least as much had it signed the same agreement twenty years after at the end of the 80s? Or would a country recently joining into an agreement in presence of NTBs gained more or less had it enrolled into this agreement much earlier in the 70s when tariff rather than NTBs were in place? Therefore, these counterfactual are useful to shed some light on how attractive and valid is the option for a RTA in the 90s for a country for which it was not worth joining into an agreement in the 70s.

In such thought experiments, it is important to attribute any change in the welfare only to the piecemeal tariff/quota reform. Clearly, $V_s = V_I$ would ensure A has the same initial welfare with either trade policy and therefore any welfare change can be attributed to the different adjustments implied by volume quota liberalization and tariff liberalization in the process of a RTA reform. The assumption of a competitive market for import quota licenses ensures the equivalence result between a tariff and a volume quota holds.[39] Therefore, the levels of prices, production, consumption, imports, exports and transfers of rents to the protected industry prevailing in the pre-reform equilibrium with tariff are identical to those characterizing the pre-agreement equilibrium with NTBs. It follows the welfare associated to both equilibrium must coincide, i.e. $V_s = V_I$. Given this equivalence, $V_q - V_s \geq V_t - V_I$ reduces to study under which conditions $A$ is better off in the $q$ equilibrium as opposed to the $t$ equilibrium ($V_q \geq V_t$) which can still be evaluated similarly to (2.13) by:

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against country $C$ after reform $v$, trade diversion translates into rents loss and gains from regionalism would be less plausible as well.

[39] See Bhagwati (1965).

$$(p_t^{wB} - p_q^{wB})E^{*B}(p_t^{*B}, p_t^{wB}) + (p_t^{wC} - p_q^{wC})E^{*C}(p_t^{*C}, p_t^{wC}) \qquad (2.19)$$
$$+(p_q - p_q^{wB})[E^{*B}(p_q^{*B}, p_q^{wB}) - E^{*B}(p_t^{*B}, p_t^{wB})]$$
$$+(p_q - p_q^{wC})[E^{*C}(p_q^{*C}, p_q^{wC}) - E^{*C}(p_t^{*C}, p_t^{wC})] \geq 0$$

(2.19) clearly holds for a small country: the first line is necessarily 0 because the terms of trade are taken as given ($p_t^{wB} = p_q^{wB} = p^{wB}$); the second line is also 0 as no quota rents arise from member countries (i.e. $p_q = p_q^{wB}$). Finally, the third line is positive and it represents exactly the change in tariff revenue from $t$ to the $q$ equilibrium.[40] Therefore, the following proposition holds true for a small country.

**Proposition 2.2** *For a small country with a competitive market for import quota licenses,* $V_q - V_s \geq V_t - V_I$.

**Proof.** See the appendix for a direct proof. ∎

Note that this proposition holds true also when VER-protection is considered, as it is shown in the appendix. However, this result does not extend to a large country setting due to possible adverse term of trade effects. Recall that the MFN tariff together with the equivalence result which is assumed to hold, imply that $p_s^{wB} = p_I^{wB} = p^w = p_I^{wC} = p_s^{wC}$. Moreover, in equilibrium $q$, $p_q^{wB} = p_s^{wB}$ and $p_s^{wC} = p_q^{wC}$, while in equilibrium $t$ we have $p_t^{wB}/p_I^{wB} \in [1/\tau_I^{*B}, \tau_I^B]$ and $p_t^{wC} \leq p_I^{wC}$. Like for a small country, the last term in (2.19) is positive also for a large country because NTBs imply a lower degree of trade diversion resulting in $E^{*C}(p_q^{wC}) \geq E^{*C}(p_t^{wC})$.[41] Supposing $p_t^{wB} \geq p_q^{wB}$, the first term in the first line is positive as imports from $B$ are cheaper in the $q$ equilibrium, but the second term on the same line is negative as trade diversion in equilibrium $t$ is compensated by favorable terms of trade movements. Unless trade of terms gain vis-à-vis non member countries are so strong to offset all other forces, (2.19) is likely satisfied for a large country who therefore would also gain relative more from a regional integration pursued in presence of NTBs. However, if $p_t^{wB} \leq p_q^{wB}$, the first term turns to be negative and the inequality will less likely be satisfied since stronger efficiency gains would be needed. In other words, the strongest the terms of trade gain achieved after the implementation of reform $t$ relative to those attained with

---

[40] Recall that for a small country, after reform $q$ is implemented, imports from $C$ are exactly the quota limit ($E^{*C}(p_q^{*C}, p_q^{wC}) = \overline{M_s}$) and following reform $t$, $E^{*C}(p_t^{*C}, p_t^{wC}) = 0$ because of complete trade diversion.

[41] Recall $p_q^{wC} = p_s^{wC} = p_I^{wC}$ and $p_t^{wC} \leq p_I^{wC}$. Given $E^{*C}$ is an increasing function of world relative price, $E^{*C}(p_q^{wC}) \geq E^{*C}(p_t^{wC})$.

reform $q$, the less likely the welfare outcome of reform $q$ is Pareto superior to the one arising after reform $t$.

To develop the intuition for this result, it is useful to express the outcome of reform $t$ in its quota-equivalent $\overline{m}^e$. Indeed, a volume quota of $\overline{m}^e = E^{*C}(p_t^{wC}) \leq \overline{m}_s^C$ set by $A$ on imports from $C$ would deliver the same outcome of reform $t$ induced by the tariff vector $\boldsymbol{\tau}_I$. In equilibrium $q$, the quota vector results less stringent than in equilibrium $t$ since $\overline{m}_t = (1, \overline{m}^e, 1, 1) \leq \overline{m}_q = (1, \overline{m}_s^C, 1, 1)$. Then, in the thought experiment of a transaction from equilibrium $t$ to equilibrium $q$, a small country would necessarily gain as this less stringent constraint on imports unambiguously enlarges its consumption possibilities. This result does not extend to large country because of terms of trade effects associated to trade diversion. Recall that $p_t^{wB}, p_q^{wB}$ are the two equilibrium world relative prices in the two reforms. When $p_t^{wB} \leq p_I^{wB} = p_q^{wB}$, $A$ would suffer a terms of trade loss from this hypothetical transaction. Such loss could erode the gains from consumption related to this hypothetical reform since $A$ would end up paying more for all its imports.

Finally, proposition (2.1) and proposition (2.2) together suggests that the option for regionalism has turned positive for small and some large countries only in the 90s in presence of quota restricted trade. However, these countries may have correctly anticipated that such valuable option for integration was temporary restricted by the WTO prescription to convert all NTBs in tariff-equivalent measures and destined to expire. Therefore, such "tariffication" process - established at the conclusion of the Uruguay round in 1994 and to be completed gradually by 2005 - was easily foreseen by WTO member countries and it may have hurried governments to realize their valuable option. This may be a further contributing factor to the regionalism spurt observed between the 1990 and the first years of 2000.

## 2.6   Conclusion

This paper uses a two goods, three countries, general equilibrium model to relate two well known features of trading relations, namely the proliferation and expansion of preferential trade agreements in the 90s to the change in the nature of trade protection occurred over the last thirty years.

It was shown that trade agreements implemented in presence of quota restricted trade naturally implements an explicit-volume preservation rule and, therefore, they result welfare improving. The relevance of this is twofold. First, an explicit volume preservation rule which result cumbersome to implement and very different from the actual WTO prescriptions for PTAs, result naturally implementable and, more importantly, induced by the WTO rules in

presence of quota restricted trade. Second, for small and some large countries, preferential trade has become a "positive-dividend" option only in the 90s, when trade was more quota-restricted than in the past, justifying a renewed policy interest for regionalism in the last fifteen years. At the basis of this result is the different mechanism with which a tariff and a quota operate: while a tariff has direct effect on prices, a quota operates on quantities and affects prices only indirectly. Because a tariff increases the prices of all imports from non-member countries, it may cause union-member to become artificially the lowest cost supplier. Trade is then diverted from non-members toward members of a FTA. Under quota protection this does not occur and a country can still import from the world lowest cost supplier provided that it does not exceed the quota limit. In turn, the pre-agreement volumes of trade are preserved.

Most likely, such benefits associated to regional integration would have expired as soon as countries had complied with the "tariffication" process established by the WTO in 1995 and to be completed in the following ten years. Anticipating such eventuality, governments may have hurried to sign agreements under negotiation.

While this paper contributes to shed some light on the spurt of regionalism in the 90s, it can not provide any answer to the types of agreements signed. Trade policy can not explain whether North-North or South.South or, as more common in the last years, North-South agreements are signed. These themes are certainly worth to be explored in future research. Finally, my model does not allow for strategic interaction of countries and, thus, for plausible retaliation actions. This is because my main interest are the welfare consequences of a trade agreement for a country that trades multilaterally and may employ different instruments of trade policy. In this respect, I follow a long tradition in the literature of piecemeal tariff reform of which regional agreements are just a special kind. This paper shares with this literature also the limit of analyzing only the two polar situations of trade policy: either tariff or non-tariff protection, whereas a framework comprising these instruments together remains in the research agenda. Clearly, the quota case is useful to understand the effects of RTAs in presence of non-linear tariffs, also defined as a system of tariff-quotas.[42]

In spite of this limitation, the model correctly predicts that bilateral agreement entailing tariff-reductions can lead to terms of trade effects consistently with empirical findings. More interestingly, given the empirical relevance of VERs, it shows that such effects can also be led by bilateral agreements calling for the elimination of formerly negotiated VERs. Although,

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[42]Alternatively defined also as tariff-rate quotas. The tariff rate is low under an volume-threshold of imports (on the in-quota quantities), while it is much higher above this threshold (on the out-of-quota quantities). For example, imported car entering under the tariff-quota (up to x cars) are generally charged 10%. Imports entering outside the tariff-quota are charged 80%.

the volume preservation outcome is a specificity of country-specific quotas not shared by VERs, the possibility that a welfare improvement will also be the outcome of such agreements abolishing VERs is not compromised.

## 2.7 Appendix

### 2.7.1 Appendix A - Derivation of formula (2.13)

In general terms, suppose country $A$ undertakes a piecemeal tariff reform such as for example a regional integration agreement. Let me index by 0 the level of a variable in the pre-reform equilibrium and by 1 the level of a variable in the post-reform equilibrium. The budget constraint of country $A$ in the pre-reform and in the post-reform are the following:

$$p(0)C_x(0) + C_y(0) \leq p(0)Q_x(0) + Q_y(0) + R(0) \tag{2.20}$$

$$p(1)C_x(1) + C_y(1) \leq p(1)Q_x(1) + Q_y(1) + TR(1) \tag{2.21}$$

where $R(0)$ is the tariff revenue (quota rents) in units of the local export good ($y$) collected in the pre-reform equilibrium and $TR(1)$ are the total transfers in units of the local export good received in the post-reform equilibrium. The representative consumer of this economy is better off after the implementation of the reform if her utility is at least as high as before the reform. By the weak axiom of revealed preferences (WA), it is enough to show that the old consumption and production bundle are still feasible and affordable in the post-reform equilibrium. Of course, if the transfer compensates the representative consumer in such a way that the old consumption-production bundle is still affordable in the new equilibrium, the WA will hold. Such transfer is the following:

$$TR(1) = [p(1) - p(0)][C_x(0) - Q_x(0)] + R(0) = [p(1) - p(0)]M(0) + R(0) \tag{2.22}$$

where the consumer receives the old tariff revenue and a subsidy to compensate her for an eventual increase in the relative domestic price of the imported good. It is easy to check that the old consumption-production bundle $(C_x(0), C_y(0), Q_x(0), Q_y(0))$ is still affordable in the new equilibrium by substituting (2.22) and $((C_x(0), C_y(0), Q_x(0), Q_y(0)))$ in (2.21):

$$\begin{aligned} p(1)C_x(0) + C_y(0) &\leq p(1)Q_x(0) + Q_y(0) + [p(1) - p(0)][C_x(0) - Q_x(0)] + R(0) \\ &\Leftrightarrow p(0)C_x(0) + C_y(0) \leq p(0)Q_x(0) + Q_y(0) + R(0) \end{aligned}$$

which is always verified as it is (2.20). Therefore, the consumer is better off. Only it is

left to prove is that transfer can be actually financed with the new tariff revenue, so that

$$
\begin{aligned}
R(1) - TR(1) \quad = \quad & \sum_{i \in \{B,C\}} t^i(1)p^{wi}(1)E^{*i}(1) \\
& - \left\{ [p(1) - p(0)]M(0) + \sum_{i \in \{B,C\}} t^i(0)p^{wi}(0)E^{*i}(0)] \right\} \\
= \quad & \sum_{i \in \{B,C\}} t^i(1)p^{wi}(1)E^{*i}(1) \\
& - \sum_{i \in \{B,C\}} [p^{wi}(1)(1 + t^i(1)) - p^{wi}(0)(1 + t^i(0))]E^{*i}(0) + t^i(0)p^{wi}(0)E^{*i}(0)] \\
= \quad & \sum_{i \in \{B,C\}} \left\{ [p^{wi}(0) - p^{wi}(1)]E^{*i}(0) + t^i(1)p^{wi}(1)[E^{*i}(1) - E^{*i}(0)] \right\} \geq 0 \quad (2.23)
\end{aligned}
$$

Note that $t^i$ can also be the implicit tariff associated to an import restriction $m^i$. The first equality uses (2.11) and (2.22), the second equality uses (2.10) and $p = (1 + t^i)p^{wi}$ and the third equality is just rearranging terms. (2.23) is exactly (2.13) where the index 0 is the initial equilibrium $s$ and the index 1 is the post-agreement equilibrium $q$. Provided (2.23) holds, the consumer is better off after the reform is implemented and the government budget is balanced.

A similar formula to (2.23) can also be derived for foreign country i undertaking a similar reform. Using (2.4), the budget constraint in units of the local export good ($x$) can be written as:

$$
C_x^{*i}(0) + C_y^{*i}(0)/p^{*i}(0) \leq Q_x(0) + Q_y(0)/p^{*i}(0) + R^{*i}(0)
$$

$$
C_x^{*i}(1) + C_y^{*i}(1)/p^{*i}(1) \leq Q_x(1) + Q_y(1)/p^{*i}(1) + TR^{*i}(1)
$$

The following transfer

$$
\begin{aligned}
TR^{*i}(1) \quad = \quad & [\frac{1}{p^{*i}(1)} - \frac{1}{p^{*i}(0)}][C_y^{*i}(0) - Q_y^{*i}(0)] + R^{*i}(0) \\
= \quad & [\frac{1}{p^{*i}(1)} - \frac{1}{p^{*i}(0)}]M^{*i}(0) + R^{*i}(0)
\end{aligned}
$$

will make the old consumption-production bundle affordable and therefore the consumer better off. Moreover such transfer is sustainable resulting in a balanced budget by the government provided:

$$R^{*i}(1) - TR^{*i}(1) = [\frac{1}{p^{wi}(0)} - \frac{1}{p^{wi}(1)}]M^{*i}(0) + \frac{t^{*i}(1)}{p^{wi}(1)}[M^{*i}(1) - M^{*i}(0)] \geq 0 \qquad (2.24)$$

Whenever the last condition holds, foreign country i will be undoubtedly better off following the implementation of the reform.

## 2.7.2 Appendix B - Proof of terms of trade preservation under reform q

I shall prove that $p_q^{wB} = p_s^{wB}$.

(2.8), (2.10), (2.9) and $E(p,T) = \sum_{i \in \{B,C\}} M^{*i}(p^{*i}, p^{wi})$ (market $y$ clearing condition) have to hold in both $s$ and $q$ equilibrium.

Using $E^{*C}(p_q^{wC}) = \overline{m}_s^C = E^{*C}(p_s^{wC})$ and $p_q^{wC} = p_s^{wC}$ and (2.8),

$$M^{*C}(p_q^{wC}) = M^{*C}(p_s^{wC}) \qquad (2.25)$$

The market $x$ clearing condition (2.10) implies the following

$$\begin{aligned} M(p_q, T_q) - E^{*B}(p_q^{*B}, p_q^{wB}) &= \overline{m}_s^C = M(p_s, T_s) - \overline{m}_s^B \Leftrightarrow \qquad (2.26) \\ M(p_q, T_q) - M(p_s, T_s) &= E^{*B}(p_q^{*B}, p_q^{wB}) - \overline{m}_s^B = k \end{aligned}$$

The market $y$ clearing condition above together implies that:

$$\begin{aligned} E(p_s, T_s) - \overline{m}_s^{*B} &= M^{*C}(p_s^{wC}) = E(p_q, T_q) - M^{*B}(p_q^{wB}) \Leftrightarrow \qquad (2.27) \\ E(p_q, T_q) - E(p_s, T_s) &= M^{*B}(p_q^{wB}) - \overline{m}_s^{*B} = H \end{aligned}$$

Using (2.25), (2.27) in (2.8), it follows

$$\begin{aligned} \overline{m}_s^{*B} + H &= p_q^{wB}\left(\overline{m}_s^B + k\right) \Leftrightarrow \\ p_s^{wB}\overline{m}_s^B + H &= p_q^{wB}\left(\overline{m}_s^B + k\right) \\ &\Rightarrow p_s^{wB} = p_q^{wB} \end{aligned}$$

where the second line uses (2.8) again for equilibrium $s$. Indeed, when $p_s^{wB} = p_q^{wB}$, then $H = p_s^{wB}k$ which is reciprocity!

## 2.7.3 Appendix C - Reform $v$ reduces $\widetilde{p}^C$ and has ambiguous effects on $\widetilde{p}^B$

I shall prove $\widetilde{p}_v^C \leq \widetilde{p}_o^C$. Recall (2.8) and (2.14) to (2.17) have to hold.

In particular, the assumption of a binding VER $(\overline{m}_s^C)$ even after the reform v is implemented together with (2.8) imply:

$$\frac{M^{*C}(p_o^{*C}, \widetilde{p}_o^C)}{\widetilde{p}_o^C} = \overline{m}_s^C = \frac{M^{*C}(p_v^{*C}, \widetilde{p}_v^C)}{\widetilde{p}_v^C}$$

$$\Leftrightarrow \quad \begin{array}{c} M^{*C}(p_v^{*C}, \widetilde{p}_v^C) = kM^{*C}(p_o^{*C}, \widetilde{p}_o^C) \\ \widetilde{p}_v^C = k\widetilde{p}_o^C \end{array} \quad \forall k \geq 0$$

Moreover, reform $v$ changes relative domestic prices lowering relative domestic prices at home because the economic value associated to the artificial scarcity created by a VER is reduced after the reform is implemented. Therefore,

$$\widetilde{p}_v^C = p_v \leq p_o = \widetilde{p}_o^C \Rightarrow 0 \leq k \leq 1$$

where the equalities between $A$'s relative domestic price and A's bilateral terms of trade with $C$ follows from the fact that $A$ is not restraining its exports of good $y$ to $C$. Therefore, the price an exporter receives at home $(p_y)$ is exactly the price received internationally as paid by the importer $(p_y^{*C})$.

I shall sketch a proof for $\widetilde{p}_v^B \gtrless ? \widetilde{p}_o^B$.

By (2.8), $\widetilde{p}_o^B = \overline{m}_s^{*B}/\overline{m}_s^B$. Since both VERs are assumed to be binding, both $M^{*B}$ and $E^{*B}$ are greater in the new equilibrium. Depending on the relative magnitude of these changes, the bilateral terms of trade with $B$ may result appreciated or depreciated.

## 2.7.4   Appendix D - Derivation of (2.18)

The logic and steps are identical to section 2.7.1 above. I shall use the same notation as well with the understanding that all variables are now expressed in units of the local import good (good x) at local prices.

$$C_x(0) + C_y(0)/p(0) \leq Q_x(0) + Q_y(0)/p(0) + R(0)$$

$$C_x(1) + C_y(1)/p(1) \leq Q_x(1) + Q_y(1)/p(1) + TR(1)$$

$$TR(1) = [1/p(1) - 1/p(0)][C_y(0) - Q_y(0)] + R(0)$$

$$R(0) = \sum_i [1/\widetilde{p}^i(0) - 1/p(0)][C_y^{*i}(0) - Q_y^{*i}(0)]$$

$$R(1) = \sum_i [1/\widetilde{p}^i(1) - 1/p(1)][C_y^{*i}(1) - Q_y^{*i}(1)]$$

Adding and subtracting $(\sum_i [1/\widetilde{p}^i(1) - 1/p(1)][C_y^{*i}(0) - Q_y^{*i}(0)])$ to $R(1) - TR(1) \geq 0$, gives exactly (2.18) where $M^{*i}(0) = C_y^{*i}(0) - Q_y^{*i}(0)$.

## 2.7.5 Appendix E - Proof of Proposition (2.2)

Recall $A$ is a small country taking $p^{wC}$, $p^{wB}$ as given and use the equilibrium result of section (2.3.1). Under the assumptions of *(a)* a competitive trade model, *(b)* of quota license holder operating in a competitive market, *(c)* of $p^{wC} \leq p^{wB} \leq \tau_I^C p^{wC}$ and *d)* tariff-equivalent quota, i.e. $\overline{m}_s^C = E^{*C}(p_I^{*C}, p^{wC})$ with an implicit tariff associated to it of $\tau_I^C$, I need to show:

$$V_q - V_s \geq V_t - V_I$$

**Proof.** Assumptions a), b) and d) imply that $p_I = p_s$. It follows

$$
\begin{aligned}
I_I &= I(p_I, p^{wC}) = p_I Q_x(p_I) + Q_y(p_I) + M(p_I, T_I) t_I^C p^{wC} \\
&= p_I Q_x(p_I) + Q_y(p_I) + M(p_I, p^{wC})(p_I - p^{wC}) \\
&= p_s Q_x(p_s) + Q_y(p_s) + \overline{m}_s^C(p_s - p^{wC}) \\
&= I(p_s, p^{wC}) = I_s
\end{aligned}
$$

where $T_I = p^{wC}$ and $\overline{m}_s^C = E^{*C}(p_I^{*C}, p^{wC}) = M(p_I, p^{wC})$ since $A$ only trades with $C$ in equilibrium $I$ given that the price level and the income in the two trading equilibria are the same, $V_I = V(p_I, I(p_I, p^{wC})) = V(p_s, I(p_s, p^{wC})) = V_s$.

Within the union, producer prices have to be equalized even after the agreement is implemented. Thus,

$$p_q = p_t = p^{wB} \implies Q_j(p_q) = Q_j(p_t) = Q_j(p^{wB}), \quad j = x, y$$

and

$$
\begin{aligned}
I_q &= I(p_q, T_q) = p^{wB} Q_x(p^{wB}) + Q_y(p^{wB}) + \overline{m}_s^C(p^{wB} - p^{wC}) \\
&\geqslant p^{wB} Q_x(p^{wB}) + Q_y(p^{wB}) \\
&= p_t Q_x(p_t) + Q_y(p_t) \\
&= I(p_t, p^{wB}) = I_t
\end{aligned}
$$

where the first equality follows from the fact that under quota protection $A$ can still import from the lowest cost supplier $C$ after the regional integration with $B$ up to the limits imposed by the binding quota. The latter inequality is the direct consequence of trade diversion arising in the tariff case which causes the loss of all tariff revenue after the agreement with $B$ is in place.

By the property of the indirect utility function that is strictly increasing in income, it follows that

$$V_q = V(p_q, I_q) = V(p^{wB}, I(p_q, T_q)) \geqslant V((p^{wB}, I(p_t, p^{wB})) = V(p_t, I_t) = V_t$$

∎

This result holds true also when VER instead of volume quotas are in place. Terms of trade are unchanged, domestic relative prices are identical to equilibrium $q$. Thus, $p_o = p_s = p_I$ and $p_v = p_q = p^{wB}$. The only difference is that tariff revenue is accrued by the foreign country.

**Proof.**

$$
\begin{aligned}
I_v &= p^{wB} Q_x(p^{wB}) + Q_y(p^{wB}) \\
&= I_t
\end{aligned}
$$

Then

$$V_q = V(p^{wB}, I_v) = V(p^{wB}, I_t) = V_t$$

Given

$$
\begin{aligned}
I_I &= p_I Q_x(p_I) + Q_y(p_I) + M(p_I, T_I) t^C p^{wC} \\
&\geq p_I Q_x(p_I) + Q_y(p_I) \\
&= p_o Q_x(p_o) + Q_y(p_o) \\
&= I_o
\end{aligned}
$$

it follows

$$V_o = V(p_o, I_o) \leq V(p_I, I_I) = V_I$$

as $p_o = p_I$. It follows $V_v - V_o \geq V_t - V_I$. ∎

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# CHAPTER 3

# THE GROWTH-EFFECT OF REGIONAL INTEGRATION: A SURVEY

## 3.1 Introduction

Since the beginning of 1990, Regional Integration Agreements (RIAs) have mushroomed again, after "lying dormant" for two decades. This is quantitatively an important phenomenon as it involves virtually almost all countries of the world and a big proportion of trade volumes are exchanged regionally.

The current regionalism can be distinguished from the regionalism of the 1960s in two important respects. First, the regionalism of the 1960s represented an extension of the import-substitution industrialization strategy from the national to the regional level and was therefore inward-looking. The current regionalism is by contrast taking place in an environment of outward-oriented policies. Second, in the 1960s developing countries pursued regionalism integration (RI) exclusively with other developing countries. Today these countries, especially those in Latin America, have their eyes on integration with large developed countries.

This has appeared to many policy makers the right premise to be a growth conducive regional integration. However, from an economic prospect, trade policies eliminating trade barriers only partially do not need to be welfare improving or growth enhancing. Therefore, the spread of regional integration agreements (RTAs) has stimulated a large body of theoretical literature aiming at discerning the conditions favorable to gains from regionalism, as well as several empirical studies evaluating actual benefits and costs of integration.

The aim of this paper is reviewing some recent theoretical and empirical literature on the growth effect of RIAs, as well as to bridge these two sides of the literature. Indeed, not only theoretical models provide the foundation for empirical work, but they also give insights how to interpret the mixed empirical findings. And the way around: it is plausible that different and often contrasting empirical results simply mirror the lack of clear cut theoretical predictions about the growth outcome of regional integration policies.

Two features characterize this essay from others in the literature. First, it focuses on

the long run gains of regional trade agreements, while most of the existing contributions emphasizes the trade-aspect of the agreements.[1] Second, it considers both the theoretical and the empirical results as the two sides of a single coin.[2]

Moreover, empirical work has always been confronted with the difficult task of identifying the causal effect of regionalism, discerning it from other changes occurring in the economies in the same period. Recently, there has been some advances made in this respect, certainly facilitated by better data as well as the development of more appropriate econometric techniques. It is then worth reviewing the achievements registered in establishing a sound framework for causality analysis and discussing its limitations and drawbacks, given the relevance this framework can have for future empirical research. To the best of my knowledge, most of the empirical surveys still refer to the early and pioneering empirical work of the early 90s, while substantial progress has been made in this field.

Once presented where the literature stands, this review points out some interesting directions for future research. In particular, Gancia (2003) shows north-south integration can be growth conducive if liberalization does not only entail trade barriers reductions, but it also provides members with improved institutions. I believe Europe offers an unique example in this respect. All economic-lagged countries before accession - such as Ireland, Greece, Spain, Portugal - have started to develop considerably and catch up after their accession to the European Community (EC). More recently, the newly Eastern and Central European accessed countries are showing already tendencies of development and catch up. The unique and distinguishing feature of the negotiation process to join the European Union (EU) is to provide the potential members with the obligation to adopt the "*acquis comunitaire*" - a full and exhaustive agenda of legal, institutional and economic reforms. Therefore, the multiyear process of negotiating accession becomes for each of them a forceful framework and road map for their national reform strategies. Overall, this may suggest that an important growth effect of north-south integration may be channeled through this institutional compliance. The "institutional channel" - as I call it - is simply missing in this literature, in spite of a growing theoretical and empirical literature on the importance of institutions for economic development[3]. The literature on regionalism should look with interest at this new developments in the growth and institutional literature to have a better understanding

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[1]See Panagariya (2000) for a recent theoretical review.

[2]See for instance Walz (1997) for a recent review of theoretical models assessing the growth effects of RTAs. Deardorff is an exception and considers both theoretical and empirical aspects of regionalism. However, his analysis is mostly focused on trade issues.

[3]See Acemoglu et. al. (2005)

of the effects of regional integration on members' development chances.

The paper is organized as follows. Section 3.2 is divided in two subsection. The first one presents the main theoretical models which are useful to interpret the impact of regional integration on growth outcome. While presenting the model's prediction, I shall also discuss the evidence supporting those predictions. The second one discusses the empirical methodology that different studies have applied to cope with the difficulty of identifying a casual relation from integration to growth. Section 3.3 discusses the "institutional channel" and argues that it should be an important part of future research. The last section concludes.

## 3.2 The growth-effect of Regional Integration

Although there is a much larger literature on the effect of regional integration - dealing for instance with its impact on trade flows and welfare consequences - my focus here is restricted to the growth consequences of RI.

### 3.2.1 Theoretical models

Models of endogenous growth in an open economy setting have constituted the workhorse to analyze the consequences of trade integration. These models identify three main growth effects of trade openness, namely, the redundancy effect, the scale effect and the reallocation effect.[4]

The redundancy effect refers to the avoidance of duplicative R&D in different countries after integration. Since international trade makes unprofitable to "discover" an already existing good for the second time, the overlap in the creation of new goods is eliminated with the integration of product markets.

The scale effect works thorough the integration of the R&D sectors of the economies in the presence of increasing returns to scale. Trade integration has two contrasting consequences. On one hand, it enlarges the product market. On the other one, it makes competition fiercer. The overall effect on R&D activities depends on the assumptions on the R&D function. In the lab-equipment formulation, an enlarged product market for innovators leads to a scale effect in the R&D sector and therefore, it lowers R&D costs. In contrast, in the knowledge-driven formulation of the R&D function, there is no scale effect with product market regulation. R&D is rather driven by a "knowledge" spillover effect. Therefore, only if trade and factor flows are valuable sources of "learning", trade integration contributes to lower R&D costs

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[4] See Walz (1997) for an extensive riview on these models.

and enhances economic growth.[5]

Finally, the reallocation effect describes the change in intra-and intersectoral resource allocation following trade integration. A reallocation of resources in (out of) the R&D sector fosters (depress) the rate of knowledge accumulation and henceforth growth.

For identical and innovating countries, Rivera-Batiz and Romer (1991) show that the growth rate of the two innovating countries is a non monotonic function of the tariff rate. For small initial tariffs, trade liberalization fosters growth, while if the initial tariffs exceed a critical threshold, tariff cuts depress growth. Therefore, we can conclude that trade integration between two industrialized countries (North-North scheme of integration - NN integration henceforth) is likely to be growth-enhancing, especially if both countries are levying low tariffs each other.

When countries are more dissimilar - as it is in Free Trade Areas (FTAs) between developed and developing countries (North-South scheme of integration - NS henceforth) - the implications of integration are not so clear cut.[6]

However, these models can not properly deal with the discriminatory nature of preferential trade liberalization typical of FTA and Custom Unions (CU), because they miss a third country or an outside world. Indeed, they basically reflect the global integration between different types of countries. Moreover, deeper scheme of trade integration than simple FTA or CU - e.g. Common Markets like the European Union (EU) - involve the free circulation of the factors of production and therefore, call also for the incorporation of regional elements in the analysis.

Walz (1997) proposes an endogenous growth model with 3 countries and a location decision for the producers of specialized inputs, to study the effects of NS integration. Country A is the most advanced country where all R&D is concentrated, while country B is a developing country producing both an industrial good (Y) which uses the specialized intermediate inputs coming from A and a traditional good (Z). Finally C plays the role of the ROW and it is assumed to be completely specialized in the traditional sector.

Ultimately the direction of the growth effect of NS initiatives depends whether the reallocation of resources favors sectors in which the Union as a whole has a comparative advantage or a comparative disadvantage. The removal of inner-union trade barriers between A and B on the final goods (Y and Z) diverts consumption of the traditional good in country A from the ROW to Z-goods produced in country B. Therefore, resources that within the Union

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[5]Grossman and Helpman (1991) investigate the implication of trade if knowledge spillovers are a positive function of trade volume - reflecting that knowledge and goods flows can not be separated from each other. Razin and Yuen (1995) explore the possibility of knowledge spillover via labour migration.

[6]See for example Grossman and Helpman (1991), Feenstra (1996), Redding (1999).

are conveyed into the traditional sector - where the Union as a whole has a comparative disadvantage - have to be subtracted to the innovating sector (R&D) and to the industrial sector (Y) - where the Union has a comparative advantage. These inefficient reallocation of resources inevitably depresses the innovation activity and, consequently growth in all countries.[7]

In contrast, the abolition of trade barriers in the intermediate goods sector has growth-enhancing effects. Trade liberalization in the intermediate-goods sector where no import competition with the ROW takes place, has a pure trade creation effect yielding production efficiency gains. Part of this gains are reflected by the expansion of R&D activities in country A.[8]

In conclusion, the overall-effect of liberalization of inner-union barriers to trade is ambiguous: only if the latter effect dominates the former, NS integration can lead to improved growth performances.

There are two main messages in this result. The first obvious one is that NS integration does not need to be necessarily growth enhancing. The second one is that for this given particular trade-specialization pattern, the static notion of trade creation and diversion maps into dynamic growth enhancing and growth depressing effect.[9]

This inconclusiveness of theoretical predictions on the dynamic long run effects of integration is reflected in the mixed evidence of empirical studies. For instance, Vanhoudt (1999) concluded from a sample of OECD countries that EU membership hardly had a positive impact on growth compared to developed countries out of the EU. On the contrary, Henrekson et. al. (1997) found that EC and EFTA membership have increased growth rates in the order of 0.6-0.8 percentage point per year. Finally, the evidence presented by Crespo et.al. (2002) seems to suggest the longer a country's membership in the EU, the higher the growth-dividend from membership.

Regional integration policies are often implemented in concomitance with broader trade

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[7]As consequence of trade diversion, resources in country B are re-directed from the contracting industrial sector Y toward the expanding traditional sector Z and, in turn, a higher demand for Y in the union has to be met by A. Resources in country A are then shifted from the R&D sector into the Y-sector. Indeed the upward wage pressure in country A pushes up innovation costs. The incentive to innovate declines and the growth rate decreases in both A and B.

[8]Lower tariffs on intermediate inputs make Y-producers in B more competitive on the world market. The Y sector in country B expands mirrored by its contraction in country A in favor of an expansion of the R&D activities.

[9]The assumption of innovation not taking place in the ROW is certainly an extreme case. However, if innovation takes place also in the ROW, trade liberalization either in the final good sector or in the intermediate good sector, will be accompanied by a trade diversion effect. Therefore the qualitative prediction of the effects of NS integration is not reversed: the dynamic gains associated to the trade creation effect have to dominate the dynamic losses induced by trade diversion.

reforms or multilateral trade liberalization. For example, the European common external tariff (CET) lowered from more than 15% in the 60s to less than 4% in 2000.[10] Only UK, Ireland and UK were classified as "open" according to the Sachs and Werner openness index at the time of the first implementation of the European Community, while for the other members of EC, broad liberalization proceeded in parallel with regional integration.[11] The model above is flexible enough to encompass the case of a CU formation (between A and B) establishing a common external tariff (CET). The reduction of the latter favors trade with the rest of the world and therefore the Union prefers to import good Z from C rather than producing and trading it locally. The reallocation of resources reflects the natural comparative advantage of the countries and enhances R&D activities in country A. Therefore, inner-union trade liberalization complemented with outward oriented policies as a bloc is growth stimulating. Indeed, Vamvakidis (1998) finds that broad trade liberalization promotes growth even controlling for regional integration and, generally, in all studies openness is always found an important determinant of growth.[12] Clearly, this poses empirical studies in front of the challenge of disentangling the effects of preferential trade liberalization from multilateral trade liberalization, as discussed in the next section.

This model could be applied as well to a subsequent enlargement of a NN trading bloc to a developing country, as the integration of Mediterranean countries or, more recently, Eastern European countries into the EU or of Mexico into NAFTA. Then, the trading bloc between A and B would be the new NS integration agreement between a technological advanced and existing North bloc (A) and a technological-follower developing country (B). The model would not deliver any clear prediction on the growth outcome of this integration.

An other interesting situation - not considered by Walz (1997) - arises if countries A and C form an integration bloc. The difference being in the development stage of the new accessed member. Although C is technologically lagged, such integration would exploit the comparative advantage of A and C and therefore - I conjecture - it may be trade creating and growth enhancing.[13] It would be then interesting to compare the outcome of these two extensions of the Walz model with the predictions stemming from Venables (2002) - that is countries with a comparative advantage between that of their partners and the rest of the

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[10]See Badinger (2005).

[11]See Vamvakidis (1998).

[12]See Vamvakidis (1998), tab. 4, column 6 and 7.

[13]A would import relatively more Z-goods from C substituting away from imports of the same good from B. People dismissed from sector Z in country B have to be re-employed in sector Y, provided that B remains incompletely specialized. The reduction of wages favors B's competitiveness of Y-goods on the international market, leading A to import relatively more Y-goods from B and specializing further in the production and the exportation of the intermediate inputs. Individual countries' growth rates as well as the world growth rate should then increase.

world (B) do better than countries with an "extreme" comparative advantage (C).

In contrast, Walz (1998) takes a different route to analyze the case of the enlargement of a NN trading bloc to a developing country. Walz (1997)'s model is slightly modified in that B is a developed country and, like country A, performs R&D activities besides producing the industrial good Y and the traditional good Z. Country C is again completed specialized in the traditional sector Z and represents the South country to be integrated into an existing NN trade agreement between A and B. After integration, the production of the traditional good is partially transferred to the accessing country and, therefore, labour in the common market is released from the traditional sector and reallocated to a the dynamic R&D sector. Thus, growth results fostered.

Contrary to the two possibilities outlined above, this approach loses the ROW and after integration the world is perfectly integrated. However, the theoretical prediction is sharper and indicate NS integrations as a growth promoting policies. The data seems to support this conclusion. For instance, Crespo et al. (2002) find evidence of catching up of the South Mediterranean economies with the richer founding members of EU. Moreover, his evidence seems to suggest that the poorer countries have profited the most from this integration process. Unfortunately, there is little evidence (no evidence) on the growth effect of other NS agreements. To my knowledge, Madriaga et al. (2004) constitute the only attempt to evaluate the consequences of NAFTA for its member's growth performances. They find some (weak) evidence of conditional beta-convergence between NAFTA-members. Unfortunately, it is too early to access any convergence hypothesis for the Eastern European countries joining the EU, although their economic performances seems encouraging.

Often, many regional agreements are also formed between only developing countries with the deliberate objective of promoting economic growth to its members - South-South integration scheme - henceforth SS. MERCOSUR, CAN (Andean Pact), CACM (Central American Common Market) formed among Latin American countries are just few examples. This situation is out of the models outlined so far. Lo Turco (2004) fills in this gap building on Walz (1997). She supposes countries B and C join into a regional trade agreement, while country A is the industrialized ROW. Following regional integration, B gives up part of the Z-good production and further specializes in the the industrial sector Y. This expansion pushes up the demand for intermediate goods and therefore it triggers an expansion of the R&D sector in country A. The efficiency gains that arise from the redistribution of resources according to the natural countries' comparative advantage, materialize in a growth-promoting trade-union. In a certain sense, B and C import the growth rate as they benefit from any situation that lead to an expansion of the dynamic sector in A, so that the growth

success of a SS integration is more likely if complemented with broad trade liberalization. This is the main result of the model which provides a possible explanation for the failure of the regional integration experiences in Latin America in the 70s as a means of promoting growth through the protection of "infant" industries in the context of a large market. Indeed, based on the Sachs and Warner's definition of openness, all Latin American countries that conducted regional trade agreements (RTAs) in the 1960s and 1970s had high protection.[14] However, one of the most prominent feature of the second wave of regionalism in South America at the beginning of the 90s, is its implementation in the context of outward oriented macroeconomic policies. As predicted by the model, policy makers have hoped to be a growth conducive policy. Lo Turco (2005) provides the first empirical assessment of SS agreements in Latin Americas and she generally finds no beneficial growth effects for its member countries. In some cases, the evidence seems rather suggesting that if there is any impact, it seems to be growth detrimental.

Although no firm predictions can be established from this class of models, I believe that we learn that growth performances are mainly related to the trade pattern specialization and that, roughly speaking, whether or not a NS-trade-union is trade creating is likely the main predictor of its success to be growth promoting as well. Moreover, CUs with the objective of implementing import-substitution policies liberalizing trade only preferentially to member countries, but isolating the bloc from the ROW are likely to fail as growth promoting strategies. The cost of such closure in this model is an industrial structure that does not reflect the natural comparative advantage.

More broadly in the growth literature, leaving aside the case of symmetric countries, that generally implies that trade liberalization is beneficial to both countries and leads to convergence in the growth rates, the results on asymmetric countries are some what more controversial. On the one side, there are models that stress the role of initial conditions, so that differences across countries can lead to differences in income levels and divergence in the growth rates (Grossman and Helpman (1991), Feenstra (1996), Redding (1999)). On the other side, models that rely upon the assumption of global knowledge spillovers predict that trade liberalization in the context North-South integration will lead to convergence of growth rates across countries (Grossman and Helpman (1991), Barro and Sala i Martin (1997), Martin and Ottaviano (1999)). If spillovers are national in scope, we would observe divergence, implying that trade by itself would not be enough to generate convergence.

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[14]See Vamvakidis (1998).

### 3.2.2   Empirical Models

The major and most problematic task in evaluating the growth effect of regional integration is disentangling the effect of RIAs from other changes in the economy. No review of this literature can hope to be exhaustive and I shall mainly focus here on the progress made by new studies to identify such dynamic effects of regional integration policies.

The first econometric approach typically employed cross-section techniques and rested on the following simple linear growth equation:

$$\Delta y_i = \alpha + \beta y_{0i} + \mathbf{D}_i \boldsymbol{\delta} + \mathbf{X}_i \boldsymbol{\theta} + u_i \qquad i = 1, ... N \qquad (3.1)$$

where $\Delta y$ is the average of the annual growth rate of real GDP per capita over a given period of time, $y_o$ is the real GDP per capita at the beginning of this period, $\mathbf{X}_i$ is a row-vector of explanatory variables, $\mathbf{D}_i = [d1_i, ..., dK_i]$ represents a row vector of integration-dummy variables (so that $dk_i = 1$ if $i \in k$, indicating country $i$'s membership in regional integration agreement $k$) and $u$ is the error term. Alternatively, in some studies $\mathbf{D}_i$ could also be a row vector of proxies for regional integration[15]. Borrowing from the empirical growth literature, $\mathbf{X}_i$ typically includes also variables that affect a country's steady state of per capita GDP, such as proxies for human capital and investments. Once controlled for $\mathbf{X}_i$, $\beta$ tests the conditional-convergence hypothesis and should have a negative sign. The interest lies in the column-vector $\boldsymbol{\delta}$: when the $k$th-element is positive and statistically significant, it indicates a positive growth effects of regional integration agreement $k$. The evidence from these studies is contrasting. For instance, none of the 6 integration-dummies in De Melo Montenegro and Panagariya (1992) are ever significant, while Henrekson et. al (1997) find evidence of a positive long run growth effect of European Community (EC) or EFTA memberships[16].

The conclusion from these studies should be taken cautiously since OLS applied to (3.1) is an inappropriate estimation method resulting in biased and (possibly) inconsistent estimates[17]. Indeed, there may be important unobservable country-specific characteristics (such as the political and diplomatic ability of a country, lobbying, political institutions, beliefs, reputation, credibility) which may determine the participation into a regional agreement. Such unobservable factors are likely to be correlated with the proxy for regional integration, causing serious econometric problems. The development of panel data technique has allowed

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[15] For example, a proxy of regional integration that has been extensively used is a country's intra-bloc trade as a share of its total trade or GDP.

[16] The 6 regional integration agreements (RIAs) considered in De Melo et al. (1992) are EC, EFTA, CACM, LAFTA, CEAO, SACU. There is one exception: the dummy for SACU turns out to be significant.

[17] Baldwin and Venables (1995) also stress out this point.

to introduce explicitly country-heterogeneity as well as an arbitrary correlation between the unobserved country factors and the observed explanatory variables. The regression equations that are usually estimated fit into this general formulation:

$$y_{it} = \alpha + \mathbf{ds}_t \boldsymbol{\lambda} + \beta y_{it-\tau} + \mathbf{D}_{it} \boldsymbol{\delta} + \mathbf{X}_{it} \boldsymbol{\theta} + c_i + u_{it} \quad i = 1, ...N; t = 1, ...T \quad (3.2)$$

where $y$ indicates the natural logarithm of real GDP per capita, $\tau$ denotes the time-span of each period (there are $T$ periods), $\mathbf{X}_i$ is a vector of time-varying explanatory variables, $\mathbf{D}_i$ is the row vector of integration-dummies (indicating country memberships in agreement $k$ at time $t$) or integration proxies and the $u$'s are the idiosyncratic disturbances[18]. $c$ is the country unobserved effect, also referred as unobserved heterogeneity in the literature.[19] $\mathbf{ds}_t = [d2_t, ..., dT_t]$ is a row vector of time dummies, so that $ds_t = 1$ if $s = t$.[20]

Studies evaluating the dynamic growth effects of regional integration mainly differ for the countries and the number of observation in the sample, for the way regional integration is measured and for the identification strategy and the estimation method implemented.

Vamvakidis (1999) is one of the few panel data analysis on a large set of countries, while Henrekson et. al. (1997), Vanhoudt (1999), Crespo et. al (2002), Brodzicki (2003), Badinger (2005) restrict their focus on the European integration and Lo Turco (2005) considers integration in Latin America. Besides the variables typically included in the augmented neoclassical growth regressions, all specifications include:

- time-dummies to control for some major macroeconomic shocks such as oil shocks, currency crisis, the collapse of the Soviet Union.

- measures of trade openness to disentangle the effect of unilateral or multilateral trade liberalization from preferential trade liberalization achieved through regional integration.

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[18] Note (3.2) is observationally equivalent to

$$y_{it} - y_{it-\tau} = \alpha + \boldsymbol{\lambda} \mathbf{ds}_t + \widetilde{\beta} y_{it-\tau} + \boldsymbol{\delta} \mathbf{D}_{it} + \boldsymbol{\theta} \mathbf{X}_{it} + c_i + u_{it} \quad i = 1, ...N \quad t = 1, ...T$$

where $\widetilde{\beta} = \beta - 1$. The time span of each period $t$ denoted with $\tau$ is typically 5 years in growth regressions, but sometimes is longer (e.g. 8 years in Crespo et. al (2002) -and sometimes is even annual - as in Lo Turco (2005) -). Therefore if period $t$ is for instance 5 years average 75-80, $y_{it-\tau}$ is the logarithm of real GDP per capita in 1975.

[19] The arbitrary correlation between $c_i$ and the explanatory variables in $\mathbf{X}_i$ is achieved through the choice of the estimation method. Most studies employ the dummy variable estimator or the fixed effects estimator or the Arellano and Bond GMM estimator and therefore assume implicitly $E(c_i|\mathbf{X}_i)$ can be any function of $\mathbf{X}_i$.

[20] Note that $\alpha$ is the intercept for the base time period $t = 1$ and can not be identified as it can not be distinguished from $c_i$. However, the $\lambda$'s are identified and measure the differences in the time effects relative to a base period.

- policy variables like the inflation rate, the exchange rate volatility, public expenditure, size of government which influence growth directly.

Ultimately, all these variables are possible confounding factors, so that their inclusion avoid to attribute their effects erroneously to regional integration. For instance, the integration dummy for the European Community may reflect possible similarities of macroeconomic policies in the member countries or the improved macroeconomic stability following the implementation of the EMU zone. Therefore, proxies for such variables ought to be included in the vector $X$ in (3.2).

With the exception of Vanhoudt (1999), Brodzicki (2003) and Lo Turco (2005), all studies mentioned above typically base their identification strategy uniquely on a good specification of the empirical model. They hope (assume) that once controlled for observable factors and unobservable heterogeneity, their measure of integration catches the relevant dynamic effects of integration. However, they completely miss any reference to the counterfactual situation - what would have happened to the integrating countries, had they not undergone through a process of regional integration. Clearly, the growth experience of the same integrating countries before the implementation of regional integration policy can not simply be representative of the counterfactual situation because integration induces profound changes in the economic environment. Unfortunately, the counterfactual situation is never observable and, therefore a group of countries - the control group - has to be careful chosen to reasonably represent what would have happened to the treatment group in absence of the treatment.

It is natural to think of the difference in the average growth performance of the treated group relative to the control group - the so called average treatment effect on the treated (ATT) - as the desirable measure of the casual effect of integration on growth. Lo Turco (2005) explicitly states the conditions needed for interpreting $\delta$ in (3.2) as the ATT which can be summarized in the following way:

i) the only difference between the pre and the post agreement period for the countries involved in it is represented by the agreement;

ii) the treated group and the control group are subject to the same factors in the same period;

iii) once controlled for the observable characteristics, the only difference between the two groups of countries is the participation in the agreement.

As a clarifying example, it is instructive to consider the identification strategy suggested in Lo Turco (2005) to analyze the growth effect of four Latin American integration agreements, namely the original Andean Community of 1969 ($d1$) and its renewed version operative since 1991 ($d2$), the MERCOSUR implemented in 1991 ($d3$) and finally the Central American Common Market, also operative from 1991 ($d4$). $d1$ to $d4$ are the four integration dummies: each one takes value 1 for the member countries in the integration agreement from the year of implementation onwards. Henceforth, $\mathbf{D}_i = [d1, d2, d3, d4]$ is the row-vector of integration dummies and $\boldsymbol{\delta}$ its associated parameter column vector. The definition of time-dummies indicating the starting year of each of the agreements is crucial for the correct identification of the causal effect of the agreement on the growth rate of the member countries. More specifically, let $\mathbf{ds} = [d69, d91]$ be the vector of these time dummies where $dxx$ takes value 1 for all countries from year $xx$ onward; $\boldsymbol{\lambda} = \begin{bmatrix} \lambda_{69} \\ \lambda_{91} \end{bmatrix}$ is its associated parameter vector. Ignoring $\mathbf{X}$, $c_i$ and the lagged income variable for the time being, (3.2) implies $\alpha$ represents the average real GDP per capita before the agreement for both the treated and control group; $\alpha + \lambda_{91} + \delta_k$ is the the total average real income per capita for the countries into agreement $k$ ($k = 1, .., 4$), while $\alpha + \lambda_{91}$ represents the average real GDP per capita among the control group. Therefore, the latter represents the missing counterfactual of the growth outcome that the integrated countries would have experienced in absence of regional integration agreement $k$. Note that $\delta_k$ (i.e. the integration agreement) is the only difference between the treated and the control group and the time dummies represent the common factors to which both the treated and the control group have been exposed over the same period of time - so that assumption *i)* and *ii)* are fulfilled. Finally, the inclusion of country unobserved heterogeneity (the $c_i$'s) and the time-varying explanatory variables in $X$ as well as the lagged $y$ make assumption *iii)* more likely to hold. This clarifies also that a good specification of the empirical model on which all previous studies have exclusively relied to correctly identify the ATT is certainly indispensable, but it is not enough on its own. Assumptions *i)* and *ii)* are also needed and are both related to the issue of defining a good control group, whose growth performances can approximate reasonably well the unobservable per capita-growth rate for the treatment group in the counterfactual situation of no integration. In this respect, studies not including a time dummy indicating the starting year for each of the agreement analyzed are failing to correctly identify the ATT.

The are two critical issues to be discussed about this approach. The first one - the *self selection problem* - arises from the fact that the assignment into treatment is not random like in the scientific experiments, but countries rather choose deliberately to join into some

integration scheme in the expectation of economic returns. Therefore, if the participation into regional agreements is affected by unobserved country factors, $\delta$ can identify correctly the ATT only to the extent that such unobservable factors are time-invariant - this is assumption in Lo Turco (2005). On the contrary, if one believes that time-varying factor are playing an important role in the participation decision, (3.2) should also be complemented with a further equation specifying the assignment into treatment and the estimation technique should properly cope with the "endogenous selection" problem.[21]

Second, whether the control group emerging from this approach is representative of the treated group or not should be critically discussed. Continuing the example above, Argentina, Brazil, Paraguay and Uruguay constitute the treated group of MERCOSUR. However, in the control group fall also countries belonging to other agreements such as $d2$ and $d4$ signed in the same period. Therefore, countries in the treated group are not subject to $d2$ or $d4$ and at the same time countries in control group are not subject to MERCOSUR ($d3$), undermining assumption $ii$). Only Latin American countries involved in no agreement would constitute a better control group, so that the quality of the control group as a good image of the treated group is at least questionable.[22] More generally, the fact that most of the countries in the world are basically integrated in some regional agreement may represent an obstacle to such analysis.

The interpretation of $\boldsymbol{\delta}$ as the ATT is also valid for Vanhoudt (1999) and Brodzicki (2003) under assumptions $i)$-$iii)$ which are only implicit in their framework[23]. Although they do not use this terminology, they employ similar definitions for the time dummies and the integration dummy. However, it is worth mentioning that they estimate $\boldsymbol{\delta}$ differently from Lo Turco (2005). While they use the least square dummy variable estimator (LSDV), Lo Turco (2005) uses Arellano and Bond GMM estimator which is more efficient and certainly consistent (and therefore preferable) with dynamic panel data - i.e. panel data that contains a lag-dependent variable among the regressors.

It is curious to notice that $\boldsymbol{\delta}$ hardly show any positive growth effect of regional integration in Vanhoudt (1999) and Brodzicki (2003) and Lo Turco (2005).[24] If this may seem a plausible

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[21]See Ichino (2006) and Wooldridge (2002). See for instance Baier and Bergstrand (2003) for an empirical model of economic determinants of Free Trade Areas.

[22]Bad matching between the treated and the control group cause biased (but still consistent) estimates. The *mean selection bias* arises from the fact that the control group is not representative of the treated in absence of the treatment. See Ichino (2006)

[23]In their work, besides integration dummies, they employ also other proxies of regional integration such as the length of EU membership or scale variables. Such conclusion on the interpretation of $\delta$ as the ATT is only valid for the integration dummy.

[24]Also Vamvakidis (1999) and Henrekson et. al. (1997) use an integration dummy and find no evidence

outcome for Latin American regional integration, it is at least surprising for the European Union and it is at odd with the recent positive growth experienced by South Mediterranean countries as well as by Eastern European countries following their inclusion in the European Community and/or in the European Union. The theory (see Walz (1998)) would also suggest that the growth effect may not necessarily be positive for the founding core members, but it is positive for the new entering members.

One possibility is that the time span usually covered by all these studies is too short - at best up to 2000 - to catch the recent positive growth performance of the new members. Yet, in a panel, the growth success of the accessing countries may result mitigated or offset by the mixed growth performances of the funding members.

Another possibility is that the control group is not properly defined, as the explicit assumption *ii)* makes clear. Indeed, Vanhoudt (1999) and Brodzicki (2003) have a sample of developed OECD countries of which Canada, Switzerland, USA, Japan, Norway are the only countries outside the European Union. I doubt whether they can constitute a good control group representative of European integrating countries because it is hard to believe that they have been subject to the same factors in the same period. Furthermore, after 1991 Canada and US have undergone through regional integration too.

Finally, the same studies or other studies employing proxies for regional integration different from integration dummies - see Vanhoudt (1999), Crespo et. al (2002), Brodzicki (2003), Badinger (2005) - find evidence of a positive influence of regional integration on the growth performance.[25] This may suggest that regional integration poses a measurement issue. Although one takes care of country and time effects, an integration dummy may be a too crude measure of integration, capturing primarily common country characteristics rather than effects of integration. Indeed, integration dummies have been supplemented with other proxies of integration such as the length of EU membership and the size of the enlarged market, reflecting the view that formal participation into the EU process as well as the access to a large market are important features of the European integration process and influence growth positively.

Badinger (2005) takes an innovative route and construct an integration index which takes into account both preferential trade liberalization within the European Community and multilateral trade liberalization in the context of GATT/WTO as reflected by the reduction of the European common external tariff. On one hand, such an attempt points out

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of the growth effects although their $\delta$ can not be interpreted as the ATT.

[25]Crespo et. al. (2002) consider only EU members in 2002 and therefore can not employ an integration dummy for EU. Therefore they center all their analysis on the length of EU membership and in the sensitivity analysis they also look at a measure of the scale of the market as proxy for integration.

that better and more comprehensive measures of integration is a pre-requisite to the full comprehension of the dynamic consequences of regional integration. Measures of integration should encompass the gradualness and continuity of a regional integration process and integration dummies certainly fail in this respect. However, in my opinion, his measure does not allow to disentangle properly the effect of regional integration from broad liberalization and therefore it could be hardly employed to establish the average treatment effect (ATT) of regional integration.

## 3.3   The institutional channel

Recent contributions in the field of economic growth have put an increasing emphasis on the role of institutions in determining different patterns of economic growth - the fundamental cause of Long-Run Growth as Rodrik et. al. (2004) and Acemoglu et. al. (2005) refer to it. At its core, this hypothesis is based on the notion that it is the way that humans themselves decide to organize their societies that determines whether or not they prosper. Acemoglu et. al (2005) think of good economic institutions as those that provide security of property rights and relatively equal access to economic resources to a broad cross-section of society. Interestingly, Gancia (2003) shows how trade and the protection of intellectual property rights (IPRs - proxies for good institutions) can jointly affect growth. If a developing country weakly protects/ does not enforce IPRs, the rent from innovation in the Southern economy will be eroded, and trade integration will be associated with an increase in the relative intensity of R&D in the developed country. Gangia shows that such reallocation of resources does not only depress growth in the South, but it may also reduce growth in the North, so that the IPRs regulatory policy of each country affects all the integrated economies. This is an application of the second best principle: any policy that aims at removing some distortions of the economy (i.e. trade barriers in this case) leaving other distortions in place (i.e. ineffective IPRs protection) need not to be necessarily welfare improving (growth enhancing in this case) neither for Southern countries nor for Northen countries. However, when trade integration is also complemented by the adoption of good institutions, NS integration is a successful growth policy.

One important implication for NS regional integration is that Northern countries have strong interests in promoting good market institutions in their Southern partners. The EU enlargement offers an unique example of such strategy: the obligation to adopt the "*acquis comunitaire*" provides each of the accessing members with a full and exhaustive agenda of legal, institutional and economic reforms. The multiyear process of negotiating accession becomes for each of them a forceful framework and road map for their national reform

strategies. In addition, the fact that reform comes embedded in the accession process gives it a credibility that it could only with great difficulty have on its own. These enhanced credibility is a valuable asset both internally and externally. Internally, it places the most important aspects of the reform program in a consensual space, protected from political and social resistance. Externally, the prospect of accession has also acted as a country's commitment to reform, given that its reversal is highly unlikely. Then, the catching up of Ireland, Spain, Portugal and Greece and, more recently, of the Eastern European economies - Slovenia, Poland, the Baltic Republics, Romania - following the integration into the EU does not come at surprise. In light of Gancia (2003), it is the consequence of deep integration process involving both trade liberalization and institutional arrangements.

Surprisingly, the literature on regional integration has been impermeable - to the best of my knowledge - to the "institutional view". The studies focusing on the EU growth effects include at most measures of macroeconomic policies to control for the effects of fiscal policy discipline - hard budget constraints. Measures of the security of property rights are hardly included in any regression - not even in the vector of control variables $X$ in (3.2).

This raise the interesting question whether the "institutional channel" of NS integration has positive growth implications. This question remains largely unexplored and it represents in my view the challenge of future research.

The main empirical difficulty is related to identify the causal effect of the induced institutional change on growth. Ideally, one would need a trade agreement displaying similar patterns of trade liberalization and production to the European Union one, without any institutional provisions. Unfortunately, EU represents a rather unique case in the history of regional integration. Moreover, a panel data analysis - as it would be appropriated in this case - would suffer of data limitations. For instance, one could proxy (even at the cost of measurement errors) the quality of institutions with some indexes. In particular, the "rule of law" index - a measure of the quality of contract enforcement - compiled by Kaufmann (2006) et. al. would seem particularly appropriate to measure institutions as Acemoglu and Rodrik intend them. However, for each country there are only four observations in time starting in 1996 - definitely a too short time span respect the much longer typically covered.

As only a purely explorative avenue, I propose here to look empirically at the "institutional channel" of north-south integration with a cross-sectional approach, similarly to the approach employed in the early studies of regional integration based on (3.1). The aim is just to assess whether institution-quality is related or not to the growth effect of NS integration. The motivation is based on recent developments of the empirical growth literature which has

focused on the effects of geographic factors (nature), trading relations (country openness) and institutions on growth.[26] In all these studies, institutions quality - as measured by "Rule of law index" - is highly significant and has sizable effect on growth. Moreover, once it is introduced it nullifies or reduce considerably the significance of proxies for geographic factors and trade, leading the institution-"advocates" to conclude on "*the primacy of institutions over geography and integration in economic development*". If the institutional channel is so fundamental to promote growth, it is natural to ask whether North-South integration that has favored the development of good institutions has also been growth conducive. If so, it is plausible that north-south integrated countries have experienced some additional growth-benefits through the institutional channel. I shall, therefore, estimate the following equation:

$$y_i = \alpha + \mathbf{X}_i\boldsymbol{\theta} + \mathbf{D}_i\boldsymbol{\delta} + \mathbf{I}_i\gamma + u_i \qquad i = 1,...N \qquad (3.3)$$

where $\mathbf{I}$ is a row vector of interaction terms between some of the covariates $\mathbf{X}_i = [G_i, T_i, R_i]$ and the integration dummy in $\mathbf{D}_i = [NS_i, NN_i, SS_i]$. $G,T,R$ are measures of respectively geographical factors, trade openness and institutions, whereas $NS,NN,SS$ are integration dummies indicating whether a country has joined into a $NS$, $NN$, $SS$ scheme of integration. The interaction term in which I am mostly interested is $R \times NS$: a positive and significant coefficient associated to it indicates that institutions have an additional impact on growth for the NS integrated countries, presumably because the process of integration has also required Southern countries to comply with appropriate institutional reforms. Indeed, one would hope that if integration has contributed to shape institutions, other things equal, one would observe higher growth among members. Clearly, such a relation could in no way be interpreted as causal relation for all problems arising with OLS - reverse causation, measurement errors, endogenous regressors $(T, R)$, self-selection, unobserved heterogeneity - discussed at length in the previous section. Albeit not causal, such correlation would mean that the institutional dimension of an integration process may be beneficial for the likelihood of growth-enhancing RI. Ultimately, this empirical exploration should be seen as a first attempt to bridge this empirical growth literature emphasizing institutions as the fundamental cause of long run prosperity with the role North-South integration can play to sustain members' growth through the promotion of good institutions. Its objective is to

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[26]See Acemoglu et. al. (2001), Acemoglu et. al (2002), Rodrik et. al (2004), Acemoglu (2005), Sach (2003), Frankel and Romer (1999), Dollar and Krey (2002). With the exception of the latter, all these studies are based on cross section evidence. They regress real GDP per capita on different measures of geographic factors, trade and institutions.

Dollar and Kray (2002) criticize such an approach and claim it is inadequate to establish the primacy of institutions on geographical and and integration factors. Instead, they propose a panel approach. However, when they employ the "Rule of law" index, their panel is a cross section analysis because of data limitations.

provide incentives for looking closer at this "institutional channel" of integration.

Note that Rodrik at. al (2004) run the same regression as in (3.3) without the **D** and the **I** terms. In that context, IV estimation is feasible because the literature has provided some instruments for $R$ and $T$ and solves the drawbacks posed by Least-square estimation. In my analysis, the integration dummies raise a serious concern for self selection of countries into the type of integration deliberately chosen, so that **D** (and therefore of **I**) are endogenous regressors. Unfortunately, the IV strategy results impracticable in this context as it can not cope successfully with the selectivity issue.

### 3.3.1 Data and Descriptive Statistics

I use the same data as Rodrik et. al. (2004) - I acknowledge them to provide me with their data.[27] This choice eases the comparison of my results with those obtained in the empirical growth literature which has inspired my crude empirical exercise.

$G$ is the distance from the equator (proxy for geography), $T$ is the logarithm of openness defined as the ratio of nominal imports plus exports to nominal GDP averaged over all available periods (1950-1998) and $R$ is the "Rule of law" index in 2002 (proxy for good institutions - see Kaufmann et. al. (2006)).[28] The dependent variable $y_i$ is the level of GDP per capita in year 1995. The integration dummies $NS$, $NN$, $SS$ catch the type of integration countries have been exposed to. I shall restrict my focus to the trade agreements covered by the studies surveyed in section 3.2. Table 3.1 presents the agreements and their classification in detail. The $NS$ integration scheme include the European Community (EC - at 15 members in 1995) and the North American Free Trade Area (NAFTA). $NN$ integration include the Closer Trade Relations Trade Agreement (CER) and the European Free Trade Association (EFTA). Given that the latter have also accessed the EC in 1973, I shall consider EFTA among $NS$ group in some regressions. Unfortunately, the number of countries that fall into the NN aggregation is very small (5 countries), making very hard to draw insightful indication from its coefficient. Indeed, I shall sometimes restrict the analysis only at $NS$ and $SS$ integration. Finally, the $SS$ integration include the trade agreements signed among the Latin American countries, the Baltic FTA (BAFTA) and the Central European FTA (CEFTA). The latter two were signed while some of these Eastern and Central European countries were negotiating access into the European Union.

Table (3.2) presents descriptive statistics (the sample mean and the standard deviation)

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[27] I am also grateful to Prof. Daron Acemoglu for providing me with the data in Acemoglu et. al. (2001) which contains the settler mortality data (the instrument for institutions).

[28] See the data appendix and Rodrik et. al. (2004) for a better description of the data.

of the relevant variables. The sample I use (140 countries) is the "large sample" used by Rodrik et .al. (2004) and include all countries for which they have some instruments for the endogenous variables $T$ and $R$. Since I shall not perform IV estimation, my sample could be extended up to 162 countries, depending on the list of regressors. However, I shall not do so here and present only the results obtained with 140 countries, since no better insight emerges from using the largest available sample.

There is almost 5 log-point GDP difference between the richest and the poorest country which translates in the richest being 107 times richer than the poorest. Such log difference is reduced to a bit less than 2 points among only NS integrated countries and a bit more than 2 points among SS countries. Interestingly, there is little difference (virtually no difference) between the average country openness in the SS and NS group, reflecting that integration in Latin America in the 90s - differently from the first wave of regionalism of the 70s - has been implemented in a context of outward oriented policies. However, the differences in the average value for the index of institutions quality is quite substantial between the SS group and either the NN or NS group, as also reflected by comparing fig.3.1 with fig.3.2. On the horizontal axis is measured institutional quality and on the vertical one, per capita output. The fitted regression line is steeper for the NS than for the SS group, while the flat line indicates the median income in the whole sample. It clearly emerges:

- that all NS countries, but Mexico have a positive value for the institution index (ranging from -2.5 to 2.5, higher values indexing better institutions);

- Among the SS countries, the Eastern and Central European countries have better institutions than Latin American countries and they contribute to raise the group average.

- Only Barbados has an index value for institution quality above 1 (as for the developed countries), while with the exception of Romania none of the former communist countries have a negative value for the institutional quality index. Therefore the latter is ranging from modestly positive to negative for all the Latin American country.

Finally, the NS group consists of 20 countries, the NN group of 5 countries and finally the SS group of 26 countries. While the first two groups lose basically no observation when the largest available sample is restricted to Rodrik et. al.'s one of 140 countries, the SS group squeeze from 37 to 26 - mostly Central American countries and Central Eastern European countries are lost. The results are not sensitive to the use of  these two different samples. Henceforth, only the results with 140 countries are reported.

### 3.3.2 Empirical Results

Table 3.3 presents different OLS specifications. Column 1 exemplifies the regression estimated by Rodrik et al. (2004) and, similarly by all other related growth studies.[29] It reflects three distinct theories on what types of factor provide fundamental explanations of comparative growth. The first theory emphasizes the importance of institutions (R), the second emphasizes geography (G) and finally the third stresses culture and trade (T). Column 2 adds the integration dummies, so that this approach looks very similar to (3.1), except for the dependent variable which is expressed in level rather than being a growth rate. Therefore, the integration dummies indicate whether the integrated countries have enjoyed on average higher per capita output (a level effect of integration). That is, they have an intercept different from the common one. Finally, the remaining column presents the saturated model where the covariates T and R have also been interacted with each integration dummy. In column 4, I add the logarithm of population (lnpop) and the logarithm of a country's surface (lnarea) among the regressors, as a proxy for within trade (see Frankel and Romer (1999)). I also have used alternative measure to the distance from the equator for G - such as a malaria index, but the results do not change substantially (not reported).

The following results stand out from table 3.3:

- $G,T,R$ are highly correlated with growth, conformably with the previous findings in the literature;

- The integration dummies NS and SS are robustly positive and significant (Column 2,3,4 below), pointing to a positive correlation between per capita output and north-south and south-south integration. However, Lo Turco (2005) finds no positive effect of integration for Latin American countries, while the evidence is mixed for EU integration in the context of panel data. While the OLS effect of NS integration seems to survive to the more appropriate methodology of panel data, the SS integration effect completely vanishes in a sound framework for causality analysis. Likely, OLS tend to overestimate the growth effect of SS integration.

- $SS \times T$ is often negative (column 2,3,4) and significant, meaning that for SS integrated country trade does not yield in average as much benefits in terms of output per capita as for other countries. This result goes in the same direction as Lo Turco (2005)'s

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[29]$T$ and $R$ are in all these approaches instrumented. Typically in a cross section, the instruments for $T$ is the constructed trade share based only on geographical factors (see Frankel and Romer (1999)), while the instrument for $R$ is typical the settler mortality (see Acemoglu et. al. (2001) or the fraction of the population speaking English and/or one of the major languages of Western Europe (see Hall and Jones (1999).

findings and fits the trade diversion story of Lo Turco (2004). Trade leads to growth depressing effects if the trade agreement between the two southern countries (B and C) result overall trade diverting. Interestingly Chang and Winters (2002) find evidence of trade diversion for Mercosur. However, the same model - Lo Turco (2004) - shows the paradoxical, although unlikely, situation that the SS trade agreement proves to be growth detrimental when B and C lowers their external protection.[30] It would then be natural to associate this outcome to a RI in Latin America taking place in an environment of outward oriented policies. Nevertheless, I would not push forward this interpretation, if not as a clear indication for the need of further theoretical and empirical research in this field.

- $NS \times R$ is rarely significant (only in column 3), indicating no additional effect of institutional quality through North-South integration. This may reflect that the estimates can not catch the recent successful enlargement of European Union where the institutional implications have been more intensive. It also partly reflects that the "control group" defined by the saturated model is totally inadequate, as I already discussed above for Lo Turco (2005) and the other studies. However, it may also suggests that North-South integration is just the means - a vehicle - to adopt credibly and effectively good institutions. Once implemented successfully, there is no reason why they should have a differentiated or stronger effect in north-south integrated countries than they have in average for other countries adopting good and sound economic institutions. Anyway, this conclusion does not contradict the "institutional hypothesis", as some countries could implement better institutions only by means of north-south integration.

One may suspect from fig. 3.1 that Mexico - the only country with a negative "rule of law" index among the NS group - may be an influential point for the latter result. Omitting Mexico from the NS group does not change any of the results. Likewise, considering only the NS and SS integration dummies and leaving out the NN dummy which has only 5 observations, does not affect these conclusions either.

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[30]When B and C lower their external tariffs, they can benefit from cheaper imports of good Y from A. Therefore, the demand for Y imports from A raise inside the trade union. Consequently, in country A resources move out from the R&D sector to convey in sector Y. Growth results then depressed by the contraction of the innovative sector. However, Lo Turco also shows that this equilibrium depends on a very specific parameter specification of the model and the degree of freedom for changing the external protection are very limited.

## 3.4 Conclusions and Open Issues

The sharpest conclusion from this literature review is that no clear cut prediction on the growth effects of RIAs emerge from endogenous growth models and we should envisage it as an application of the "second best" principle. In turn, this is mirrored by a mixed evidence on the growth effect of regional integration. While no growth effect (or if anything a negative one) it is found for integration characterizing the South America area, mixed evidence it is found for a positive effect of integration in Europe. European Community constitutes a unique exception in the panorama of regional integration as far the deepness of the integration process is concerned. In particular, assessing the EU requires the credible adoption of the "*acquis comunitaire*", so that all members in the union share common economic as well as political institutions. The success of EU to promote growth and development to the "Southern" members can be seen as the consequence of a regional integration process that has brought trade liberalization together with the implementation of sound and growth-friendly institutions.

Therefore, the "the institutional channel" of regionalism - its ability to promote growth through institutional changes - should be carefully considered in the future research agenda and it represents, in my view, the missing aspect in the regionalism literature. Recent contributions have started to develop an institutional framework to study both the determinant of institutional change and their effect on economic development. Therefore, this emerging literature can constitute a fruitful source for analyzing the consequences of institutional changes within the context of regional integration.

Finally, I presented recent empirical work which have successfully come up with a convincing causality framework for analyzing the growth effect of a trade agreement. In my opinion, this should be the building framework for further empirical investigation in this field. Indeed, we are lacking better measures of integration which are able to take into account trade liberalization (within-union and extra-union trade barriers reduction), as well as the institutional reforms entailed in RI. Indeed, a dummy variable seems to be a too crude and unsuccessful way of capturing the effects of integration.

# APPENDICES

## A.   Data Appendix

**(y) lcgdp95** = Natural logarithm of per capita GDP in Purchasing-Power-Parity US dollars (PPP GDP) in 1995. Source: Penn World Tables, Mark 6.

### Geographic factors

**(G) Disteq** = Distance from the equator of capital city measured in absolute Latitude. Source: World Bank (2002)[31].

**malfal94** = Malaria index, year 1994. Source: Gallup and Sachs (1998).

**lnarea** = Land area in thousands square meters. Source: Frankel and Romer (1999).

**lnpop** = Natural logarithm of population. Source: World Bank (2002).

### Integration Dummies

**NS** = dummy variables taking value one if a country belongs to a North-South type of integration. See table (3.3) for a list of agreements classified as North-South RTAs.

**NN** = dummy variable taking value one if a country belongs to a North-North integration. See table (3.3) for a list of agreements classified as North-North RTAs.

**NN** = dummy variable taking value one if a country belongs to a South-South integration. See table (3.3) for a list of agreements classified as South-South RTAs.

### Institution quality

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[31]It was kindly provided by Rodrik, Subramanian, and Trebbi together with many of the variables listed here. They refer to the data set used in Dollar and Kraay which is the one available from World Bank.

**(R) Rule** = Rule of law index. It is one of the six clusters with which Kaufmann, Kraay and Zoido-Lobaton (2006) have measured institutions quality through the 1990s. Source: Kaufmann, Kraay and Zoido-Lobaton (2006).

**SM** = Natural logarithm of estimated European settlers' mortality rate. It is measured as the deaths per thousand of European solders (with each death replaced with a new soldier) during the early $19^{th}$ Century. Replacement implies that mortality rate estimates can greater than one thousand. Source: Acemoglu, Johnson, Robinson (2001)[32].

**engfrac** = fraction of the population speaking English. Source: Hall and Jones (1999)

**eurfrac** = fraction of the population speaking one of the major languages of Western Europe: English, French, German, Portoguese, or Spanish. Source: Hall and Jones (1999)

**NS x R** = NS x rule. Interaction between ns dummy and rule. Source: Author's calculation.

**NN x R** = NN x rule. Interaction between nn dummy and rule. Source: Author's calculation.

**SS x R** = SS x rule. Interaction between ss dummy and rule. Source: Author's calculation.

*Integration*

**(T) lnopen**= Natural logarithm the trade share measured as the ratio of (nominal) imports plus exports to nominal GDP in US dollars. Source: Penn World Tables, Mark 6. Average over all 1950-1998.

**FR_constructed trade** = Natural logarithm of the predicted trade share as it is computed in Frankel Romer (1999) from a bilateral gravity model with pure geography variables. Source: Frankel and Romer (1999).

**NS x T** = ns x lnopen. Interaction variable between ns dummy and trade. Source: Author's calculation.

**NN x T** = nn x lnopen. Interaction variable between nn dummy and trade. Source: Author's calculation.

**SS x T** = ss x lnopen. Interaction variable between ss dummy and trade. Source: Author's calculation.

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[32]The data has been kindly provided by Acemoglu Johnson and Robinson.
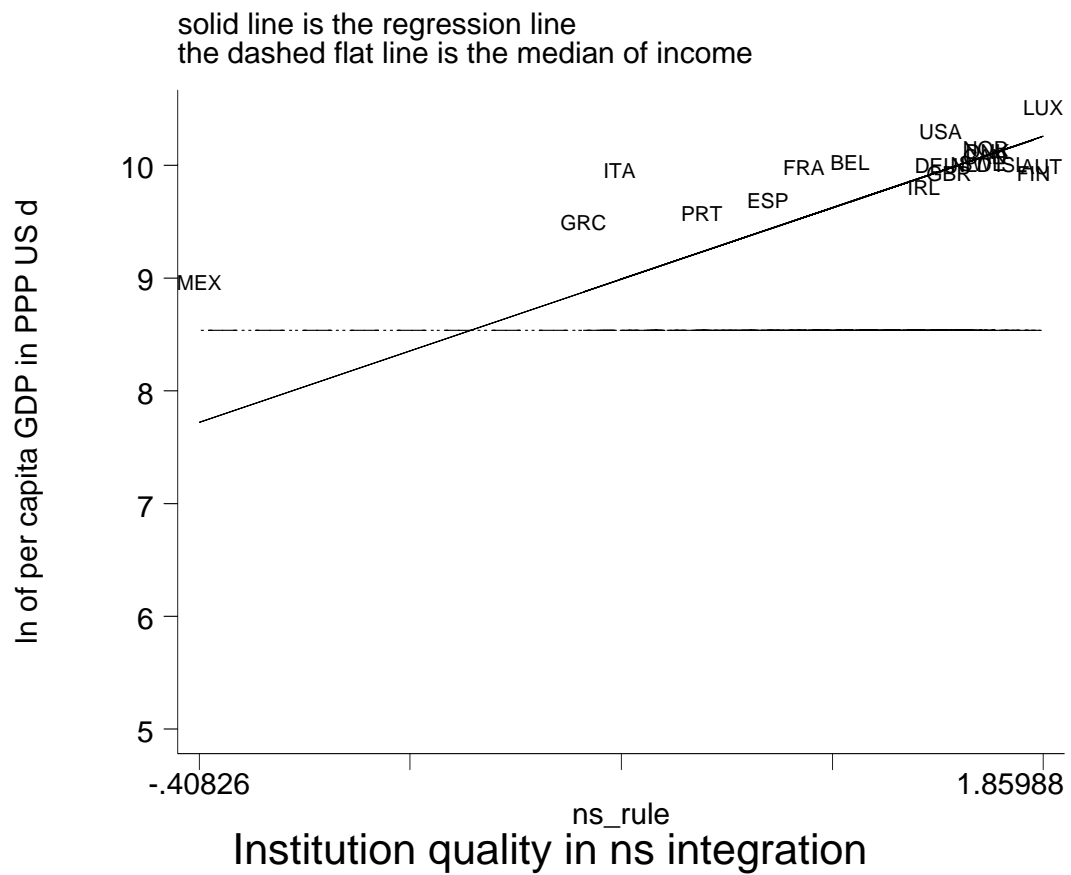
Graphics



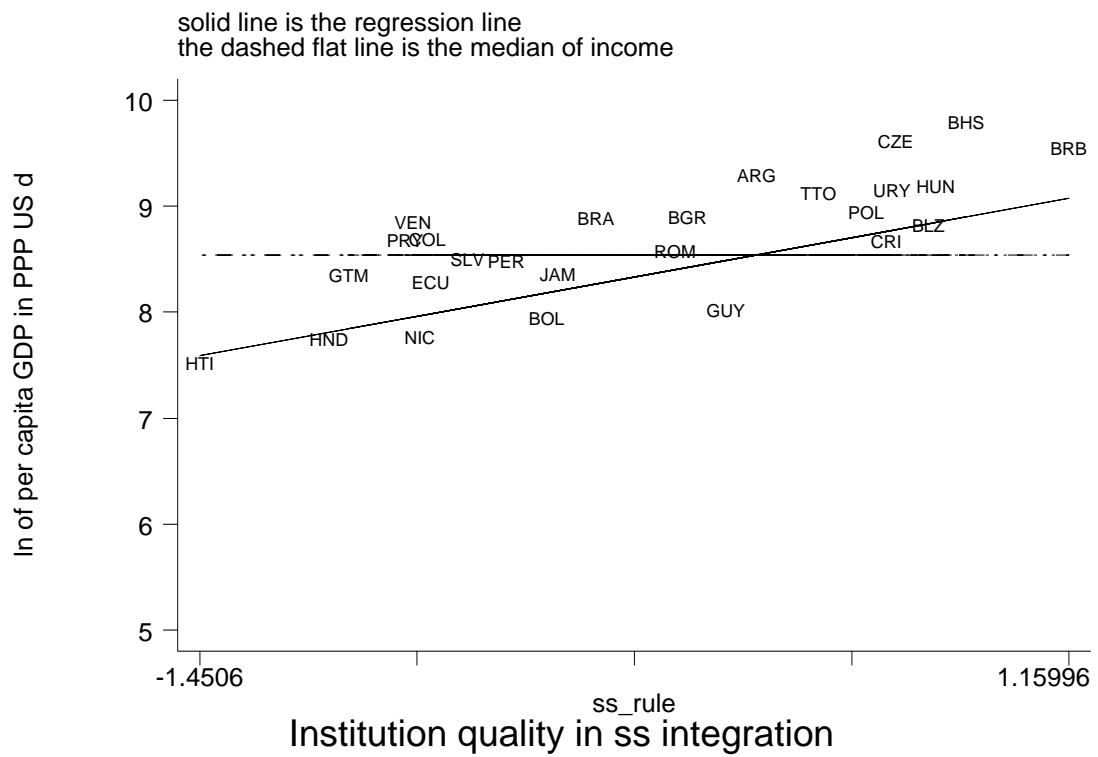Figure 3.1: The correlation between income and institutional inequality among NS integrated countries

Figure 3.2: The correlation between income and institutional quality among SS integrated countries

Table 3.1: Classification of RTAs according to the integration scheme (NS, NN, SS)

| Membership | RTAs | Year | Integration |
|---|---|---|---|
| Austria (1995),Belgium, Denmark (1973), Finland (1995), France, Germany, Greece (1981), Ireland (1973), Italy, Luxembourg, Netherlands, Portugal (1986), Spain (1986), Sweden (1995), United Kingdom (1973) | EC (European Community) | 1958 | NS |
| Canada, Mexico, USA | NAFTA (North America Free Trade Area) | 1994 | NS |
| EC + Iceland, Norway, (Liechtenstein) | EEA (European Economic Area) | 1973 | NS |
| Australia, New Zealand | CER (Closer Trade Relations Trade Agreement) | 1989 | NN |
| Iceland, (Liechtenstein), Norway, Switzerland | EFTA (European Free Trade Association) | 1960 | NN |
| Bolivia, Colombia, Ecuador, Peru, Venezuela | CAN (Andean Community) | 1988 | SS |
| (Antigua and Barbuda), Bahamas, Barbados, Belize, (Dominica), (Grenada), Guyana, Haiti, Jamaica, (Monserrat), Trinidad and Tobago, (St. Kitts Nevis), (St. Lucia), St. Vincent and the Grenadines Surinam | CARICOM (Caribbean Community and Common Market) | 1973/1997 | SS |
| Costa Rica El Salvador Guatemala Honduras Nicaragua | CACM (Central America Common Market) | 1961/1991 | SS |
| Argentina, Brazil, Paraguay, Uruguay | MERCOSUR (Southern Common Market) | 1991 | SS |
| (Estonia), (Latvia), (Lithuania) | BAFTA (Baltic FTA) | 1994 | SS |
| Bulgaria, Czech Republic, Hungary, Poland, Romania, (Slovak Republic), (Slovenia) | CEFTA (Central European FTA) | 1993 | SS |

Legend: Membership lists the countries joined in each of the RTA. A Parenthesis around a country indicates that it is not in the sample used in my estimation, although it is part of the agreement. The year in parenthesis next to a country indicates the year of its accession into the agreement, if different from the founding date.

Source: WTO

Table 3.2: Descriptive Statistics

**All sample**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| (y) lcgdp95 | 140 | 8.4 | 1.14 | 5.77 | 10.45 |
| NS | 140 | 0.14 | 0.35 | 0 | 1 |
| NN | 140 | 0.04 | 0.19 | 0 | 1 |
| SS | 140 | 0.19 | 0.39 | 0 | 1 |
| (G) disteq | 140 | 23.6 | 16.29 | 0 | 64 |
| (T) lnopen | 140 | 4.01 | 0.57 | 2.55 | 5.78 |
| (R) rule | 140 | 0.09 | 0.94 | -2.09 | 1.91 |
| lnpop | 140 | 15.94 | 1.74 | 11.2 | 20.91 |
| lnarea | 140 | 11.05 | 2.18 | 4.8 | 15.97 |

**NS group**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| (y) lcgdp95 | 20 | 9.86 | 0.32 | 8.9 | 10.45 |
| NS | 20 | 1 | 0 | 1 | 1 |
| NN | 20 | 0.1 | 0.31 | 0 | 1 |
| SS | 20 | 0 | 0 | 0 | 0 |
| (G) disteq | 20 | 47.9 | 10.38 | 19 | 64 |
| (T) lnopen | 20 | 3.94 | 0.57 | 2.63 | 5.13 |
| (R) rule | 20 | 1.38 | 0.56 | -0.41 | 1.86 |
| lnpop | 20 | 16.38 | 1.72 | 12.5 | 19.39 |
| lnarea | 20 | 11.33 | 1.9 | 6.91 | 15.16 |

**SS group**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| (y) lcgdp95 | 26 | 8.62 | 0.59 | 7.46 | 9.73 |
| NS | 26 | 0 | 0 | 0 | 0 |
| NN | 26 | 0 | 0 | 0 | 0 |
| SS | 26 | 1 | 0 | 1 | 1 |
| (G) disteq | 26 | 21.31 | 15.02 | 0 | 52 |
| (T) lnopen | 26 | 3.97 | 0.57 | 2.62 | 4.85 |
| (R) rule | 26 | -0.12 | 0.72 | -1.45 | 1.16 |
| lnpop | 26 | 15.61 | 1.62 | 12.28 | 18.9 |
| lnarea | 26 | 10.81 | 2.12 | 5.11 | 15.01 |

Note: See the Data Appendix for a description of the variables. R (institutional quality), T (country's openness), G (geographic factors - i.e. distance from the equator), lnpop (logarithm of population) , lnarea (logarithm of a country's surface) , NS (dummy for NS integration), NN (dummy for north-north integration), SS (dummy for south-south integration).

Table 3.3: OLS estimation - Rodrik et. al. (2004) sample

dependent variable   log per capita PPP GDP 1995

|  | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| rule (R) | 0.82*** | 0.81*** | 0.85*** | 0.79*** |
|  | (0.08) | (0.08) | (0.09) | (0.09) |
| lnopen (T) | 0.14 | 0.17* | 0.38*** | 0.48*** |
|  | (0.10) | (0.09) | (0.11) | (0.14) |
| disteq (G) | 0.01*** | 0.01*** | 0.02*** | 0.01*** |
|  | (0.01) | (0.01) | (0.01) | (0.01) |
| NS |  | 0.28 | 2.63*** | 2.90** |
|  |  | (0.19) | (1.02) | (1.01) |
| NN |  | -0.05 | 2.93 | 5.17 |
|  |  | (0.29) | (5.73) | (5.72) |
| SS |  | 0.55*** | 2.81*** | 3.16*** |
|  |  | (0.13) | (0.97) | (0.96) |
| NSxR |  |  | -0.56** | -0.43 |
|  |  |  | (0.27) | (0.27) |
| NNxR |  |  | -0.17 | -0.99 |
|  |  |  | (3.32) | (3.27) |
| SSxR |  |  | -0.30 | -0.21 |
|  |  |  | (0.19) | (0.18) |
| NSxT |  |  | 0.43 | 0.52* |
|  |  |  | (0.28) | (0.28) |
| NNxT |  |  | -0.66 | -0.8 |
|  |  |  | (1.00) | (0.99) |
| SSxT |  |  | -0.57** | -0.65*** |
|  |  |  | (0.24) | (0.24) |
| ln pop |  |  |  | 0.11** |
|  |  |  |  | (0.05) |
| ln area |  |  |  | -0.07** |
|  |  |  |  | (0.03) |
| const | 7.42*** | 7.23*** | 6.30*** | 4.95*** |
|  | (0.44) | (0.42) | (0.48) | (1.09) |
| obs. | 140 | 140 | 140 | 140 |
| Adj R-squared | 0.7 | 0.73 | 0.76 | 0.77 |

Note: The list of regressors are: R (institutional quality), T (country's openness), G (geographic factors - i.e. distance from the equator), lnpop (logarithm of population) , lnarea (logarithm of a country's surface) , NS (dummy for NS integration), NN (dummy for north-north integration), SS (dummy for south-south integration), the interaction terms between the integration dummies with both R and T. Standard errors are reported parenthesis. Significance at 1%, 5%, 10% are denoted respectively by ***, **, *.

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