

# Regional Integration and the (Re)Location Choice of MNCs

Facundo Albornoz & Gregory Corcos\*  
DELTA (CNRS-EHESS-ENS), PARIS-Jourdan  
48, bd Jourdan 75014 Paris

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## Abstract

How does regional integration affect the location of MultiNational Companies, and member countries' investment incentives? The welfare effects of integration and subsidy competition are found to depend crucially on market structure, technological differences, ownership, positive externalities to the MNC's investment and the interplay between subsidies and tariffs. We show how Subsidy Competition may reduce welfare relative to the mutual interdiction of subsidies. We find justifications for intra-regional transfers and identify under which conditions the gain associated with supra-regional agreements increases with integration. We also identify conditions under which, with a local MNC in oligopoly, integration may reduce regional welfare.

JEL-Classification: F15, F21, F23

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## 1 Introduction

### 1.1 Preliminary discussion

This paper discusses the impact of regional integration on location decisions by Multi-National Companies (henceforth MNCs), and on the reaction of member countries to a potential relocation by those MNCs.

At various degrees of cooperation among partner countries, regional integration interacts with the decisions of MNCs in a complex manner. MNCs routinely exploit the possibility of relocation as a means of increasing their bargaining power over governmental agencies and labour unions. Casual evidence supporting this view abounds <sup>1</sup>.

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\*corcos@delta.ens.fr (Corresponding author). We gratefully acknowledge helpful suggestions and comments from Antonio Cabrales, Hector Calvo Pardo, Philippe Martin, Anne Perrot, Thomas Piketty, Bernard Salanié, Akiko Suwa, Jean-Philippe Tropicano and Thierry Verdier, as well as seminar participants at PARIS-Jourdan, CREST-LEI, and the ADRES Journées Doctorales. All errors remain ours.

<sup>1</sup>Two examples: VW threatens workers from its Spanish subsidiary to relocate its production in the Czech Republic unless they accept less advantageous labour contracts (*La Vanguardia*, 18th August 2002). Some subsidiaries of other MNCs in Argentina confront policymakers with the possibility of relocation in Brazil to obtain sectoral deregulation, exchange rate stability or reductions of the tax burden (*Página 12*, 23rd October 2000).

Indeed, there are many compelling arguments for governments to induce MNCs to locate production facilities in their country : job creation, fiscal revenue, technology transfer, externalities, improvement of the capital account.... Again, there is considerable evidence of countries using various instruments to attract FDI <sup>2</sup>. Competition between governments to attract FDI from such MNCs is commonplace ; competition also often arises between regions from the same country, not least in the US (as evidenced by Hines 1996), but also in China, in Brazil or in India (Oman 1999) <sup>3</sup>.

More specifically, member countries of regional agreements may compete for such investment through specific measures targeted at MNCs. But location or relocation decisions are themselves crucially affected by member countries' policies, particularly by trade policies. Therefore, in order to analyse the intra-regional competition for FDI, one must take into account the multidimensionality of member state policy, and in particular of the interaction between trade policy and specific investment-promotion measures.

Neary (2002) shows how further integration towards the completion of a single market may cause MNC location decisions to be determined by the interplay between a 'tariff-jumping motive' and an 'export-platform motive'. The tariff-jumping motive biases the location decision towards operating as many subsidiaries as there are countries in the single market, while the export-platform motive pushes for serving the whole market from a single member country. A prominent example is Mercosur. MNCs created subsidiaries in Brazil and Argentina in order to 'escape' trade protection and serve these two markets ; more often than not, those subsidiaries had similar operations, used similar technologies, and sold similar products. Regional integration (taking the form of a Customs Union in 1995) encouraged MNCs to use one of the member countries as an export platform. This coincided with a rise in the provision of investment incentives from member countries, most notably Argentina and Brazil<sup>4</sup>.

Member states naturally react to MNC decisions. Thus, the common interests that brought about regional integration or even bilateral trade agreements may be weighed against potential conflicts regarding location or relocation decisions by MNCs. Indeed, there has been a number of such conflicts in existing regional agreements <sup>5</sup>.

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<sup>2</sup>To focus on the European Union, Hanson (2001) mentions the case of job subsidies granted by the Irish government in 1995 to induce Citibank and IBM to locate database management activities. Germany also subsidised the location of a Motorola plant in Bavaria in 1998.

More than any other sector, the automobile industry provides with numerous examples. Giving some historical perspective, Oman (1999) observes exponential growth in investment incentives over the last 20 years : in the early 1980s a typical Japanese company investing in the US would receive around 15000 dollars per worker as a subsidy. In contrast, Alabama accepted to pay as much as 168000 dollars per worker in 1993 to Mercedes-Benz, and Volkswagen received as much as 340000 dollars per worker in Brazil in 1996. Some cases are more intimately linked with regional integration, as mentioned by Hanson (2001), e.g. tax reductions granted to Ford and VW by Portugal in 1991 or to Honda by Turkey in 1996.

<sup>3</sup>In practice, many countries do offer MNCs investment incentives, which we may classify into three broad categories, following Oman (1999). Firstly, a large part of those incentives aim at reducing the cost of capital : this includes direct subsidies to a specific investment projects, the provision of loans or insurance at a preferential rate... Second, fiscal incentives play a major part, especially in developing countries : these include tax holidays, fiscal reductions on various tax bases (corporate sales, value added, profits, the wage bill...), accelerated depreciation regimes. Third, MNCs may also benefit from indirect subsidies, i.e. dedicated infrastructure or land, preferential treatment in government procurement, free consulting and administrative services, or even permissive competition regimes. A survey conducted by UNCTAD (1995) lists 99 countries using financial incentives, and 59 countries both for fiscal and indirect incentives.

<sup>4</sup>With, respectively 22% and 40% of FDI in the manufacturing sector being subject to incentives from the central State. Some sectors are more specifically targeted at by authorities, especially the automobile and the computer industry, as suggested by the creation of state-funded programmes dedicated to these industries (Chudnovsky and Lopez, 2001).

<sup>5</sup>As Toyota announced the building of a plant dedicated to the European market, many countries began

## 1.2 Related literature

Competition between countries for MNC location has been analysed both from a positive and a normative point of view by two complementary strands of literature, answering two questions : (1) do public incentives affect the location decision of MNCs<sup>6</sup>? and (2) beyond this empirical concern, does competition for firms improve economic welfare?

Empirical research answering the first question has confirmed economic intuition : governments succeed in influencing the location decision of firms by using various kinds of incentives. Hines (1996) compares the distribution of FDI among US States competing through tax reductions. He finds that percentage differences in the corporate tax rate are associated with differences up to 9-11% in the fraction of foreign investors (eligible to incentive provision) among all investors. This result suggests that in each State the tax rate significantly affects the structure of FDI in the US. Devereux and Pearson (1995) find similar results for Europe.

There have also been attempts to explain theoretically the impact of government intervention on firms' location decisions (i.e. the magnitude of the elasticity of investment w.r.t subsidies)<sup>7</sup>. Justifications for this stylised fact may be found in Black and Hoyt (1989) and Haaparanta (1996). These articles are related to the tax competition literature, as reviewed by Wilson (1999), that seeks to explain the effects of intergovernmental competition for mobile capital on the provision of public goods and overall efficiency, predicting suboptimally low tax rates and underprovision of public goods.

The second strand of literature addresses the welfare evaluation of competition among states. The results emerging from this literature do not seem to be robust to changes in the assumptions, in particular, they seem to hinge on which (positive) external effects of FDI are assumed. For instance Barros and Cabral (2000) focus on the reduction of unemployment allowed by the presence of FDI, an assumption justifiable in a partial equilibrium setting. In such a case the effect of competition will be positive since the country suffering the most from unemployment will have a higher willingness to pay for the location of the MNC, and therefore will win the bidding contest : the gain in employment will outweigh the expense in subsidies and competition will have a positive effect on allocative efficiency. Fumagalli (2003) develops a similar argument, adding positive technological externalities<sup>8</sup> and local competitors to the picture. She finds that with substantial technological differences between countries, the least advanced country should win the contest, as opposed to what would happen without incentives, and that should improve overall welfare. Besides, subsidies also bias the export vs. (extra-regional) FDI decision towards FDI, again improving regional welfare.

These papers succeed in capturing interesting features of the normative issue, but fail to give a general understanding of the problem. This would require a general framework adapting to bidding countries' specificities, making it possible to assess under which conditions subsidy competition should increase welfare w.r.t coordination as well as w.r.t non-intervention.

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to offer fiscal and financial incentives (*Financial Times*, 14 April 1997). A similar story involved ACER (*FT* 22 December 1997). The relocation of Hoover from France to Scotland was also suspected of 'social dumping' (Barros and Cabral, 2000).

<sup>6</sup>Note that we focus exclusively on direct investment, related to the decision of building productive facilities, thus leaving aside portfolio investment.

<sup>7</sup>See Devereux et Griffith (2002)

<sup>8</sup>The point of having positive technological externalities arising from FDI point is not exempt of controversy, (see Devereux and Griffith 2002), all the more in developing countries (Aitken and Harrison, 2002 and Chudnovsky and Lopez, forthcoming).

Moreover, the link between competition for MNCs' location and trade policy has been somewhat neglected by the literature. To be sure, the recent economic geography literature has emphasized how agglomeration effects, either in a core-periphery or in a 'footloose capital' framework, may matter for governments willing to tax mobile capital (see *inter alia* Baldwin and Krugman 2002, Ottaviano and van Ypersele 2002, Dupont and Martin 2003). Two important insights from these models are that that further integration makes firms even more responsive to profit differentials resulting from incentive provision, and that a core country may be able to set a limit tax barring investment in the periphery. These two interesting features will be present in our model, even though our focus is on MNCs, operating several subsidiaries in potentially several countries, rather than simple industrial firms.

Outside this research program, the only other paper specifically dealing with this issue, to the best of our knowledge, is Adams and Regibeau (1998). In this paper an endogenous tariff allows governments to alleviate the potential damage of subsidy competition, suggesting some substitutability between trade policy and investment policy in a non-cooperative context. However, their focus differs from ours as we are rather interested in reconsidering the benefits of exogenous regional integration, once relocation decisions and corresponding bidding wars are taken into account.

To summarize, the literature generally favours subsidy competition, but neglects the effects of trade liberalisation on the productive structure and ignore the interplay between investment promotion measures and trade policy.

To that purpose, we shall construct a general framework analysing how trade policy and investment incentives interact. As a first step, we model location decisions within a regional bloc in the absence of intervention (section 2), and then introduce the possibility of subsidy competition between member states (section 3). In section 4 we give an analytical treatment of a simple version of the model that predicts some form of complementarity between trade policy and investment incentives (section 5). In section 6 we perform a simulation exercise that enables us to address a large array of particular cases, adapting to various types of economic blocs and varying market structure. We treat the case of an extraregional MNC as well as that of a MNC originating from one of the member countries. Section 7 concludes.

## 2 A location model

### 2.1 Modelling strategy

Our problem allows for using a simple model. All we need, basically, is some sort of imperfect competition so that subsidies provided by governments affect equilibrium outputs. Our equilibrium concept will simply be a Cournot equilibrium with homogenous goods.

For the sake of simplicity we will model the region as a group of two countries, indexed by  $j = A, B$  competing to attract the investment of a MultiNational Company producing a single good. Extending to a larger number of countries or goods does not affect the main conclusions.

From our discussion of location decisions, we will restrict the location choice to a set of two location *regimes*, reflecting the conflicting influences of the tariff-jumping motive and the export-platform motive<sup>9</sup>.

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<sup>9</sup>In the case of a multi-product company, a third strategy, namely specialisation by product, should be considered. The single market would then be served from a different export platform for each product.

In section 6 we extend our model to an MNC producing two goods, labelled 1 et 2. Without loss of generality, we define *RC* as the location regime corresponding to the specialisation of country *A* in good 1

$$R_r = \begin{cases} U & \text{if the MNC keeps } \mathbf{operating} \\ & \mathbf{one subsidiary in each country} \text{ (} \mathit{ubiquity} \text{)} \\ C & \text{if the MNC chooses to } \mathbf{relocate its operations} \\ & \mathbf{in a single country} \text{ (} \mathit{concentration} \text{)} \end{cases}$$

By convention we will only allow for relocation in country  $A$ , which amounts to calling  $A$  the winning country whenever the bidding game comes out with the building of an export platform.

## 2.2 The model

We will assume segmented markets with a linear inverse demand function in each country, such that  $p^j = A - \bar{x}^j$ , where  $\bar{x}^j$  stands for total sales in country  $j$  and  $A$  represents the maximal willingness to pay for the good.

Production follows constant returns to scale, thus the MNC's total costs equal

$$C^j = \begin{cases} (\alpha^j + \beta^j) q^j & \text{to serve market } j \\ (\alpha^j + \beta^j + t) q^j & \text{to serve the other market} \end{cases} \quad (1)$$

where  $t$  is the Union's common internal *ad valorem* tariff, regional integration meaning a reduction of  $t$ . This parameter could also be interpreted as any unitary transaction or transport cost incurred by exporting.

The constant marginal cost may be decomposed between an exogenous firm-specific component,  $\alpha^j$ , and an endogenous country-specific component  $\beta^j$ . Our modelling choice will be to capture the role played by incentives with the  $\beta^j$  variable, which because of Cournot competition conditions equilibrium output and profits<sup>10</sup>.  $\beta^j$  therefore affects the location decision of the MNC and works as government  $j$ 's control variable<sup>11</sup>.

Profit may be written as:  $\Pi^{Rr} = \sum_j (A - \bar{x}^j) q^{j,Rr} - C^j$

The first order condition for profit maximisation yields :

$$q^{j,Rr} = A - \bar{x}^j - t - \alpha^{j,Rr} - \beta^{j,Rr} \quad (2)$$

Therefore equilibrium profit equals  $\Pi^{j,Rr} = (q^{j,Rr})^2$ . When a three-firm oligopoly with a MNC is considered, competing with one local firm from  $A$  and another local firm from  $B$ . Summing (2) for all firms, we compute industry output for each market :

$$\bar{x}^{j,Rr} = \frac{3A - 3t - \alpha^{j,Rr} - \bar{\alpha}_n - 3\beta^{j,Rr}}{4} \quad (3)$$

Plugging this last equation into (2) yields the MNC's Cournot equilibrium output:

$$q^{j,Rr} = \frac{A + t + \bar{\alpha}_n - 3\alpha^{j,Rr} - \beta^{j,Rr}}{4} \quad (4)$$

where  $\bar{\alpha}_n$  represents the marginal cost faced by both local competitors (symmetric in that respect). We may now deduce the MNC's regional profit as  $\Pi^{Rr} = \sum_j (q^{j,Rr})^2$

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and country  $B$  in good 2 (see Figure 9.1).

<sup>10</sup>It should be noted that in partial equilibrium, a lower marginal cost does not necessarily stem from lower factor rewards but could reflect superior factor productivity.

<sup>11</sup>In our partial equilibrium setting a marginal cost-reducing subsidy acts as a reduction of the cost of capital (with a linear homogenous production function), or any fiscal or indirect subsidy related to output. It should be noted that subsidy competition resulting in negative optimal subsidies (taxes), is not equivalent to fiscal competition, since this typically involves corporate profit taxes. This will be captured by our variable  $\varphi$ , as explained below.

### 2.3 The location decision without intervention

In this model imperfect competition may be represented in various forms. We choose to concentrate on the simple forms of monopoly of the MNC (market structure  $m$ ) and the above-mentioned three-firm Cournot oligopoly (market structure  $rlc$ ). For the sake of exposition we will here derive profits and determine the location choice in the  $rlc$  market structure<sup>12</sup>. We will shortly derive two intuitive propositions predicting the location choice as a function of country characteristics and market access restrictions.

We may now express profits according to the location decision

$$\begin{aligned}\Pi_{rlc}^{U,MNC} &= \Pi^{A,A} + \Pi^{B,B} \\ \Pi_{rlc}^{C,MNC} &= \Pi^{A,A} + \Pi^{A,B}\end{aligned}$$

with  $\Pi^{j,k}$  the profit from exports from country  $A$  to country  $B$ . The location decision of the MNC amounts to choosing  $Rr$  such that :

$$\Pi_{rlc}^{MNC} = Max(\Pi_{rlc}^{U,MNC}, \Pi_{rlc}^{C,MNC})$$

As the following proposition shows, the location decision is determined by regional characteristics and the internal tariff.

**Proposition 1** *When barriers to trade are sufficiently high, the MNC will always choose a symmetric location in both countries. In particular, there exists a threshold tariff  $\bar{t}$  whose value is determined by regional characteristics.*

**Proof.** To simplify notation, let us define  $a = A - 3\alpha^A + 2\bar{\alpha}_n + \beta^B - 2\beta^A$  and  $c = A - 3\alpha^B + 2\bar{\alpha}_n + \beta^A - 2\beta^B$ . More specifically in the three-firm oligopoly case we get  $\Pi_{rlc}^{U,MNC} = \left(\frac{a+t}{4}\right)^2 + \left(\frac{c+t}{4}\right)^2$  and  $\Pi_{rlc}^{C,MNC} = \left(\frac{a+t}{4}\right)^2 + \left(\frac{a-2t}{4}\right)^2$ . Let us call  $\chi_{rlc}^{-i}$  the profit differential  $\Pi^{Rr} - \Pi^{R-r}$ . Then :  $\chi_{rlc}^{UC} = \frac{1}{16} \left( (c+t)^2 - (a-2t)^2 \right)$ .

$\chi^{13}$  increases with  $t$  so that in autarky  $U$  is always preferred by the MNC. This is a very intuitive result : for a large enough tariff, the tariff-jumping motive dominates the export platform motive (as well as the specialisation motive in the two-good extension). When  $t$  belongs to the relevant interval, we may characterize the optimal location choice depending on regional characteristics. ■

**Proposition 2** *Regional integration, in the sense of a lowering of the tariff  $t < \bar{t}$ , involves a new location by the MNC, depending on regional characteristics. In a technologically homogenous region, the MNC will choose to operate two subsidiaries (location  $U$ ) ; when then region exhibits technological asymmetries, the MNC will choose to relocate production so as to run a single subsidiary (location  $C$ ).*

**Proof.** Consider full integration ( $t = 0$ ). Obviously  $a = c$  when technologies in each country are the same, therefore  $\chi^{UC}$  must equal zero in that case. In the case of an asymmetric region, we know that by convention  $\alpha^A = m\alpha^B$  et  $\beta^A = p\beta^B$  with  $m, \text{ and } p \in [0, 1)$ . Clearly  $a > c$  and finally  $\chi_{rlc}^{UC} = \frac{1}{16} (c^2 - a^2)$  is negative. ■

## 3 Introducing Subsidies

In the previous section we constructed a theoretical framework enabling us to analyze the location decision in the absence of intervention : hereafter we shall refer to this situation

<sup>12</sup>Detailed calculations and comparisons of profits in the 2x2 (market structure  $x$  type of region) array of cases are available upon request.

as our Benchmark Case. This situation amounts to mutual interdiction of investment incentives<sup>13</sup>.

We will now be introducing government intervention. The subsidy choice will affect the marginal cost through  $\beta_j$  which we decompose as :

$$\beta_j = \beta_j^* + s_j \quad j = A, B$$

Normalising  $\beta_j^*$  (the exogenous country-specific component) to zero, we obtain a purely endogenous and non-cooperatively chosen country-specific component :  $s_j$  the amount of the *ad valorem production subsidy*.

We now consider Subsidy Competition between governments  $A$  and  $B$  using such subsidies decrease the value of  $\beta^j$ . We would like to compare this non-cooperative outcome with two other polar political contexts, namely the Benchmark Case (mutual interdiction) and a reciprocal commitment to choose subsidies that maximise *regional* welfare, which we will call 'Policy Coordination'. The latter agreement mimicks what would happen if the two countries had delegated investment promotion measures to a benevolent supranational authority.

We will thus be interested in welfare comparisons between Competition, the Benchmark Case and Coordination.

### 3.1 The Subsidy Competition game

Our goal is to establish how subsidy competition affects the choice between locations U,S and C, rather than to define the identity of the country where the MNC will concentrate its operations<sup>14</sup>.

#### 3.1.1 Formalisation

We choose to model subsidy competition as a two-stage non-cooperative game between governments and the MNC :

- In the first stage, governments simultaneously and non-cooperatively choose and commit to subsidy levels  $s_A$  and  $s_B$  to influence the location decision.
- In the second stage, the MNC chooses its location  $R$  among the set of location alternatives  $\{U, C, S\}$ .

This formalisation should capture both the non-cooperative aspect of subsidy competition and the ability enjoyed by governments to credibly commit to a certain amount of subsidies<sup>15</sup>.

The solution to that game will be denoted by a *triple* composed of a location regime chosen by the MNC and two amounts of unit subsidies offered by the governments  $\{R, s_A, s_B\}$ . We now turn to the governments' objective to characterize the set of optimal subsidies.

<sup>13</sup>Our Benchmark Case may suitably be described as 'harmonisation' of production subsidies to zero.

Imperfect competition in our implies that zero subsidies will presumably suboptimal. Still, we consider this alternative not on the basis of welfare maximisation but rather on the grounds of political feasibility. Besides, it is also consistent with principles underlying multilateral trade negotiations.

<sup>14</sup>This is a major difference with Barros et Cabral (2000) and Fumagalli (2003). From this point of view our work has more generality.

<sup>15</sup>We assume away the credibility issue, even though in one case government  $A$  might be tempted to renege on its commitment. In real economic situations reputational concerns w.r.t potential investors (out of the scope of this paper) may arguably be enough to alleviate the credibility problem.

### 3.1.2 Welfare-maximising governments

We consider the governments of countries  $A$  and  $B$  as two perfectly informed central authorities willing to maximise national welfare. We will use the most general objective functions : national welfare will amount to the sum of consumer surplus, local producers' surplus, some part of the MNC's producer surplus, and government surplus, i.e. tariff revenue minus the cost of subsidies<sup>16</sup>. Formally for two distinct countries  $j$  and  $k$

$$W^j(R_r, s_j, s_k) = \underbrace{\frac{1}{2}(\bar{x}^j)^2}_{c.surplus} + \underbrace{\varphi\pi^{MNC,j} + \pi^{lc,j}}_{p.surplus} + \underbrace{t(m^{mnc,j} + q^{rc,j}) - s_j q^j}_{gvt.surplus} \quad (5)$$

where  $m^{mnc,j}$  represents imports from the foreign subsidiary of the MNC, if any, from the point of view of country  $j$ .

Recalling that the MNC is extra-regional, only a part of its profits enters the national welfare function of governments  $A$  and  $B$ . We parametrise by  $\varphi$  the ability of nation  $j$  to appropriate some part of the MNC's profit as national welfare. This may be interpreted in several interesting ways. In the case of an extraregional MNC,  $(1 - \varphi)$  would then measure the (identical) profit repatriation rate<sup>17</sup>. A natural interpretation of  $\varphi\pi^{MNC,j}$  could be profit tax revenue ;  $\varphi\pi^{MNC,j}$  could also be thought of as any non-appropriable externality to country  $j$ , whose generating process we do not model. For instance  $\varphi\pi^{MNC,j}$  could be the benefit from an investment in training the local workforce, should that investment be proportional to profit by the factor  $\varphi$ .

Three remarks are in order. First, the choice of the objective function crucially affects the results. We attempt to be as general as possible, while Barros and Cabral (2000) only consider consumer surplus and Fumagalli (2003) uses the sum of consumer surplus and local competitors' profits. Second, we consider national welfare without imposing a budget constraint on the government : the budget will be balanced as long as the government may tax the other surpluses in a lump-sum fashion. Third, taxation in the model follows the 'source principle', i.e. profit is taxed where the source activity takes place, rather than in the residence country of the MNC owners, hence the superscript  $j$  to the MNC's profit.

### 3.1.3 Equilibrium subsidies

The two-stage game is solved by backward induction.

**In the second stage** The MNC chooses its location so as to maximize its regional profits, which we may write as the best-reply function

$$R^* = R(s_A, s_B)$$

satisfying

$$\Pi^{MNC}(s_A, s_B, R^*) \geq \Pi^{MNC}(s_A, s_B, R)$$

for all  $R \neq R^*$ .

<sup>16</sup>Using Marshallian surplus to evaluate social welfare makes sense as long as income effects associated with the goods under study are negligible (see Vives 1999, chapter 3, for a general equilibrium rationalization of this approach). Besides, the implicit quasi-linear specification of utility makes welfare commensurate in monetary units, and so that summing surplus and fiscal revenues makes sense.

<sup>17</sup>Interpretations of imperfect repatriation involving institutional or technical factors must be consistent with our assumption of countries of identical size. Therefore we find it natural to assume identical  $\varphi$ 's for the two countries.

**In the first stage** Governments choose subsidy levels simultaneously. We will find two subgame-perfect equilibria.

As a preliminary step, define as  $s_j^{opt}(R)$  the subsidy maximising the national welfare function of country  $j$ , for a given location regime  $R$  :

$$s_j^{opt}(R) = s_j^{opt} \left( s_{k \neq j}^{opt}, R \right) = \arg \max_s W^j(s, s_k^{opt}, R(s, s_k^{opt})) \quad (6)$$

For both countries we obtain a triple of (nationally) "optimal" subsidies <sup>18</sup>. We may pause here to make the following remarks.

**Remark 1** "Optimal subsidies" (nationally optimal subsidies, conditional on regime  $R$ ) correspond to the Nash equilibrium subsidies of the simultaneous game between governments and the MNC. In the sequential game, they belong to the equilibrium set.

This means than restricting our analysis to 'nationally optimal' subsidies would be tantamount to solving a simultaneous game. By emphasizing our predictions when subsidies are not of the 'nationally optimal' type, we will be able to identify the role of the commitment capacity of governments.

**Remark 2** The value of the optimal subsidy set by one country does not depend on the subsidy offered by the other country. At the margin, an increase in the subsidy of one country does not **directly** affect the subsidy choice of the other country. However, such an increase indirectly affects the subsidy decision through its influence on the second-stage decision of the MNC.

This observation stems from the assumption of segmented markets, whereby the quantity sold in a market does not affect the price on the other market. Consequently, there is no product term in the the derivatives of the welfare functions w.r.t subsidies, therefore no apparent strategic substitutability or complementarity. The familiar graphic plotting best-reply functions in the subsidy space, conditional on a given regime, should exhibit a vertical and a horizontal line.<sup>19</sup>

Obviously, there may be other subsidies, outside this set of 'optimal subsidies', that give higher national welfare to some government if it induces the MNC to choose a more desirable location (from the point of view of that government). Consider the following definition :

**Definition 1** We call 'decisive subsidy'  $s_A^{dec}(C)$  the minimal subsidy such that the MNC chooses regime  $C$ , while giving country  $A$  the highest value of welfare under that constraint. This constrained optimum differs from the global national optimum reached with  $\{s_A^{opt}(R), s_B^{opt}(R)\}$  but not available because of the participation constraint of the MNC.

Formally, we may define  $s_A^{dec}(C)$  in two steps. Let us first define  $\tilde{s}(C, R')$  the amount of subsidy such that :

$$\forall R', \Pi^{MNC}(\tilde{s}(C, R'), 0, C) = \Pi^{MNC}(s_A^{opt}(R'), s_B^{opt}(R'), R')$$

By construction  $\tilde{s}(C, R')$  makes the MNC indifferent between regime  $C$  and another regime  $R'$  (ubiquity ou specialisation) with 'nationally optimal' subsidies. This condition

<sup>18</sup>A full characterization of  $\{s_A^{opt}(R), s_B^{opt}(R)\}$  is available upon request

<sup>19</sup>Values of regionally and nationally optimal subsidies are available upon request.

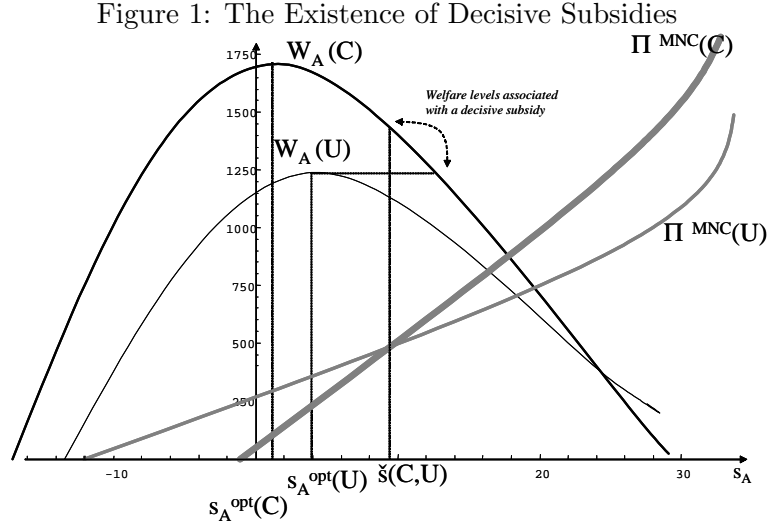
amounts to a participation constraint for the MNC to accept regime C. We may then define

$$s_A^{dec}(C) = \tilde{s}(C, R') + \varepsilon$$

with  $\varepsilon$  arbitrarily small.

The possibility to resort to this decisive subsidy comes from the commitment capacity of governments to offer generous subsidies so that all MNC operations be concentrated on their soil. Its existence depends on the mismatch between the MNC's preferred location and the welfare-maximising choice. Whenever the welfare-maximising regime is not maximising regional profits with 'nationally optimal' subsidies, a higher subsidy may overturn the MNC's choice so as to align it with the constrained national optimum.

This may be seen on Figure 1 below, plotting, profits and welfare functions against  $s_A$ . It illustrates how country A may obtain concentration on its soil by offering a nationally suboptimal subsidy, while the MNC would have chosen the ubiquity regime with 'nationally optimal' subsidies. On the graphic we may see that the subsidy maximising A's welfare in the concentration regime (the highest bell curve) brings lower profits to the MNC than the subsidy maximising A's welfare in the ubiquity regime (the second bell curve). Therefore, absent a decisive subsidy, the MNC would have chosen regime U. By construction, the decisive subsidy makes the MNC slightly in favor of regime C, while making country A better off.



In order to solve the sequential game between governments and the MNC, we must assess the existence of decisive subsidies, since by construction they are subgame-perfect. We will therefore have two types of subgame-perfect equilibria, either with 'nationally optimal' subsidies, or with decisive subsidies.

### 3.2 Policy Coordination between States

We began this section by announcing a comparison between three institutional settings : the mutual interdiction of subsidies (Benchmark Case), Subsidy Competition and Policy Coordination. Before we undertake this comparison (see next section), we must describe Policy Coordination.

We will proceed by determining the amounts of subsidies that maximise regional welfare, which are the amounts that a benevolent supranational authority would set. In our

view, a coordination agreement would mimick the decision of the regional planner. We shall treat problems related with the implementation of the regional optimum later on, when we address the possibility of transfers between member countries.

'Regionally optimal' subsidies, conditional on each regime, are denoted by  $s_j^{reg}(R)$  so that :

$$\{s_j^{reg}(R), s_k^{reg}(R)\} \in \arg \max_{s_j(R), s_k(R)} \{W_A(s_A(R), s_B(R), R) + W_B(s_A(R), s_B(R), R)\}$$

with  $R = U, S, C$

We are now ready to begin our analysis of location decisions with subsidies <sup>20</sup>.

## 4 A simple model : the case of a monopoly MNC producing a single good

A simple version of the location model suffices to illustrate the complexity of the relationship between regional integration, investment subsidization and profit repatriation. We will consider an *extraregional* MNC enjoying a monopoly (market structure  $m$ ) producing a single good, therefore confronted with two location alternatives  $U$  and  $C$ .

We intend to compare both the effect of subsidy competition on welfare as regional integration develops, and the overall welfare effect of integration once potential subsidy competition is taken into account. Our reasoning will follow three steps. First, we shall characterize optimal subsidies for each location regime and derive the subgame-perfect optimal location. Second, we will compare all possible agreements between countries. Finally, we will assess the overall welfare effect of integration.

### 4.1 Optimal subsidies

Under the ubiquity regime ( $U$ ), the MNCs operates one subsidiary in each country and sells locally, therefore output is independent of integration. Given (5), national welfare of country  $j = A, B$  may be written as :

$$W^j(U) = \left(\frac{1}{2} + \varphi\right) \frac{1}{4} (A - \alpha^j - \beta^{*j} + s^j)^2 - s^A \left(\frac{A - \alpha^j - \beta^{*j}}{2}\right),$$

and the optimal subsidy equals :  $s^j(U) = \frac{\varphi - \frac{1}{2}}{\frac{3}{2} - \varphi} (A - \alpha^j - \beta^{*j})$

Under the concentration regime ( $C$ ), welfare from the host country may be written as

$$W^A(C) = \left(\frac{1}{2} + \varphi\right) \frac{1}{4} (A - \alpha^A - \beta^{*A} + s^A)^2 + \frac{\varphi}{4} (A - \alpha^A - \beta^{*A} + s^A - t)^2 - s^A \left(A - \alpha^A - \beta^{*A} + s^A - \frac{t}{2}\right),$$

so that the optimal subsidy equals  $s^A(C) = \frac{t(\frac{\varphi}{2} - \frac{1}{2}) - (\varphi - \frac{3}{4})(A - \alpha^A - \beta^{*A})}{(\varphi - \frac{7}{4})}$

In that location regime the optimal subsidy depends on  $t$  as well as  $\varphi$ . We may now establish the following Lemma.

<sup>20</sup>In an omitted subsection available upon request we compute the values of regionally optimal subsidies and compare them with 'nationally optimal' subsidies in all possible localisation regimes.

**Lemma 1** *Under the ubiquity regime, the sign of the optimal subsidy depends on the spillover/repatriation parameter  $\varphi$  : whenever  $\varphi$  is large (higher than  $\frac{1}{2}$ ) the subsidy is positive, otherwise the optimal subsidy is a tax.*

*Under the concentration regime, the sign of the optimal subsidy depends on the relationship between tariffs and the repatriation rate. The optimal subsidy will be positive for low values of  $t$  whenever  $\varphi$  is high  $\left(\varphi > \frac{3(A-\alpha^A-\beta^{*A})-2t}{4(A-\alpha^A-\beta^{*A})-2t}\right)$ . For higher values of the tariff, the constraint on  $\varphi$  will be laxer, and there will be positive subsidies for ever lower values of  $\varphi$ .*

**Proof.** Let's analyse first the case under (U). If  $\varphi = 1$  then  $s^j = (A - \alpha^A - \beta^{*A}) > 0$  ; if  $\varphi = 0$  then  $s^j = -\frac{1}{3}(A - \alpha^A - \beta^{*A}) < 0$ ; finally if  $\varphi = \frac{1}{2}$ , then  $s^j = 0$ . Besides  $s^j$  is monotonically increasing in  $\varphi$ ,  $s^j = (A - \alpha^A - \beta^{*A})f(\varphi)$  with  $f'(\varphi) = \frac{2}{(\frac{3}{2}+\varphi)^2} > 0$ . If under (C)  $s^{A,3} = 0, (\varphi - 1)\frac{1}{2}t + (\frac{3}{4} - \varphi)(A - \alpha^A - \beta^{*A}) = 0 \Rightarrow \varphi((A - \alpha^A - \beta^{*A}) - \frac{t}{2}) = -\frac{1}{2}t + \frac{3}{4}(A - \alpha^A - \beta^{*A})$ . Given that  $((A - \alpha^A - \beta^{*A}) - \frac{t}{2}) < 1$ , the sign of the optimal subsidy will be positive if  $\varphi > \frac{3(A-\alpha^A-\beta^{*A})-2t}{4(A-\alpha^A-\beta^{*A})-2t}$ . ■

## 4.2 Location choice of the MNC

In the simple case of a MNC selling a single good in monopoly, Propositions 1 and 2 remain valid. We thus know the location decision in the Benchmark Case. Let us look now at the location decision under subsidy competition. Profits equal

$$\begin{aligned}\Pi(U) &= \frac{1}{4}((A - \alpha^A - \beta^{*A} + s^A)^2 + (A - \alpha^B - \beta^{*B} + s^B)^2) \\ \Pi(C) &= \frac{1}{4}((A - \alpha^A - \beta^{*A} + s^A)^2 + (A - \alpha^A - \beta^{*A} + s^A - t)^2)\end{aligned}$$

Writing  $\Delta = \Pi(U) - \Pi(C)$ , we are in a position to state the location decision.

$$R = \begin{cases} U \text{ (ubiquity) if } \bar{\Delta} \geq 0 \\ C \text{ (concentration) if } \bar{\Delta} < 0 \end{cases}$$

The location decision hinges on the technological attributes of the two countries<sup>21</sup>, as shown in the following Proposition.

**Proposition 3** *With Subsidy Competition, the location choice depends on the extent of regional integration, on the technological gap between member countries, and on the spillover/repatriation parameter. More precisely :*

1. *Without regional integration, the MNC will always choose the ubiquity regime.*
2. *For technologically similar countries, regional integration will not affect the MNC's location choice.*
3. *For technologically asymmetric countries, irrespective of the size of the gap, regional integration will not affect the location choice as long as the MNC profits are important enough to the national social planner.*

<sup>21</sup>We shall find it easier to normalise  $\alpha^A = \alpha^B$  to zero (an innocuous assumption in a linear-demand constant-marginal-cost Cournot oligopoly) and suppose that  $\beta^{*A} = 0, \beta^{*B} = b$ , so that  $\bar{\Delta} = \frac{1}{4}((1 + \Psi)^2(A^2 + (A - b)^2) - ((1 - \Phi)A + t\Omega)^2 - ((1 - \Phi)A + t(\Omega - 1))^2)$ , where  $\Omega = \frac{2\varphi-2}{4\varphi-7}$ ,  $\Phi = \frac{4\varphi-3}{4\varphi-7}$ ,  $\Psi = \frac{2\varphi-1}{3-2\varphi}$ . This enables us to focus on marginal cost differences that merely depend on government intervention.

4. *Whenever MNC profits are not important enough to the national social planner, the MNC will relocate its operations in the technologically advanced country only for a large enough technological gap (e.g.  $b > 0.31A$  for  $\varphi = 0$ )*

**Proof.** Notice first that for a sufficiently high value of tariffs regime C is not viable, since the profits of exporting from A to B become negative. (in this case profits become negative for  $t > A - s$ .)

Take now the case of a low rate of repatriation ( $\varphi = 1$ ). In this case,  $\Delta = \frac{40}{9}A^2 - 8Ab + 4b^2 + \frac{8}{3}At - t^2$  is always positive independently the degree of regional asymmetry (notice that  $b$  must be always lower than  $A$  for a positive production under monopoly).

Consider now the opposite case ( $\varphi = 0$ ). Delta becomes  $\frac{104}{441}A^2 - \frac{8}{9}Ab + \frac{4}{9}b^2 + \frac{24}{49}At - \frac{29}{49}t^2$ . If  $b < A - \frac{1}{14}\sqrt{(92A^2 - 216At + 261t^2)}$  then  $\Delta$  is positive. If the region is very asymmetric delta will be negative which means that the MNC will concentrate its production. ■

This results shows how regional integration exacerbates subsidy competition, which in turn affects the MNC's location choice. Only for a large enough technological asymmetry between countries do subsidies induce relocation towards the most efficient regime. We term the resulting location behaviour "excess inertia", in the sense that subsidy competition annihilates the original export-platform motive for relocation associated with regional integration. We summarize location decisions in the following tables.

	<b>Benchmark Case</b>	Hom. Region	Asym. region
	$\varphi = 1$	<i>ubiquity</i>	<i>concentration</i>
	$\varphi = 0$	<i>ubiquity</i>	<i>concentration</i>
	<b>Subsidy Competition</b>	Hom. region	Asym. Region
	$\varphi = 1$	<i>ubiquity</i>	<i>ubiquity</i>
	$\varphi = 0$	<i>ubiquity</i>	small gap    large gap <i>ubiquity</i> <i>concentration</i>

Our analysis of location decisions so far has been correct only if subsidies are given by  $\{s_A^{opt}(U), s_B^{opt}(U)\}$  or  $\{s_A^{opt}(C), s_B^{opt}(C)\}$ . Whenever subgame-perfect subsidies differ from these values (the 'decisive subsidies' case, as mentioned in the previous section) the concentration regime will always be chosen. This motivates the following Remark :

**Remark 3** *Decisive subsidies are typically not available in the case of a monopolistic MNC selling one good. They may be sustained at the subgame perfect equilibrium only for extremely high values of the technological gap between countries (this requires  $b > 0.846A$  when  $\varphi = 1$ ).*

**Proof.** See Appendix. ■

### 4.3 Welfare effects of Subsidy Competition

Under autarky the MNC will always choose the ubiquity location. In a technologically homogenous region, the location choice will remain unchanged by integration, so that by construction optimal subsidies can only improve national welfare w.r.t the Benchmark Case. In a technologically asymmetric region, the analysis is less clear-cut. We shall formalise it in the following Proposition.

**Proposition 4** *In a technologically asymmetric region, the effects of subsidy competition on national welfare and regional welfare w.r.t. our Benchmark Case depend on the profit repatriation rate and the size of the technological gap. In particular :*

1. For a weak enough repatriation rate and a high enough technological asymmetry, (e.g.  $b > 0.3A$  if  $\varphi = 1$ ), subsidy competition worsens regional welfare w.r.t. our zero subsidies benchmark. For smaller values of the technological gap subsidy competition increases regional welfare but *ex post* transfers are necessary to compensate for country A's loss.
2. For a high enough repatriation rate, subsidy competition increases regional welfare conditional on the existence of transfers to the losing country.

**Proof.** See Appendix 9.2 ■

Typically nationally optimal subsidies imply excess inertia in the location decision : this entails gains and losses that will be diversely enjoyed by member countries. We refine the analysis by defining one possible instrument of member countries' solidarity.

**Definition 2** *An intra-regional transfer is a lump sum transfer from one member country to another, compensating exactly for the latter's losses.*

With a low repatriation rate and substantial technological asymmetry, excess inertia is costly in terms of welfare, since local production in the less advanced country is inefficient, and even suboptimal w.r.t. the Benchmark Case. For limited technological asymmetry the region as a whole gains but country A must be compensated for not hosting all MNC operations.

With a high repatriation rate, national subsidies are beneficial to the region as a whole. Indeed, the MNC will relocate, and since this would happen in the Benchmark Case, by revealed preference this must be nationally advantageous for country A. Country B will enjoy a welfare loss since for high repatriation rates national subsidies are negative (i.e. taxes). While we obtain a globally beneficial effect, transfers are necessary for a Pareto-improvement.

In our setting welfare effects of subsidy competition may not be positive, unlike previous findings in the literature. These results originate from contradictory effects of relocation. For a low enough  $\varphi$ , relocation occurs : in each type of region, country B's welfare function simply boils down to consumer surplus. But given  $\varphi$  optimal subsidies are taxes and therefore harm the consumer w.r.t. to the Benchmark Case. The final outcome depends on technological possibilities. In a homogenous region, the gains enjoyed by the other country are therefore not sufficient to offset B's loss for a low enough  $\varphi$ , which explains the regional loss. In an asymmetric region, the final effect will be positive, thanks to additional gains in productive efficiency (from moving production to the country where the MNC produces more efficiently).

For larger values of  $\varphi$  there won't be any relocation, so that optimal subsidies will always increase welfare, as in autarky.

#### 4.4 Autarky vs. Integration

The welfare evaluation of the integration process must account for the possibility of subsidization and relocation ; this is the object of this subsection. Our theoretical framework allowed for gains from trade only through two channels : first, the possibility of efficient relocation exploiting productivity or factor reward differentials ; second, increased competition from a potential (foreign) local competitor. In this section, we focus on the first channel, in a monopolistic model with two possible types of regions. As mentioned above, whatever the type of region, the MNC will not relocate its operations for high enough values of  $\varphi$  i.e. the location decision will not be affected by integration (excess inertia).

By construction, integration under subsidy competition will be Pareto-indifferent. In contrast, for low enough values of  $\varphi$  we must distinguish between homogenous and asymmetric regions.

**Proposition 5** *Regional integration under subsidy competition involves a change in welfare only if there is a substantial technological gap between member countries and significant profit repatriation. In that case integration increases regional welfare. However, there will not be any Pareto-improvement unless the size of the technological gap is very large.*

**Proof.** See Appendix 9.2. ■

In our very simple setting, subsidy competition makes regional integration most of the times harmless but ineffective, neutralising relocation opportunities. Whenever relocation is still profitable, the region enjoys some productive efficiency gain, but that gain must be very large for the abandoned country to benefit from integration. Otherwise, intra-regional transfers are deemed necessary.

## 4.5 Gains to regional coordination and the extent of integration

As we just saw, the harmonisation of investment incentives is typically Pareto-dominated by Subsidy Competition. Let us now consider a more advanced level of coordination involving the determination of a regionally optimal level of subsidies by a supranational authority. How does the benefit from creating such a supranational agency vary with increasing integration?<sup>22</sup> To answer this question, we need study how the regional welfare improvement upon Subsidy Competition is affected by a change in the internal tariff.

### 4.5.1 The location decision

To determine the outcome of regional planning, we derive the regionally optimal subsidy pair  $\{s_A^{reg}(R), s_B^{reg}(R)\}$  maximising the sum of national welfare functions, for each possible location regime, and examine the MNC's decision. Calculations are given in Appendix 9.2. We may summarize location decisions in the following table

	Subsidy Competition	Regional Planning
Homogenous region		
$\varphi = 1$	<i>ubiquity</i>	<i>concentration</i>
$\varphi = 0$	<i>ubiquity</i>	<i>concentration</i>
Asymmetric region		
$\varphi = 1$	<i>ubiquity</i>	<i>concentration</i>
$\varphi = 0$	depends on $b$	<i>concentration</i>

Regional subsidies allow the MNC to build an export platform, compensating for any internal tariff. To the contrary, nationally optimal subsidies typically induce the MNC to choose the ubiquity regime since countries enjoy welfare gains from the presence of the MNC.

### 4.5.2 Do more open economies benefit more from policy coordination ?

We are now equipped to answer our main question in this section. The following Proposition states that falling trade barriers increase the welfare gain associated with regional coordination.

**Proposition 6** *Further integration (in the sense of a lowering of tariff  $t$ ) typically increases the gain to resorting to policy coordination, i.e. the difference in regional welfare between policy coordination and subsidy competition. More precisely :*

- a) *For high values of the profit repatriation rate (low  $\varphi$ ) and a large enough technological gap (high  $b^B$ ), the gain to coordination increases with  $t$ .*
- b) *In all other cases, a falling internal tariff increases the gain to coordination.*

<sup>22</sup>We are grateful to Philippe Martin for suggesting us to address this question.

**Proof.** The gain to coordination may be written as

$$\begin{aligned} \Gamma(C, R') &= \left[ W^A (C, s_A^{reg}(C), s_B^{reg}(C)) + W^B (C, s_A^{reg}(C), s_B^{reg}(C)) \right] \\ &\quad - \left[ W^A (R', s_A^{opt}(R'), s_B^{opt}(R')) + W^B (R', s_A^{opt}(R'), s_B^{opt}(R')) \right] \end{aligned}$$

with  $R'$  the MNC's location regime with nationally optimal subsidies. Whenever  $R' = U$ , the second part of  $\Gamma(C, U)$  does not depend on  $t$ . In contrast, the first part does depend on  $t$ : it is a decreasing function of  $t$ . Therefore  $\frac{\partial \Gamma(C, U)}{\partial t} \leq 0$

$\Gamma(C, C)$  is less straightforward to compute. We know that regime C obtains when  $\varphi$  is low and  $b^B$  is high. In the case where  $\varphi = 0$ , this yields

$$\Gamma(C, C) = \frac{1}{3}A^2 - \frac{3}{16}t^2 - \left( \frac{16}{49}A^2 - \frac{3}{98}tA - \frac{87}{392}t^2 \right) = \frac{1}{147}A^2 + \frac{27}{784}t^2 + \frac{3}{98}tA$$

which is obviously increasing with  $t$ . ■

Our result shows that the gain to the coordination of subsidization policies *gradually increases as regional integration proceeds*. Intuitively, an export platform strategy becomes more attractive with deeper regional integration, which raises the payoff to reorganizing the MNC's regional production facilities into a single location through subsidies. In contrast, under subsidy competition the MNC chooses ubiquity, so that regional welfare does not depend on trade openness. In that sense subsidy competition eliminates some new location possibilities made possible by integration.

This property does not hold in the particular case of a high repatriation rate and a large technological gap between countries. In that case indeed both cooperative and non-cooperative subsidies make the concentration regime more advantageous for the MNC: subsidy competition does not prevent the MNC from exploiting the new location possibility made available by regional integration. Thus given that non-cooperative subsidies raise the level of exports relative to cooperative subsidies, it comes as no surprise that falling trade barriers make for higher welfare gains under subsidy competition than under coordination.

The creation of a supranational institution coordinating subsidy expenses among member States should be all the more desirable as regional integration proceeds. Considering trade policy in conjunction with related policies such as investment incentives, this result confirms that the interaction between both policies may raise the payoff to implementing one particular policy. We are now bound to examine more rigourously this interaction.

## 5 The interaction between tariff and subsidies

We are interested in understanding how the liberalisation of regional trade interacts with subsidization measures. Technically, we would like to know how optimal subsidies vary with exogenous changes in the tariff. This leads us to the two following Propositions:

**Proposition 7** (*Interaction between the tariff and cooperative subsidies*). *Regionally optimal subsidies offered to an extra-regional MNC typically exhibit some complementarity with the internal tariff, in the sense that subsidies increase with the exogenously set tariff.*

- a) *Under monopoly, subsidies are complementary with the tariff.*
- b) *Under oligopoly, subsidies are complementary except for low values of the repatriation rate, in the ubiquity regime.*

**Proof.** See Appendix9.6 ■

**Proposition 8** (*Interaction between the tariff and non-cooperative subsidies*).

*There is always substitutability between the internal tariff and nationally optimal subsidies offered to an extra-regional MNC, in the sense that subsidies decrease with the exogenously set tariff.*

**Proof.** See Appendix 9.6 ■

Regional subsidies are set so as to compensate for regional welfare losses due to a higher tariff. A higher subsidy as well as a lower tariff raise global output and therefore Marshallian surplus. It is only natural that a regional planner seek to compensate for tariff increases with subsidy increases.

National planners, in contrast, seek to match a higher tariff with lower subsidies. This occurs because national planners do not take into account how foreign local competitors may be hurt by tariff increases, while national local competitors gain from them<sup>23</sup>.

This qualitative difference between coordination and subsidy competition in the interaction between subsidies and tariff should be borne in mind as we will now investigate the welfare effects of subsidy competition and regional integration.

## 6 Selected results from numerical simulations

Since our formalisation already involves a large number of variables, we find it natural to illustrate further our predictions by conducting simulations. We may thus treat a larger number of cases. First and foremost, this allows us to extend our model to a multi-product MNC. We will model this possibility by introducing a second good, whose demand and cost conditions will be *unrelated* to the first<sup>24</sup>. Therefore a third locational alternative will be contemplated by the firm, i.e. the possibility to specialise the production of each good in a distinct country. We will denote the two goods by 1 and 2 and the new location possibility by  $S$ , representing the production of good 1 in country  $A$  and of good 2 in country  $B$ . Treatment of goods 1 and 2 will systematically symmetric, so that the specialisation motive is represented by  $S$  without loss of generality. Such specialisation makes sense within a region where for each good, the MNC may enjoy an absolute technological advantage in a different country. Such a region will be called a *complementary* region, completing our typology (see Figure 9.1).<sup>25</sup>

A second addition to the original model is to address the 'local' or intraregional MNC case. We may justify the extension of our model to the local MNC framework on various grounds. Obviously, there are numerous real examples of 'local' MNCs operating in regional unions, especially in NAFTA and the EU. Besides, the sensitivity of our previous results to the value of the parameter  $\varphi$  suggests that the extent to which MNC profits affects governments' decision rules plays a crucial role in explaining the provision of location incentives, and therefore the resulting location choice of MNCs. We may thus gain some additional insight by examining the polar case where profits fully enter government  $A$ 's objective function (MNC profits are entirely distributed among by  $A$  residents). However, the other government enjoys the capacity to tax some part  $\varphi_B$  of the profits originating from local activities (again, in accordance with the source principle).

This yields the following welfare functions under monopoly :

$$W^A(R, s_A, s_B) = \sum_{i=1,2} \left[ \frac{1}{2} (\bar{x}_i^A)^2 + \pi_i^{MNC,A} + (1 - \varphi_B) \pi_i^{MNC,B} + tm_i^{mnc,A} - s_A q_i^A \right]$$

$$W^B(R, s_A, s_B) = \sum_{i=1,2} \left[ \frac{1}{2} (\bar{x}_i^A)^2 + \varphi_B \pi_i^{MNC,B} + tm_i^{mnc,B} - s_B q_i^B \right]$$

<sup>23</sup>Indeed, in monopoly, the tariff does not affect the variation of welfare due to a change in subsidies.

<sup>24</sup>This assumes away economies of scope as well as complementarity or substitutability between the two products.

<sup>25</sup>It should be noted that in this two-good extension of our model, Propositions 1 and 2 still hold. Besides, in the Benchmark Case, the specialisation regime  $S$  is preferred by the MNC for a complementary region.

where  $\pi_i^{MNC,B}$  denotes the part of profits originating from country B, for the production of good  $i$ . Therefore government A is partly interested in the MNC's operations in country B through profit repatriation. This motivates two remarks.

**Remark 4** *Remark 2 is no more valid in the local MNC framework since some part of the profits from country B operations are (positively) affected by the choice of  $s_B$ .*

**Remark 5** *In this framework the case where  $\varphi_B = 1$  (no intra-regional profit repatriation) is tantamount to the case where  $\varphi = 1$  in the extra-regional MNC framework.*

A third remark concerns the relationship between tariffs and subsidies.

**Remark 6** *The origin of ownership modifies the relationship between tariffs and subsidies. In the case of a local monopolistic MNC, we may observe complementarity between the tariff and optimal subsidies. This result stems from the capacity enjoyed by country A to partially or fully capture MNC profits in its welfare function : it will seek large increases of the Marshallian surplus and match higher tariffs by more than compensating subsidy levels. To some extent, this behaviour reflects a high degree of internalisation of regional welfare, as it is reminiscent of the decision made by a regional planner.*

In the numerical simulations the local MNC specification will be used with the same parameter values as the extraregional MNC specification, in the polar case where  $\varphi_B = 0$ <sup>26</sup>.

To summarize, our methodology will be applied to a 3X2X2 matrix of special cases : 3 different types of region (homogenous, asymmetric and complementary), 2 possible market structures (monopoly and oligopoly) and 2 types of MNCs (an extraregional MNC and a local MNC)<sup>27</sup>. To save space, only selected original results with respect to the predictions of our analytical framework<sup>28</sup> will be presented. Our results address 3 main questions: (a) the existence or not of decisive subsidies and the eventual MNC location choice, the (b) welfare effects of the non cooperative setting of subsidies and (c) the overall effects of integration.

## 6.1 The existence or not of decisive subsidies and the eventual MNC location choice

Contrary to the monopolistic case, when entry of firms generates an oligopoly, there may exist decisive subsidies. With an extraregional MNC, we obtain the following results :

### 6.1.1 Excess inertia in monopoly

**Lemma 2** *When the market structure is monopolistic, Subsidy Competition biases the location choice towards the ubiquity regime, since both countries offer large subsidies to have a subsidiary operating on their soil.*

<sup>26</sup>We shall turn back to this assumption when discussing the main results with a local MNC.

<sup>27</sup>We have carried out simulations for the whole constellation of special cases mentioned in the 3X2X2 matrix, using the following set of parameters

	A	$\alpha_1^A$	$\alpha_1^B$	$\alpha_2^A$	$\alpha_2^B$	$\bar{\alpha}$
Hom. region	30	0	0	0	0	1
Asym region	30	0	0.5	0	0.5	1
Comp. region	30	0	0.5	0.5	0	1

We have checked the robustness of our results to parameter changes. These values have been chosen to allow positive output from the MNC as well as local competitors.

<sup>28</sup>The exhaustive exposition of simulation results is available upon request.

**Proof.** See Appendix 9.3. ■

In the Benchmark Case, we know by Proposition 2 that relocation takes place, except in the homogenous region. Subsidy Competition makes the ubiquity regime more attractive, because of high subsidies from both governments. This may be explained by the fact that relocation would imply large losses in national welfare for country B ; decisive subsidies are therefore out of reach for country A, and the MNC maintains the ubiquity regime.

**Simulation Result 1** *When the market structure is monopolistic, the predicted inertia distorts the productive structure from the 'ideal structure', except in a homogenous region.*

**Proof.** See Appendix 9.3. ■

Such excess inertia may even be more likely since we overlook the additional costs of shutting down productive facilities, that should be incurred in the concentration regime.

Maximising regional welfare would set subsidies below the 'competitive' level for regime *U* and above their 'competitive' level for regimes *S* and *C* ; this would yield location decisions identical to those of the Benchmark Case. In particular, in a homogenous region, ubiquity would be the regionally optimal location, and it may be obtained either through Competition or Coordination.

### 6.1.2 Excess concentration in oligopoly

As mentioned before, we neglect the case where Subsidy Competition drives one or both local competitors out of the market. With a three-firm oligopoly we obtain the following lemma :

**Simulation Result 2** *In each type of region country A will optimally set its subsidy to the decisive level, so as to provoke concentration of the MNC's subsidiaries.*

**Proof.** See Appendix 9.3 ■

Compared to the monopoly case, we now expect governments to take into account local producers' interests in setting their optimal subsidies. This is particularly true for regime *U* for which contingent subsidies are much lower. But this makes room for decisive subsidization<sup>29</sup>, as country A will now find it less costly to outbid *U* subsidies with high subsidies conditional on concentration. Relocation will therefore always take place.

## 6.2 Welfare Effects of Non-cooperative Setting of Subsidies

In a number of cases, simulations suggest that country *B*'s welfare may decrease with Subsidy Competition, but also under Coordination. A natural addition to the latter case is to consider the possibility of intra-regional transfers, in order to expand the scope of acceptable coordination agreements.

**Definition 3** *An intra-regional transfer under Policy Coordination is a lump-sum transfer from the better-off country to the worse-off country that makes it indifferent to some policy change. Changes include switching from Competition to Coordination, or from autarky to integration.*

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<sup>29</sup>i.e. limit-subsidization, see definition in section 3.1.3

### 6.2.1 Winners and losers

We discuss the case of an extra regional MNC. The conjectures validated by our simulations are as follows:

**Simulation Result 3** *Subsidy competition generally entails a Pareto-improvement w.r.t. the Benchmark Case when the MNC enjoys monopoly power, but fails to make both countries better off in the case of oligopoly.*

**Proof.** In that case, country B strictly loses from Subsidy Competition. See Appendix 9.3 ■

**Simulation Result 4** *Policy Coordination typically requires intra-regional transfers to be Pareto-improving w.r.t. the Benchmark Case.*

By construction regional welfare under Coordination is maximal, and we know that it is significantly higher than under Competition or the Benchmark Case. However, a conflict of interests between the two countries makes it necessary to use intra-regional transfers to achieve Pareto-improving coordination rather than Competition. For an extraregional MNC, country A always prefers Coordination, but still is better off under Competition ; surprisingly, country B prefers Competition, keeping some part of the MNC's profit while making country A heavily subsidize home consumption. We then predict a transfer from A towards B to achieve Coordination.

### 6.2.2 When Harmonisation Dominates Competition

As shown above in the case of an asymmetric region with a monoproduit monopolistic extraregional MNC and high values of  $\varphi$ , Subsidy Competition might reduce welfare w.r.t. the Benchmark Case. By means of our simulations, we find new cases under which subsidy harmonisation dominates non-cooperative subsidies.

**Simulation Result 5** *Welfare under Competition may be lower than in the Benchmark Case in the case of oligopoly with an extraregional MNC, and for large values of  $\varphi$ .*

**Proof.** The following tables show the simulated regional welfare values under harmonization, subsidy competition and coordination.

Région	$\varphi = 0.3$			Région	$\varphi = 0.9$		
	BC	compet	coord		BC	compet	coord
hom.	1436.8	1467.7	1518.7	hom.	1590.4	1577.7	1609.7
asym.	1434.9	1471.1	1518.7	asym.	1581.4	1581.7	1609.7
comp.	1434.9	1464.5	1516.1	comp.	1581.4	1561.6	1596.7

■ Generally speaking, Subsidy Competition has two main virtues, relative to mutual interdiction : first it brings countries closer to the first-best by alleviating the distortion due to market power ; second, it may generate a productive efficiency gain in the relocation process. However, in the special cases we refer to, decisive subsidies cause a large welfare loss to country B, increasing with  $\varphi$ , making the region as a whole worse off.

We now turn to our third question.

## 6.3 Are there net gains from trade?

To answer this question we investigate whether or not regional integration is still mutually advantageous even when we allow for possible adverse welfare effects of relocation. Recall that our setting neutralises traditional gains from trade such as domestic factor reallocation following comparative advantage, increased product variety, to focus on the disciplining

effect of imports on market power and potential productive efficiency gains. Thus mutual gains from trade are built in the model for almost all the cases we consider, to the exception of the case of an extraregional MNC enjoying monopoly power in a homogenous region. We focus on the case of oligopoly either with an extraregional or a local MNC.

**Simulation Result 6** *When the market structure is oligopolistic and for large values of  $\varphi$ , regional integration is not Pareto-improving w.r.t autarky so intra regional ex post transfers are needed.*

**Proof.** See Appendix 9.3 ■

**Simulation Result 7** *For the special case of a local oligopolistic MNC we find that under coordination, positive tariffs are welfare improving.*

**Proof.** See Appendix 9.3 ■

With a local MNC, under oligopoly, integration may even reduce regional welfare despite the Coordination agreement. Indeed, regionally optimal subsidies more than match tariff increases (see below) and more than offset the welfare loss due to trade restrictions. Therefore the optimal tariff is positive. It should be noted that for such a situation to be achieved, there should be transfers from country *B* to country *A* in order to reach coordination (which country *A* would not accept otherwise). There are therefore insitutional requirements for the regional union to reach the first-best allocation.

## 7 Conclusions

We have studied one indirect effect of trade liberalisation. Regional integration modifies firms' location incentives, predominantly MNCs who by definition may locate their economic activities in several economic areas. In this model, we account for the possibility that governments may anticipate location choices and compete to preserve or manipulate the location of productive activities of a MNC. The global welfare effect of such subsidy competition (including potential relocation) may reverse as well as reinforce gains from trade enjoyed through regional integration.

We have shown the interaction between the integration policy and the way countries decide their subsidies. We find that the nature of such relationship changes with the different ways of subsidy setting. With co-operative setting subsidies and tariff are strategic complements while they become strategic substitutes when subsidies are determined uncooperatively. Such differences imply different MNC location choices once countries have integrated. We show how different location choices depending on the subsidy schemes affect the net welfare effect of integration.

By analysing the interaction between tariff and subsidies we obtain original results on the effect of subsidy competition as well as on the welfare effects of economic integration.

No general result emerges from the analysis, since the nature of our topic excludes such a possibility. Our results are sensitive to the type of market structure (oligopoly or monopoly), the regional technological heterogeneity, and the absorption capability of governments, and, furthermore, of the kind of agreement between countries. Our theoretical framework is general enough to adapt to the specificities of various regions and economic unions. This enables us to make policy recommendations that may apply to real regional agreements, such as Mercosur (which resembles our extra-regional monopolistic or oligopolistic case, with a possible technological complementarity between Argentina and Brazil), the 15-country European Union (a relatively homogenous region, with some local

MNCs, and some coordination between partner countries, as well as intra-regional transfers), the 25-country EU (relatively more asymmetric), and the NAFTA (an asymmetric region with no explicit subsidy coordination).

We show how the gains from coordination increase with integration, except for high values of the profit repatriation rate and a large enough technological gap (Proposition 6). In other words integration generally increases the benefit associated with of coordination supranational institutions.

Moreover, we find conditions for the harmonisation of subsidy levels to dominate subsidy competition between partner countries, namely a high technological asymmetry under monopoly (Proposition 4), a high absorption capability under oligopoly for every kind of region (Simulation Result 5). In any case, non-cooperative subsidization may result in excess inertia in the location of the MNC, which is inefficient from the point of view of a regional social planner (cf. Remark 3, Proposition 4, and Simulation Result 1).

As regards the net effect of integration, we show that once the effects of relocalisation and subsidization are included, a mutual welfare improvement requires ex post intra-regional transfers in order to compensate for possible losses suffered by one of the countries.

One original input from this paper is to consider the case of a local MNC. This illustrates how the origin of ownership modifies the effects of integration as well as subsidies. We find special conditions under which the optimal internal tariff is strictly positive (Simulation Result 7).

Generality may be found in our results in the sense that, by accounting for economic agents' reactions, the success of regional integration depends on the existence of a central authority capable of establishing and enforcing operative rules and mechanisms.

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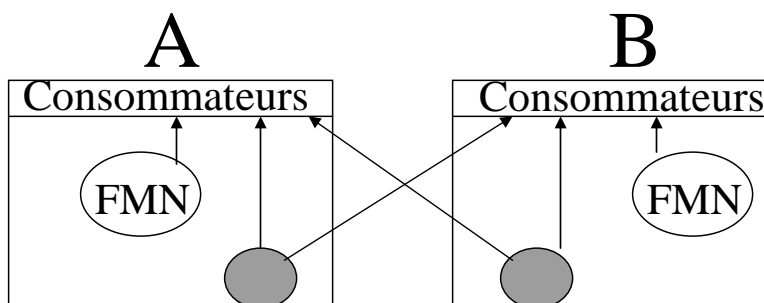
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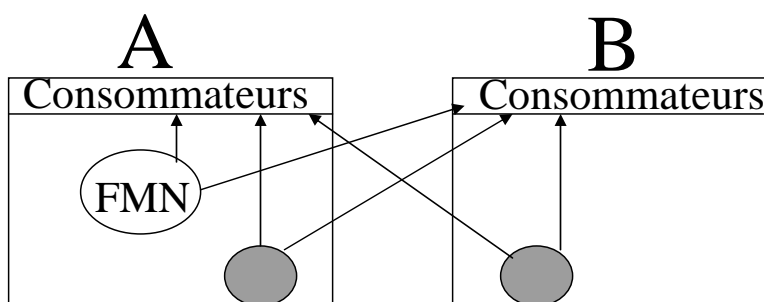
## 9 Appendixes

### 9.1 MNC locations

#### Ubiquity regime U

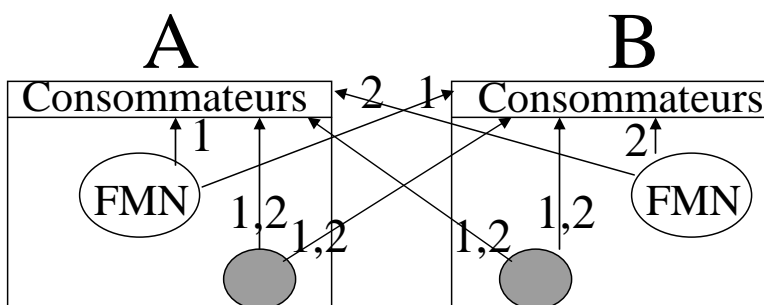


#### Concentration regime C



#### Specialisation regime S

*Two sectors, 1 & 2 : specialisation (A1,B2)*



## 9.2 Proofs for the simple model

### 9.2.1 Proof of remark 3

**Proof.** There are 2 conditions to be satisfied for proving the existence of decisive subsidies:

1. At such level of subsidy the concentration regime is as profitable as the ubiquity regime at  $\{s^A(U), s^B(U)\}$ .
2. The welfare of country A under concentration when paying decisive subsidies is greater than that of paying  $\{s^A(U), s^B(U)\}$  under ubiquity.

Satisfying both conditions relies upon the degree of technological heterogeneity and upon the governments' capacity of appropriating the MNC's profits.

The first condition is satisfied whenever  $s_A^{dec} \geq \frac{\sqrt{2\Pi^U - t^2} + t - 2A}{2}$ .

For verifying the second condition we need to have a look at the different welfare levels for country A under concentration when paying a decisive subsidy and under ubiquity with optimal subsidy. The difference ( $W^{A,subdec}(C) - W^{A,sub}(U)$ )

$$\text{is } \Delta = \left(\frac{1}{2} + \varphi\right) \frac{1}{4} (A + s_A^{dec})^2 + \frac{\varphi}{4} (A + s_A^{dec} - t)^2 - \frac{s_A^{dec}}{2} (2A + 2s_A^{dec} - t) - \left[\left(\frac{1}{2} + \varphi\right) \frac{1}{4} (1 + \Psi)^2 A^2 - \frac{\Psi(1+\Psi)}{2} A^2\right]$$

It is easy to verify that  $\Delta$  depends on  $\Pi^U$  and thus on the degree of regional heterogeneity.

In a symmetric region it is straightforward that  $W^{A,subdec}(C) - W^{A,sub}(U)$  is always negative and, under integration, it equals  $-\frac{313}{2904}A^2$  for  $\varphi = 0$  and  $-\frac{7}{8}A^2$  for  $\varphi = 1$ . Therefore government of country A never bids a decisive subsidy and therefore ubiquity regime prevails over concentration.

In an asymmetric region things are a bit more complicated. We know that, in this case, the final location depends on  $\varphi$ . A decisive subsidy will be never chosen when the FMN prefers concentration at optimal subsidies which, by definition, implies a greater welfare. Therefore the only case to analyse is when the MNC would choose ubiquity. This implies to eliminate the cases where  $\varphi$  is low and technological diversity is strong ( $b > A - \frac{1}{14}\sqrt{(92A^2 - 216At + 261t^2)}$ ). We can verify that for  $\varphi = 0$  and for any value of  $b$ ,  $W^{A,subdec}(C) - W^{A,sub}(U)$

$$\text{is negative after full integration. } \left( \Delta = \frac{-2210A^2 + 1242Ab - 621b^2 + 1584\sqrt{(A^2 - Ab + \frac{b^2}{2})}}{5808} \right). \text{ This difference becomes}$$

$\frac{1}{16} \left( -30A^2 + 38Ab - 19b^2 + 16A\sqrt{A^2 - Ab + \frac{b^2}{2}} \right)$  for high values of  $\varphi$ . Easy examination allows us to conclude that  $\Delta$  is always negative except for very high levels of regional heterogeneity ( $b > 0.85A$  when  $\varphi = 1$ ). ■

## 9.2.2 Proof of Proposition 2

**Proof.** We analyse first the case of weak profit repatriation. When  $\varphi = 1$  we need to compare the welfare functions in the concentration case under harmonisation with those in the ubiquity cases under national decentralised subsidies.

The welfare of country A for each case is  $W^{A,bench}(C) = \left(\frac{3}{2}\right)\left(\frac{A}{2}\right)^2 + \left(\frac{A-t}{2}\right)^2$  in the benchmark case and  $W^{A,sub}(U) = \left(\frac{1}{2} + \varphi\right) \frac{1}{4} (A + s^A)^2 - s^A \left(\frac{A+s^A}{2}\right)$  when it bids  $s^A(U) = \frac{(\varphi - \frac{1}{2})A}{(\frac{3}{2} - \varphi)}$ . If  $\varphi = 1$   $s^A(U)$  equals  $A$  and then  $W^{A,sub}(U) = \frac{1}{2}A^2$ . Let  $\Delta W^A$  be the difference between A's welfare under harmonisation and that of decentralised subsidisation. So  $\Delta W^A = \left(\frac{3}{2}\right)\left(\frac{A}{2}\right)^2 + \left(\frac{A-t}{2}\right)^2 - \frac{1}{2}A^2 = \frac{1}{8}A^2 - \frac{1}{2}At + \frac{1}{4}t^2$ , which is positive for low values of  $t$ . This means that country A suffers from subsidy competition.

For B, welfare under concentration when harmonisation is  $W^{B,bench}(C) = \frac{1}{8}(A-t)^2 + \frac{t}{2}(A-t)$  while for ubiquity it is  $W^{B,sub}(U) = \frac{1}{2}(A-b)^2 = \left(\frac{1}{2}A^2 - Ab + \frac{1}{2}b^2\right)$ . The difference  $\Delta W^B$  is  $\frac{1}{8}(A-t)^2 + \frac{t}{2}(A-t) - \left(\frac{1}{2}A^2 - Ab + \frac{1}{2}b^2\right) = -\frac{3}{8}A^2 + \frac{1}{4}At - \frac{3}{8}t^2 + Ab - \frac{1}{2}b^2$ . When full integration  $\Delta W^B$  equals  $Ab - \frac{3}{8}A^2 - \frac{1}{2}b^2$ . The roots of this polynomial are  $b = \frac{1}{2}A$  and  $b = \frac{3}{2}A$  (which is incompatible to the existence of the MNC). So  $\Delta W^B$  is negative for low values of regional asymmetry ( $b < \frac{1}{2}A$ ) and therefore country B gains from subsidisation.

Our result at the regional level is easy to state. We already know that A loses from positive subsidies as well as country B for high regional heterogeneity ( $b > \frac{1}{2}A$ ). Therefore subsidy competition reduces regional welfare whenever technological differences are strong. For weaker differences it is still possible regional loses in terms of welfare even if country B gains from subsidies. We need to find out the value of  $b$  such as competition reduces regional welfare. At the regional dimension  $\Delta$  becomes  $\Delta = -\frac{1}{4}A^2 - \frac{1}{4}At - \frac{1}{8}t^2 + Ab - \frac{1}{2}b^2$ . If  $t = 0$  then  $\Delta = -\frac{1}{4}A^2 + Ab - \frac{1}{2}b^2$ .  $\Delta$ 's roots are  $b = \left(1 + \frac{1}{2}\sqrt{2}\right)A$  (which is incompatible value to non-negative FMN's profits) and  $b = \left(1 - \frac{1}{2}\sqrt{2}\right)A \cong 0.3A$ . Therefore decentralised subsidies reduce regional welfare whenever the regional heterogeneity is greater than 0.3A. When heterogeneity is weak, competition improves regional welfare but needs regional transfers to be a Pareto improvement.

We turn to the case of low repatriation. When  $\varphi = 0$ , we distinguish 2 cases; First, if  $b < 0.3$  and countries bid subsidies, MNC's location will be that of ubiquity. For A, we have  $\Delta = \left(\frac{1}{2}\right)\left(\frac{A}{2}\right)^2 - \left(\frac{1}{2}\right)\frac{1}{4}\left(\frac{2}{3}A\right)^2 - \left(\frac{A}{3}\right)\left(\frac{1}{3}A\right) - \frac{1}{24}A^2$ , which means that A prefers competition to harmonisation. For B,  $\Delta = \left(\frac{1}{2}\right)\left(\frac{A}{2}\right)^2 - \left(\frac{1}{8}\right)\left(\frac{2}{3}(A-b)\right)^2 - \left(\frac{A-b}{3}\right)^2 = -\frac{1}{24}A^2 + \frac{1}{3}Ab - \frac{1}{6}b^2$ . The sign of  $\Delta$  depends on the level of heterogeneity. If  $b > \frac{1}{2}(2 - \sqrt{3})A \approx 0,13A$  country's B loses from competition. At the regional level,  $\Delta = \frac{1}{4}A^2 - \frac{4}{72}A^2 - \left(\frac{2}{3}A\right) - \left(\frac{1}{8}\right)\left(\frac{2}{3}(A-b)\right)^2 - \left(\frac{A-b}{3}\right)^2 =$

$-\frac{1}{12}A^2 + \frac{1}{3}Ab - \frac{1}{6}b^2$ .  $\Delta$  is negative for  $b > \left(1 - \frac{1}{2}\sqrt{2}\right)A \approx 0,30A$ . However  $b$  must be lower than 0.31 for ubiquity to be chosen. Therefore for  $\varphi = 0$  and low values of  $b$ , competition between countries is Pareto improving.

Finally, if  $b > 0.3$ , we need to compare the case of concentration with and without national subsidies. By definition of optimal subsidies country A gains from implementing subsidies. Country B gains whenever A's subsidies are positive. However we know that for low values of  $\varphi = 0$  subsidies are always negative ( $s^A(C) = \left(\frac{2}{7}t - \frac{3}{7}A\right)$ ). Therefore country B loses from competition comparing to the benchmark case.

At the regional level we obtain:  $\Delta = \left(\frac{1}{2}\right)\left(\frac{A}{2}\right)^2 + \left(\frac{1}{2}\right)\left(\frac{A-t}{2}\right)^2 + t\left(\frac{A-t}{2}\right) - \left(\frac{1}{2}\right)\left(\frac{A + \left(\frac{2}{7}t - \frac{3}{7}A\right)}{2}\right)^2 + \left(\frac{2}{7}t - \frac{3}{7}A\right)$   
 $\left(A + \frac{2}{7}t - \frac{3}{7}A - 2t\right) - \left(\frac{1}{2}\right)\left(\frac{A-t + \left(\frac{2}{7}t - \frac{3}{7}A\right)}{2}\right)^2 - t\left(\frac{A-t + \left(\frac{2}{7}t - \frac{3}{7}A\right)}{2}\right)$

Which is equivalent to:

$$\Delta = -\frac{15}{196}A^2 + \frac{55}{196}At - \frac{15}{98}t^2$$

We straightforwardly see that  $\Delta$  becomes negative when the integration process develops. Therefore at the regional level, subsidy competition increases regional welfare even if regional transfers are needed for this to be a Pareto improvement ■

### 9.2.3 Proof of Proposition 5

**Proof.** When countries implement subsidies, integration will prompt relocation only for strong heterogeneity levels and the countries do not appropriate profits MNC. We therefore consider the case of  $\varphi = 0$ . In such case, the welfare of country A under autarky is  $W^{A,autarc}(U) = \frac{3}{2}(\frac{1}{3}A)^2$  (the location is ubiquity) and  $W^{A,integ}(C) = \frac{2}{7}A^2 - \frac{3}{14}At + \frac{1}{14}t^2$  under integration (location is concentration). Take  $\Lambda$  as the difference of welfare under autarky and under integration ( $\Lambda^A = W^{A,integ}(C) - W^{A,autarc}(C)$ ). Since  $\Lambda^A = \frac{5}{42}A^2 - \frac{3}{14}At + \frac{1}{14}t^2$  is positive when  $t$  tends to zero we clearly see how country A gains from integration.

The case of B is different. B's welfare is  $W^{B,autarc}(U) = \frac{2}{9}(A - b^B)^2$  in autarky and  $W^{B,integ}(C) = \frac{1}{8}\left(A + \left(\frac{2t-3A}{7}\right) - t\right)^2 + t\left(A + \left(\frac{2t-3A}{7}\right) - t\right) = \frac{2}{49}A^2 + \frac{23}{49}At - \frac{255}{392}t^2$  in integration.  $\Lambda^B = W^{B,integ}(C) - W^{B,autarc}(U) = -\frac{37}{294}A^2 + \frac{23}{49}At - \frac{255}{392}t^2 + \frac{1}{3}Ab - \frac{1}{6}b^2$ . The roots of  $\Lambda^B$  indicate the values of  $b$  from which the country B loses from integration. If  $b < A - \frac{1}{14}\sqrt{48}A \simeq 0.5A$  integration is welfare reducing for B.

In order to analyse the effect of integration on regional welfare we need to analyse  $\Lambda = \Lambda^A + \Lambda^B$ . For  $\varphi = 0$  and  $t = 0$   $\Lambda = -\frac{1}{147}A^2 + \frac{1}{3}Ab - \frac{1}{6}b^2$  which is positive for any  $b$  greater than  $A - \frac{1}{7}\sqrt{47}A \simeq 0.02A$ . However such degree of heterogeneity is not compatible with concentration (at such heterogeneity MNC will choose ubiquity). Therefore when integration pushes the MNC to concentrate its production, regional welfare increases.

Does integration mean a Pareto improvement? The answer depends on the degree of asymmetry. We have concentration for any  $b$  greater than 0.31. We also know that country B loses from integration whenever heterogeneity is lower than 0.5. Therefore for some values of  $b$  (between 0.31 and 0.50) a Pareto improving integration needs regional transfers. ■

### 9.2.4 The location decision with regionally optimal subsidies

In our simple model, regionally optimal subsidies equal  $s_j^{reg}(U) = \frac{(\varphi - \frac{1}{2})(A - b^j)}{(\frac{3}{2} - \varphi)}$  for the ubiquity regime and  $s_A^{reg}(C) = \frac{(\varphi - \frac{1}{2})(A - b^A)}{(\frac{3}{2} - \varphi)} + \frac{t}{2}$  for the concentration regime.

We may now see how the extent of integration affects the location decision under regional planning. This decision hinges upon the sign of the profit differential with regional subsidies. Setting again for the sake of simplicity  $b^A = b^B = 0$  for a symmetric region and  $b^A = 0 < b^B$  for an asymmetric region yields :

$$\begin{aligned} \Delta &= \Pi^U - \Pi^C = \left(A + \frac{(2\varphi - 1)A}{(3 - 2\varphi)}\right)^2 + \left(A - b^B + \frac{(2\varphi - 1)(A - b^B)}{(3 - 2\varphi)}\right)^2 \\ &\quad - \left(A + \frac{(2\varphi - 1)A}{(3 - 2\varphi)} + \frac{t}{2}\right)^2 - \left(A + \frac{(2\varphi - 1)A}{(3 - 2\varphi)} - \frac{t}{2}\right)^2 \end{aligned}$$

a positive  $\Delta$  meaning the chosen location will be ubiquity.

We find this profit differential  $\Delta$  to be always negative for all values of  $\varphi$  and  $b$ , indeed for  $\varphi = 1$  we have  $\Delta(t) = -8Ab^B + 4(b^B)^2 - \frac{1}{2}t^2$  and for  $\varphi = 0$  we have  $\Delta(t) = -\frac{8}{9}Ab^B + \frac{4}{9}(b^B)^2 - \frac{1}{2}t^2$ . Interestingly, with regionally optimal subsidies, the MNC will always choose to build an export-platform (concentration), even in the case of a perfectly symmetric region.

## 9.3 Simulation results

### 9.3.1 The location choice of an extraregional MNC : excess inertia and excess concentration

In the following figures, the dashed line represents MNC profits with the ubiquity regime, while the thick line represents profits in the specialisation regime and the thin line in the concentration regime. <sup>30</sup>

### 9.3.2 Proof of lemma 2

In the figure 2 monopoly profits are plotted against the internal tariff,  $t$ .

<sup>30</sup>We adopt the same convention in all figures.

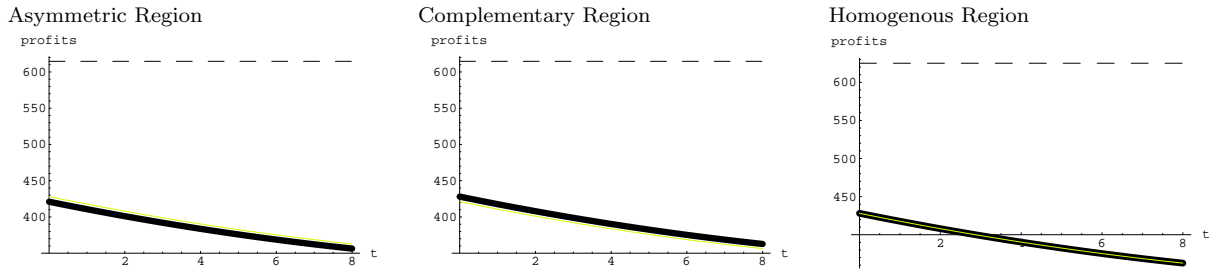


Figure 2: Monopoly Profits

### 9.3.3 Proof of Simulation Result 1

We proceed to evaluations of regional welfare.

The figures 3, 4 and 5 compare regional welfare under Subsidy Competition to regional welfare under Policy Coordination, for each location regime. The following results are straightforward to verify : In a homogenous region, optimal location  $U$  is chosen under competition; in an asymmetric region, concentration is the regionally optimal location but is not chosen under competition and in the complementary region, the optimal regime  $S$  is again not chosen under competition.

This is the excess inertia result.

### 9.3.4 Proof of Simulation Result 2

In contrast, in oligopoly, we obtain excess concentration because of decisive subsidies. In Figure 6 we graphically illustrate this result for a complementary region (to save space, we do not show similar figures for the homogenous and asymmetric regions).

## 9.4 Welfare Effects of Competition

### 9.4.1 Proof of Simulation Results 3 and 4

We look at our simulated values of national welfare

In monopoly, with an extraregional MNC, in all regions, competition is Pareto-improving, and Coordination requires transfers to be Pareto-improving.

Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>
$\varphi = 0.3$	360	375	593.75	$\varphi = 0.3$	360	375	156.25
$\varphi = 0.9$	630	750	875	$\varphi = 0.9$	630	750	625
Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>
$\varphi = 0.3$	360	375	593.75	$\varphi = 0.3$	348.1	362.604	156.25
$\varphi = 0.9$	630	750	875	$\varphi = 0.9$	609.175	725.208	625
Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>
$\varphi = 0.3$	354.05	368.801	375	$\varphi = 0.3$	354.05	368.801	375
$\varphi = 0.9$	619.588	737.596	750	$\varphi = 0.9$	619.588	737.596	750

In oligopoly with an extraregional MNC, country B always loses from trade under Competition and prefers Coordination even without transfers.

	$\varphi = 0.3$					$\varphi = 0.3$			
Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>		
<i>sym</i>	718.4	782.6	802.8	<i>sym</i>	718.4	685	715.9		
<i>asym</i>	721.9 (756)	785.3	802.8	<i>asym</i>	712.9 (680)	685.8	715.9		
<i>comp</i>	718.4	778.7	798.5	<i>comp</i>	718.4	685.8	717.5		
	$\varphi = 0.9$					$\varphi = 0.9$			
Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>		
<i>sym</i>	795.2	858.3	934.8	<i>sym</i>	795.2	719.3	675		
<i>asym</i>	798.7 (914)	866.9	934.8	<i>asym</i>	782.7 (680)	714.7	675		
<i>comp</i>	795.2	846.9	923.1	<i>comp</i>	795.2	714.7	673.6		

In oligopoly, with a local MNC, competition is Pareto-improving and Coordination also requires transfers.

Country A	<i>BC</i>	<i>compet</i>	<i>coord</i>	Country B	<i>BC</i>	<i>compet</i>	<i>coord</i>
hom.	1125	1175	900	hom.	225	522	900
<i>asym.</i>	1125	1176	900	<i>asym.</i>	225	521	900
<i>comp.</i>	1125	1155	885	<i>comp.</i>	225	514	885

## 9.5 Are there any gains from trade?

### 9.5.1 Proof of Simulation Result 6

As displayed in the following tables, integration makes country *B* worse off even though it increases regional welfare. Intra-regional transfers are therefore necessary for both countries to accept integration. For a small repatriation rate country *B* loses from trade, while country *A* succeeds in becoming an export platform, through the use of 'decisive subsidies'. i.e. in excess of the welfare-maximising level given the location choice. It is therefore necessary to offer a transfer to country *B* so as to preserve its incentive to join the Union. We may notice that coordination also involves a transfer from the less advanced country to its more advanced partner to prevent it from entering in harmful competition.

We use the same presentation as above.

<b>Autarky(duopoly)</b>				<b>Integration(triopoly)</b>			
				<i>Subsidy Competition with transfers</i>			
				(in brackets, without transfers)			
$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>	$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>
<i>A</i>	696	696	692	<i>A</i>	783(805)	795(809)	781(799)
<i>B</i>	696	688	692	<i>B</i>	696(674)	688(674)	692(674)
<i>Region</i>	1392	1384	1384	<i>Region</i>	1479	1483	1473
				<i>Policy Coordination with transfers</i>			
				(in brackets, without transfers)			
$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>	$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>
<i>A</i>	783(767)	834	781(767)	<i>A</i>	751(767)	700	753(767)
<i>B</i>	751(767)	700	753(767)	<i>B</i>	1534	1534	1534
<i>Region</i>	1534	1534	1534	<i>Region</i>	1534	1534	1534

With a local MNC integration also depends on the availability of transfers. Integration reduces regional welfare even when coordination with transfers is possible, and when countries compete integration makes country *A* better off but country *B* worse off. The global effect is positive.

<b>Autarky(duopoly)</b>				<b>Integration(triopoly)</b>			
				<i>Subsidy Competition with transfers</i>			
				(in brackets, without transfers)			
$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>	$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>
<i>A</i>	979	978	965	<i>A</i>	1073	1072	1058
<i>B</i>	670	666	666	<i>B</i>	609(680)	605(680)	607(680)
<i>Region</i>	1649	1644	1631	<i>Region</i>	1682	1677	1665
				<i>Policy Coordination with transfers</i>			
				(in brackets, without transfers)			
$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>	$\varphi = 0.6$	<i>Hom.</i>	<i>Asym.</i>	<i>Comp.</i>
<i>A</i>	1073(756)	1072(756)	1058(782)	<i>A</i>	743	744	721
<i>B</i>	743	744	721	<i>B</i>	1816	1816	1779
<i>Region</i>	1816	1816	1779	<i>Region</i>	1816	1816	1779

Note that in this case, paradoxically, transfers must flow from country *B* to country *A*. Indeed, country *B* must compensate country *A* for not entering Competition, and is still better off after transfers relative to Competition. However, this makes integration harmful.

### 9.5.2 Proof of Simulation Result 7

Look at the following table displaying our simulated regional welfare values under coordination for different values of *t*.

Under positive tariff ( $t = 4$ )

Coor	Country A	Country B	Region
<i>hom.</i>	442	1389	1831
<i>asym.</i>	442	1389	1831
<i>comp.</i>	488	1303	1791

Under full integration:

Coor	Country A	Country B	Region
<i>hom.</i>	756	1060	1816
<i>asym.</i>	756	1060	1816
<i>comp.</i>	782	997	1779

## 9.6 How do optimal subsidies interact with the internal tariff?

With an extraregional MNC in monopoly, optimal subsidies exhibit some substitutability with the tariff, in the sense that a higher tariff implies lower subsidies from both governments. This can be seen by looking at the coefficient before *t* in the following formula.

$$\begin{aligned}
s_A^{opt}(R) &= \begin{cases} (2\varphi - 1) \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2(3-2\varphi)} & \text{if } R = U \\ (4\varphi - 3) \frac{A - \alpha_1^A - \beta^A}{(7-4\varphi)} - \frac{2(1+\varphi)}{(7-4\varphi)} t & \text{if } R = S \\ (4\varphi - 3) \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2(7-4\varphi)} - \frac{2(1+\varphi)}{(7-4\varphi)} t & \text{if } R = C \end{cases} \\
s_B^{opt}(R) &= \begin{cases} (2\varphi - 1) \frac{2A - \alpha_1^B - \alpha_2^B - 2\beta^B}{2(3-2\varphi)} & \text{if } R = U \\ (4\varphi - 3) \frac{A - \alpha_2^B - \beta^B}{(7-4\varphi)} - \frac{2(1+\varphi)}{(7-4\varphi)} t & \text{if } R = S \\ 0 & \text{if } R = C \end{cases} \\
s_A^{reg}(R) &= \begin{cases} (2\varphi - 1) \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2(3-2\varphi)} & \text{if } R = U \\ (2\varphi - 1) \frac{2A - 2\alpha_1^A - 2\beta^A}{2(3-2\varphi)} + \frac{t}{2} & \text{if } R = S \\ (2\varphi - 1) \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2(3-2\varphi)} + \frac{t}{2} & \text{if } R = C \end{cases} \\
s_B^{reg}(R) &= \begin{cases} (2\varphi - 1) \frac{2A - \alpha_1^B - \alpha_2^B - 2\beta^B}{2(3-2\varphi)} & \text{if } R = U \\ (2\varphi - 1) \frac{2A - 2\alpha_2^B - 2\beta^B}{2(3-2\varphi)} + \frac{t}{2} & \text{if } R = S \\ 0 & \text{if } R = C \end{cases}
\end{aligned}$$

For an extraregional MNC in oligopoly, we observe the same substitutability for nationally optimal subsidies, and complementarity for regionally optimal subsidies, except when  $\varphi$  is low, in the ubiquity regime.

$$\begin{aligned}
s_A^{opt}(U) &= \frac{2}{3(7-6\varphi)} \left[ (6\varphi - 3) \left( \frac{2A - 3\alpha_1^A - 3\alpha_2^A + 4\bar{\alpha}_n}{4} \right) + \frac{(12\varphi - 22)t}{4} \right] \\
s_A^{opt}(S) &= \frac{2}{3(7-6\varphi)} \left[ \frac{(12\varphi - 6)A - (12\varphi - 7)3\alpha_1^A - 3\alpha_2^B - 3(3+2\varphi)t + (24\varphi - 13)\bar{\alpha}_n}{4} \right] \\
s_A^{opt}(C) &= \frac{2}{3(15-6\varphi)} \left[ \frac{(12\varphi - 5)(2A - 3\alpha_1^A - 3\alpha_2^A + 4\bar{\alpha}_n) + 2t(6\varphi - 7)}{4} \right] \\
s_A^{reg}(U) &= \frac{(12\varphi - 10)A - (18\varphi - 7)\alpha_1^A - (18\varphi - 7)\alpha_2^A + (24\varphi - 4)\bar{\alpha}_n + (12\varphi - 10)t}{2(19 - 18\varphi)} \\
s_A^{reg}(S) &= \frac{(12\varphi - 10)A - 2(18\varphi - 7)\alpha_1^A + (24\varphi - 4)\bar{\alpha}_n + (9 - 6\varphi)t}{2(19 - 18\varphi)} \\
s_A^{reg}(C) &= \frac{(12\varphi - 10)A - (18\varphi - 7)\alpha_1^A - (18\varphi - 7)\alpha_2^A + (24\varphi - 4)\bar{\alpha}_n + (9 - 6\varphi)t}{2(19 - 18\varphi)}
\end{aligned}$$

For a local MNC in monopoly, we observe complementarity between subsidies and the tariff, for nationally as well as regionally optimal subsidies.

$$s_A^{opt}(R) = \begin{cases} \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2} & \text{if } R = U \\ \frac{A - \alpha_1^A - \beta^A}{3} & \text{if } R = S \\ \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{6} & \text{if } R = C \end{cases} \quad s_B^{opt}(R) = \begin{cases} \frac{2\varphi_B - 1}{3 - 2\varphi_B} \frac{2A - \alpha_1^B - \alpha_2^B - 2\beta^B}{2} & \text{if } R = U \\ \frac{4\varphi_B - 3}{7 - 4\varphi_B} \frac{A - \alpha_2^B - \beta^B}{2} + \frac{2(1 - \varphi_B)}{7 - 4\varphi_B} t & \text{if } R = S \\ 0 & \text{if } R = C \end{cases}$$

(To be sure, the  $\varphi_B = 0$  assumption does not qualitatively modify the relationship between subsidies and the tariff).

$$s_A^{reg}(R) = \begin{cases} \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2} & \text{if } R = U \\ A - \alpha_1^A - \beta^A + \frac{t}{2} & \text{if } R = S \\ \frac{2A - \alpha_1^A - \alpha_2^A - 2\beta^A}{2} + \frac{t}{2} & \text{if } R = C \end{cases} \quad s_B^{reg}(R) = \begin{cases} \frac{2A - \alpha_1^B - \alpha_2^B - 2\beta^B}{2} & \text{if } R = U \\ A - \alpha_2^B - \beta^B + \frac{t}{2} & \text{if } R = S \\ 0 & \text{if } R = C \end{cases}$$

For a local MNC in oligopoly, regionally optimal subsidies positively vary with the level of the tariff. There is therefore, again, complementarity between the tariff and Coordination subsidies.

Competition subsidies again exhibit substitutability with the tariff, except in the particular case of the specialisation regime for country B for a low enough  $\varphi_B$ . But generally speaking, there will be substitutability between the tariff and nationally optimal subsidies. Below are formulas of the nationally and regional optimal subsidies.

$$s_A^{reg}(R) = \begin{cases} \frac{2A-11\alpha_1^A-11\alpha_2^A+10\beta^B-12\beta^A+20\bar{\alpha}}{2} + t & \text{if } R = U \\ \frac{2A-22\alpha_2^B+10\beta^A-12\beta^B+20\bar{\alpha}}{2} + \frac{3}{2}t & \text{if } R = S \\ \frac{2A-11\alpha_1^A-11\alpha_2^A+10\beta^B-12\beta^A+20\bar{\alpha}}{2} + \frac{3}{2}t & \text{if } R = C \end{cases}$$

$$s_B^{reg}(R) = \begin{cases} \frac{2A-11\alpha_1^B-11\alpha_2^B+10\beta^A-12\beta^B+20\bar{\alpha}}{2} + t & \text{if } R = U \\ \frac{2A-22\alpha_2^B+10\beta^A-12\beta^B+20\bar{\alpha}}{2} + \frac{3}{2}t & \text{if } R = S \\ 0 & \text{if } R = C \end{cases}$$

$$s_A^{opt}(R) = \begin{cases} \frac{6A-9\alpha_1^A-9\alpha_2^A-4\beta^A-2\beta^B+12\bar{\alpha}}{6} - \frac{5}{3}t & \text{if } R = U \\ \frac{3A-17\alpha_1^A-2\beta^A-\beta^B+14\bar{\alpha}}{7} - \frac{5}{7}t & \text{if } R = S \\ \frac{6A-17\alpha_1^A-17\alpha_2^A-4\beta^A-2\beta^B+28\bar{\alpha}}{14} - \frac{5}{7}t & \text{if } R = C \end{cases}$$

$$s_B^{opt}(R) = \begin{cases} \frac{2\varphi_B-1}{7-6\varphi_B} \frac{6A-9\alpha_1^A-9\alpha_2^A+12\bar{\alpha}}{6} + \frac{(12\varphi_B-14)\beta^A+(20-24\varphi_B)\beta^B}{6(7-6\varphi_B)} + \frac{12\varphi_B-22}{7-6\varphi_B}t & \text{if } R = U \\ \frac{(12\varphi_B-9)A+(19-36\varphi_B)\alpha_2^B+(12\varphi_B-13)\beta^A+(22-24\varphi_B)\beta^B+(24\varphi_B-10)\bar{\alpha}}{43-36\varphi_B} + \frac{1-6\varphi_B}{43-36\varphi_B}t & \text{if } R = S \\ 0 & \text{if } R = C \end{cases} .$$

In particular, when  $\varphi_B = 0$ , as in the simulations, we find that  $s_B^{opt}(U)$  decreases with  $t$  and  $s_B^{opt}(S)$  increases with  $t$ .

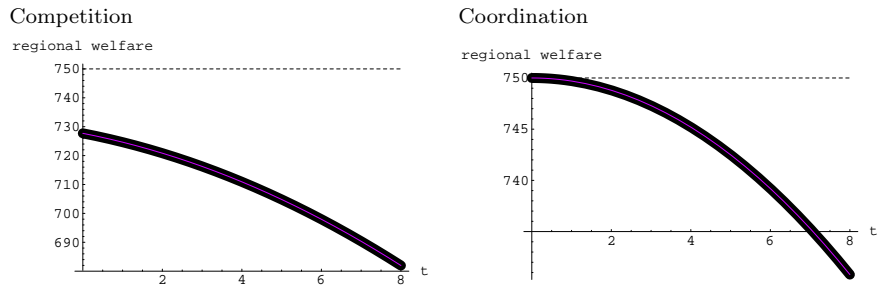


Figure 3: Homogenous Region

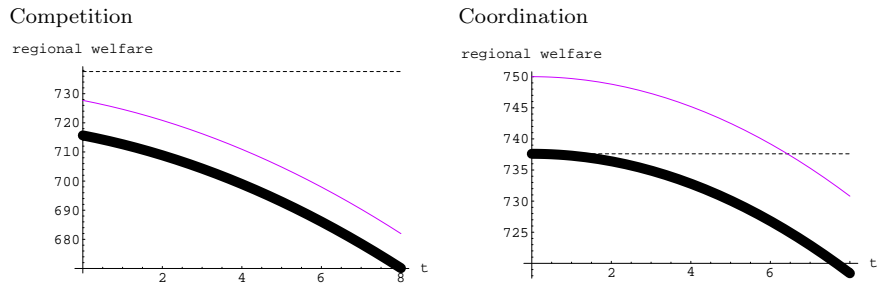


Figure 4: Asymmetric Region

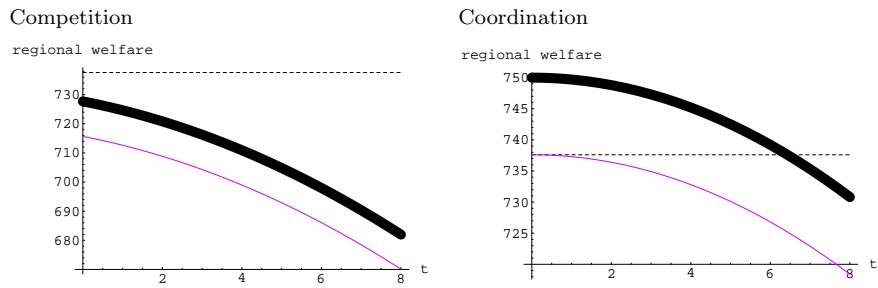
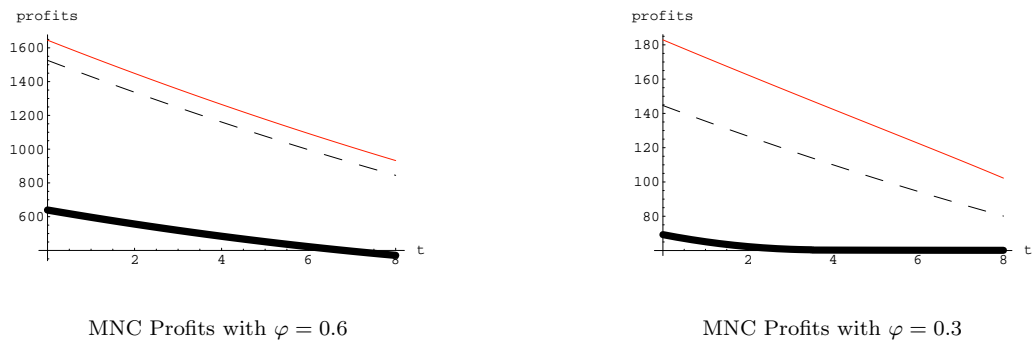


Figure 5: Complementary Region



MNC Profits with  $\varphi = 0.6$

MNC Profits with  $\varphi = 0.3$

Figure 6: MNC Profits for a Complementary Region