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Import quota allocation between regions under Cournot competition☆

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ABSTRACT

The paper analyzes the impact of import quotas on the welfare of different regions belonging to a single country. The regions compete with one another using Cournot conjectures and international trade is hindered by import quotas. Our results can help the country to determine the optimal import quotas and the best way to allocate import permits between regions. We find three mains results. First, we show how the world price, the difference in production costs between regions and the relative market size determine the allocation of import quotas, the interregional trade and the rent of import permits holders. Second, we show that in the presence of interregional trade in both directions, the region with the largest market size will obtain the largest share of imports while in the absence of trade, the allocation of import permits between regions also depends on the production cost asymmetry. Third, when only the most efficient region exports to the least efficient one, production cost asymmetry, transaction costs and world price determine whether the smaller or larger region obtains the larger share of importations allowed under import quotas.

1. Introduction

The prevalence of import quotas in several countries and economic sectors has spawned rich literature on this question, including recent works by Chao and Yu (1991), Feenstra (1995), Maggie and Rodriguez-Clare (2000), Kreickemeier (2005) and Chao et al. (2010). Overall, the literature has largely focused on analyzing the equivalence between tariff and quota (see e.g. Gervais and Lapan, 2002; Larue et al., 2008; Scoppola, 2010; Chen et al., 2011; Okumura, 2015), the impact of implementing quotas on producer surplus, consumer surplus and global welfare (see e.g. Pouliot and Larue, 2012), the arbitrage between the reduction of in-quota and out-of-quota tariffs and the expansion of the quota (see e.g. Scoppola, 2010; Gouel et al., 2011; Owen and Winchester, 2014) and the implication of change in trade policies following an agreement (Jean et al., 2014; Raff and Wagner, 2010).

Several import quota management systems coexist (WTO, 2013b). For example, in the European Union, for some productions, they are reassigned to countries, and import permits are consequently managed by importers in these states. For other productions, import quotas are managed according to the first-come first-served principle, on a historical basis or are allocated to trading partners (WTO, 2013a). Hraianova et al. (2006) show that not penalizing firms for the non-use of import licenses increases inefficiency while Pouliot and Larue (2012) indicate that the 'use-it or lose-it' clause is not necessary to ensure that import quotas are fulfilled when domestic production is imperfectly competitive.[1] However the literature assumes that there are no transaction costs between regions within a given country. This assumption is difficult to sustain when considering countries like Russia, Canada or the European Union.[2] Existence of transaction costs between regions could have practical implications. Indeed, Mrazova and Neary (2014) show that, when relaxing the assumption of constant elasticity of substitution preferences in monopolistic competition, integrated and segmented markets behave differently, the latter typically exhibiting reciprocal dumping; the price charged abroad—including trade costs—being lower than the home price (Brander and Krugman, 1983). It is therefore important not only to be able to determine the

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[1] More specifically, holders of import licences would have the incentive to use them fully when the world price lies between the marginal cost of production and the domestic price received by upstream producers (Pouliot and Larue, 2012).

[2] As an example, existence of transaction costs between Canadian's provinces resulted in the signing in 1995 of the Agreement on Internal Trade (AIT), whose *purpose is to reduce and eliminate, to the extent possible, barriers to the free movement of persons, goods, services, and investment within Canada and to establish an open, efficient, and stable domestic market* (see http://www.ait-aci.ca/index_en/intro.htm, accessed May 6, 2014). Reducing transaction costs in internal market is also an issue for the European Union (see http://ec.europa.eu/enterprise/policies/single-market-goods/internal-market-for-products/index_en.htm, accessed May 6, 2014).

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optimal import quotas, but also optimal national assignments of imports when the national market is segmented. To the best of our knowledge, this issue has not been addressed when analyzing import quotas.

This paper analyzes the impact of import quotas on the welfare of different regions belonging to a single country. Firms consider the regions as segmented markets and compete with one another using Cournot conjectures. There are transport costs incurred in exporting products from one region to another and international trade is hindered by import quotas. We derive the conditions under which it is optimal to observe interregional trade and those for which trade does not exist. This has an implication when allowing import permits to different regions. World price and differing production cost between regions play an important role here. For a low (high) world price, the quotas maximizing import permit holders' rent will be higher (lower) than the quotas maximizing global welfare. Further, the greater (lesser) the production cost asymmetry between regions, the larger (smaller) the difference between the world price that maximizes the welfare of permit holders compared with the price that maximizes global welfare. Also, when the most efficient region exports to the least efficient region and not the inverse, production costs asymmetry, transaction costs and the world price determine whether the smaller or the larger region obtains the largest share of import permits.

The rest of the paper is organized as follows. Section 2 presents the theoretical model, and in Section 3 we analyze the situation in which import quotas are optimal, and allocations of national production are such that interregional trade exists. Section 4 defines the conditions under which only one region exports to the other region, whereas Section 5 describes conditions under which there is no interregional trade.[3] Section 6 concludes the paper.

2. The model

Let us assume a model with two regions, $i = 1, 2$; belonging to a single country plus the rest of the world. To satisfy a certain demand for a good, the country may import this good at international price p_w plus the applied tariff, or it can produce it locally in both regions. We assume that the country has import quotas $\overline{M}$ distributed between the two regions such that:

$$\overline{M} = \sum_i M_i \tag{1}$$

where M_i is imports intended for region i. Further, we consider that without loss of generality, imports are only those allowed under import quotas.

Each region i produces a single good according to a technology with constant returns to scale. The production cost function in region i is defined by:

$$G_i(y_i) = \alpha g y_i \text{ with} \begin{cases} \alpha = 1 & \text{for } i = 1 \\ \alpha \in \,]0,1[& \text{for } i = 2 \end{cases} \tag{2}$$

where g and y_i represent the marginal cost of production and the quantity produced in region i respectively. The parameter α measures production cost asymmetry between the two regions. Therefore, the marginal cost is lower in region 2. Further, we assume that interregional and bilateral trade is possible; q_{ij} represents sales from region i to region j. The unit cost of transport between regions i and j is represented by the positive constant c_{ij} such that $c_{ii} = 0$ and $c_{ij} = c_{ji} = c$. Each region i must ensure that the quantity demanded locally (Q_i) does not exceed the sales of both regions plus the import volume permitted under import quotas:

$$\sum_j q_{ji} + M_i \geq Q_i \quad , \quad i = 1, 2. \tag{3}$$

In addition, for each region i, the sum of the quantity sold locally and that sold in the second region cannot exceed local production:

$$y_i \geq \sum_j q_{ij} \quad , \quad i = 1, 2. \tag{4}$$

Under the assumption of homogeneous products, and following Oshiro (2013) among others, the inverse demand function region i faces is denoted by:

$$p_i^d = \left(a - (a\gamma_i)^{-1} M_i\right) - (a\gamma_i)^{-1} \sum_j q_{ji}. \tag{5}$$

The parameter γ_i is a measure of the relative market i size and the other parameters as defined above. Without loss of generality, we assume that $\gamma_1 = 1$ and $\gamma_2 = \gamma$, with $\gamma \neq 1$. We assume that the two regions compete *à la* Cournot on the market of each region.[4]

The game is played in two steps. In the first step, the country selects import quotas that maximize the total welfare of both regions. The welfare of each region is the sum of the producer and consumer surplus and import permit holders' rent. In the second step, each region determines the sales that maximize its profits, and therefore the total quantity produced. As usual, the problem is solved using backward induction, and is presented in the following section.

3. Optimality of import quotas in a context of trade in both directions

The profit maximization program of the producer in region 1 that sells its product in both regions is:[5]

$$\max_{q_{1j}} \pi_1 = \sum_{j=1}^{2} \left(a - \left(a\gamma_j\right)^{-1} M_j - \left(a\gamma_j\right)^{-1} \sum_{i=1}^{2} q_{ij}\right) q_{1j} - g \sum_{j=1}^{2} q_{1j} - \sum_{j=1}^{2} c_{1j} q_{1j}. \tag{6}$$

The first-order condition of the maximization problem given by (6) is:

$$\frac{\partial \pi_1}{\partial q_{1j}} = a - \left(a\gamma_j\right)^{-1} M_j - \left(a\gamma_j\right)^{-1} q_{2j} - 2\left(a\gamma_j\right)^{-1} q_{1j} - (g + c_{1j}) \leq 0 \;\left(= 0 \text{ for } q_{1j} > 0\right). \tag{7}$$

[3] We do not present three other possibilities, namely that where: (i) the producer in region 2 acts as a monopoly on the market of each region; (ii) the producer in region 2 acts as a monopoly on the market of its region, and sales of the two regions are zero on the market of region 1; and (iii) nothing is produced locally. These results are available upon request.

[4] Few papers on import quotas have considered market power (e.g. de Gorter and Boughner, 1999; Hraianova and de Gorter, 2005; Okumura, 2015; Rude and Gervais, 2006). They assume the product to be homogenous and firms compete *à la Cournot*, to avoid the Bertrand paradox. By modelling firms' behavior under capacity constraints, Kreps and Scheinkman (1983) consider a two-stage game. In the first stage, firms choose capacity, whereas in the second, after observing their rivals' capacity, firms compete on price. Kreps and Scheinkman thus argue that because quantities are fixed, the outcome of this particular two-stage game is exactly that of Cournot. Moreover, Scopolla (2010) asserts that if the cost of increasing capacity in the second stage is very high, then the capacity commitment remains relevant and firms compete on quantity, that is, the outcome of the game is Cournot. Scopolla (2010) shows that if the cost of increasing capacity in the second stage is equal to that incurred by firms in the first stage, then the capacity chosen in the first stage does not work as a commitment device; in this case, the capacity constraint is negligible and firms compete on price, that is, the outcome of the game is Bertrand.

[5] The profit maximizing choice of q_{11} is independent of q_{12} and similar for q_{21} and q_{22}: each region can be considered separately. This separation is a very convenient simplification that arises from the assumption of constant marginal cost (Brander and Krugman, 1983).

Eq. (7) lets us obtain the reaction functions of the producer in region 1:

$$q_{1j} = \left(\left(a\gamma_j\right)(a-g-c_{1j})-M_j-q_{2j}\right)/2 \text{ for } j=1,2.$$

Similarly, for the producer in region 2, we obtain $q_{2j} = ((a\gamma_j)(a - \alpha g - c_{2j}) - M_j - q_{1j})/2$.

By simultaneously solving all of the reaction functions, we determine the interior solutions of q_{1j} and q_{2j} given by:[6]

$$\begin{array}{l} q_{1j}^* = \left(a\gamma_j\right)\left(a-2(g+c_{1j})+(\alpha g+c_{2j})-\left(a\gamma_j\right)^{-1}M_j\right)/3 \\ q_{2j}^* = \left(a\gamma_j\right)\left(a-2(\alpha g+c_{2j})+(g+c_{1j})-\left(a\gamma_j\right)^{-1}M_j\right)/3 \end{array}, \text{ for } j=1,2. \tag{8}$$

According to (8), sales depend negatively on import quotas. An increase in import quotas lowers the demand that the local producer faces, which decreases sales. Further, sales from one of the regions to the other region depend on the degree of production cost asymmetry measured by the parameter α. We have assumed that region 2 is more efficient. An improvement in production efficiency in region 2 favors an increase in local sales in this region ($\partial q_{22}/\partial\alpha < 0$) and development of unilateral interregional trade (from region 2 to region 1) because $\partial q_{21}/\partial\alpha < 0$. In contrast, improving production efficiency in region 2 reduces local sales in region 1 and sales of region 1 in region 2 simultaneously ($\partial q_{12}/\partial\alpha > 0$ and $\partial q_{11}/\partial\alpha > 0$). Lastly, as expected, transaction costs negatively influence sales ($\partial q_{ij}/\partial c_{ij} < 0$ with $i \neq j$) whereas market size has a positive effect ($\partial q_{ij}/\partial\gamma_j > 0$ with $i \neq j$). By using expressions of sales in different regions given by (8), the constraints given by Eqs. (3) and (4) and the demand function given by Eq. (5), it is possible to deduce the quantity demanded $Q_i^* = \sum_j q_{ji}^* + M_i$, the quantity produced $y_i^* = \sum_j q_{ij}^*$ and the price $p_i^* = a - (a\gamma_i)^{-1}M_i - (a\gamma_i)^{-1}\sum_j q_{ji}^*$.

The last step in solving the problem consists of finding import quotas M_i that maximizes the total welfare of both regions. The problem is defined as follows:

$$\max_{\{M_i\}_{i=1,2}} W = \sum_i \left[U_i(Q_i^*)-p_i^*Q_i^*+\sum_j p_j^*q_{ij}^*-g_iy_i^*-\sum_j c_{ij}q_{ij}^*+(p_i^*-p_w)M_i\right] \tag{9}$$

where $U_i(Q_i^*)$ is the utility function of consumers. The first-order condition is:

$$\frac{\partial W}{\partial M_i} = (1/9)\left(a+4(c+(1+\alpha)g)-(a\gamma_i)^{-1}M_i\right)-p_w \leq 0 \quad (=0 \text{ for } M_i>0). \tag{10}$$

Solving (10), it is possible to determine optimal import quotas for region i:

$$M_i^* = a\gamma_i(a+4(c+(1+\alpha)g)-9p_w). \tag{11}$$

According to (11), the region with a larger market (γ_i) will receive more of the imports.

Optimal import quotas of the country are the sum of imports of both regions:[7]

$$\overline{M}^* = a(1+\gamma)(a+4(c+(1+\alpha)g)-9p_w). \tag{12}$$

Our results depend on the mode of quota administration. However, each management mode requires a specific modeling. In our model, country first determines the optimal quota of each region and then the optimal importation of the country. Because license distribution takes into account each region's size and efficiency, we explicitly assume that, like within the "use-it or lose it" clause, the attributed licenses are entirely used. This is the case for most products under import quotas (see e.g. Grant et al., 2009; Pouliot and Larue, 2012; WTO, 2013b). However, if the management method is based on first come first served, the country first determines the optimal national import quotas which would then be distributed among the importers of different regions according to their ranking.

3.1. Conditions for trade in both directions

Based on the interior solutions of q_{1j} and q_{2j} given by (8), we deduce the following market conditions under which interregional trade is possible ($q_{ij} > 0$, $\forall\ i = 1, 2$ et $j = 1, 2$):

$$\begin{array}{l} \text{For region 1}: \begin{cases} q_{11} \geq 0 \text{ if } M_1 \leq a(a-2g+(\alpha g+c)) \\ q_{12} \geq 0 \text{ if } M_2 \leq a\gamma(a-2(g+c)+\alpha g) \end{cases} \\ \text{For region 2}: \begin{cases} q_{21} \geq 0 \text{ if } M_1 \leq a(a-2(\alpha g+c)+g) \\ q_{22} \geq 0 \text{ if } M_2 \leq a\gamma(a-2\alpha g+(g+c)) \end{cases}. \end{array} \tag{13}$$

Under optimal import quotas solution given by Eqs. (11) and (13), local sales in a given region i and interregional trade in both direction are possible only if the world price reaches a certain value. This is given by the Proposition 1, the proof of which appears in Appendix 1.

Proposition 1. Local sales in a region i ($q_{ii} > 0\ \forall\ i = 1, 2$) and interregional trade from region i to region j ($q_{ij} > 0\ \forall\ i \neq j\ ;\ \forall\ i = 1, 2\ ;\ \forall\ j = 1, 2$) are possible only if $p_w > \frac{1}{3}((2+\alpha)g + 2c)$.

Proposition 2 presents the implications of the above results in terms of trade flow between the regions.

Proposition 2. Given the parameter of production cost asymmetry between the two regions defined by α,

(i) Exports from the region with the highest costs to the region with the lowest costs exist ($q_{12} > 0$) if and only if $\alpha < (g)^{-1}[3p_w - 2(g + c)]$.
(ii) Exports from the region with the lowest costs to the region with the highest costs exist ($q_{21} > 0$) if and only if $\alpha < 0.5(g)^{-1}[3p_w - (g + 2c)]$.

Proposition 2 implies that, *all things being equal*, as expected, the reduction in transaction costs increases the likelihood that the region with the highest production costs exports to the region with the lowest costs. Let $\Phi \equiv g^{-1}[3p_w - 2(g + c)]$. The reduction in transaction costs makes the constraint less restrictive given that $\partial\Phi/\partial c < 0$ while the decrease in world price makes it more restrictive given that $\partial\Phi/\partial p_w > 0$. It is therefore possible to define bilateral trade zones according to the value of transaction costs (c) and world price (p_w). Fig. 1.a represents the zone in which there is trade between the regions, according to transaction costs, and Fig. 1.b presents the zone in which there is bilateral trade between regions, according to world price.

Note that the most restrictive condition presented in Proposition 2 concerns sales from the region with the highest production costs to the region with the lowest production costs. Therefore, exporting from the region with the highest costs to the region with the lowest costs is possible ($q_{12} > 0$) only if the gain from production efficiency of region 2 (lowest costs) relative to region 1 (α) is markedly lower than the difference between the gain from the international price level relative to the marginal cost of region 1 represented by $\frac{p_w}{g}$ and

[6] The Nash equilibrium in a multilateral trade context with n regions is: $q_{ij} = \frac{a\gamma_j}{(n+1)}\left[a - n(g_i+c_{ij}) + \sum_{m\neq i}(g_m+c_{mj}) - (a\gamma_j)^{-1}M_j\right]$.

[7] The solution of optimal import quotas for region i in a multilateral trade context with n regions is $M_i^* = (a\gamma_i)(a+(n+2)\sum_{j=1}^{n} g_jc_{ji}-(n+1)^2p_w)$ and the solution of optimal import quotas for the country in a multilateral trade context with n regions is $\overline{M}^* = a\sum_{i=1}^{n}\gamma_i\left(a+(n+2)\sum_{j=1}^{n} g_jc_{ji}-(n+1)^2p_w\right)$.

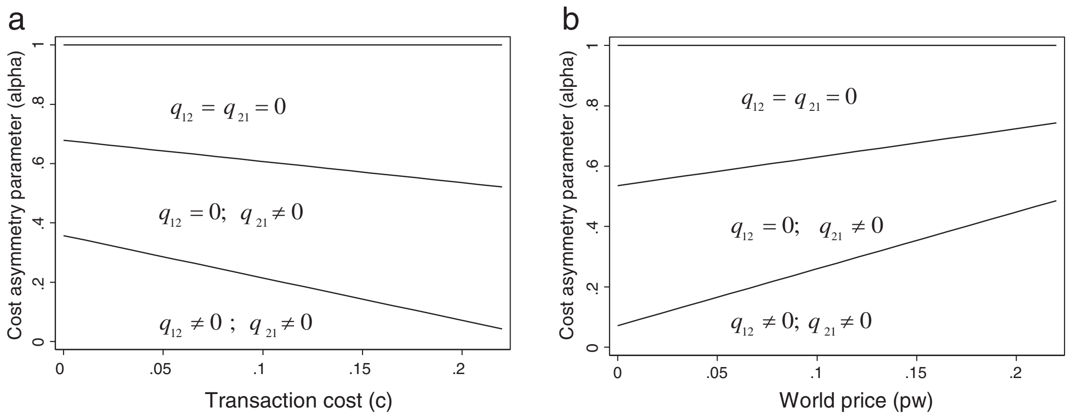

Fig. 1. Effect of transaction costs, cost asymmetry and world price on regions' regions' capacity to trade with each other. a. Effect of transaction costs and cost asymmetry parameter on regions' capacity to trade with each other. b. Effect of world price and cost asymmetry parameter on regions' capacity to trade with each other.

the gain from the transaction cost relative to the marginal cost in the same region $\frac{g+c}{g}$.[8]

3.2. Welfare impact of an increase in import quotas

The Comprehensive Economic Trade Agreement (CETA) between Canada and European Union is an example of an increase in import quotas. Under the deal principle of the CETA, EU producers will be able to ship additional cheese into Canada while Canadian beef producers will be eligible for new quota access into the European Union.[9] Current Trans-Pacific Partnership (TPP)[10] trade talks as well as the Transatlantic Trade and Investment Partnership (TTIP)[11] between the European Union and the United States specifically target import quotas. We now examine the effect on welfare of the increase in import quotas. Let us denote by $M_1^{\max}$ and $M_2^{\max}$ the maximum quantity of imports in regions 1 and 2 respectively, under which interregional trade is possible. Based on (13) we have:

$$M_1^{\max} \begin{cases} = a(a-2(\alpha g + c) + g) \; if \; g < \alpha g + c \\ = a(a-2g + (\alpha g + c)) \; if \; g > \alpha g + c \end{cases}$$
$$M_2^{\max} = a\gamma(a-2(g+c) + \alpha g).$$

Fig. 2 shows that the total welfare in both regions increases as the import quotas in each region rise to the optimal. Beyond optimal import quotas, total welfare decreases until it reaches a quantity that corresponds to imports $M_1^{\max}$ and $M_2^{\max}$. The variation in welfare depends on the variation in producer and consumer surplus, along with permit holders' rent.

An increase in import quotas in region 1 decreases the demand that the local producer faces, which lowers the price and quantity produced, and consequently decreases the producer surplus. Further, an increase in quotas in region 2 reduces the sales of region 1 on the market of region 2. This decrease in sales lowers the producer surplus and the welfare of region 1. An increase in import quotas decreases the price paid by consumers, and consequently improves their welfare.

3.3. Import permit holder's rent

We analyze in greater detail the impact of quotas on import permit holders' rent $M_1^R = (p_1^* - p_w)M_1$ and welfare in region 1. The results are presented in the following proposition, the proof of which appears in Appendix 2.

Proposition 3. *Let* M_1^* *be the optimal import quotas and* M_1^R *the import that maximizes permit holders' rent in region 1. The difference between* M_1^* *and* M_1^R *is:*

(i) strictly positive when $p_w \in \left]\frac{1}{15}(a+7(c+(1+\alpha)g)), \; \frac{1}{9}(a+4(c+(1+\alpha)g))\right[$
(ii) strictly negative when $p_w \in \left]0, \; \frac{1}{15}(a+7(c+(1+\alpha)g))\right[$
(iii) zero when $p_w = \frac{1}{15}(a+7(c+(1+\alpha)g))$

According to Proposition 3, there is a world price for which the interests of import permit holders coincide with the objective of maximizing total welfare (condition (iii)). More interestingly, condition *(ii)* indicates that a low world price increases the probability of the quotas that maximize import permit holders' rent (M_1^R) being higher than the quotas that maximize global welfare (M_1^*). This is explained by the higher negative effect of increasing imports quotas on the producer surplus, which outweighs the positive effect of the increase in import quotas on the consumer surplus and permit holders' rent. In contrast, condition (*i*) indicates that a higher world price increases the probability of welfare-maximizing import quotas being higher than the import quotas that maximizes import permit holders' rent. In this case, for

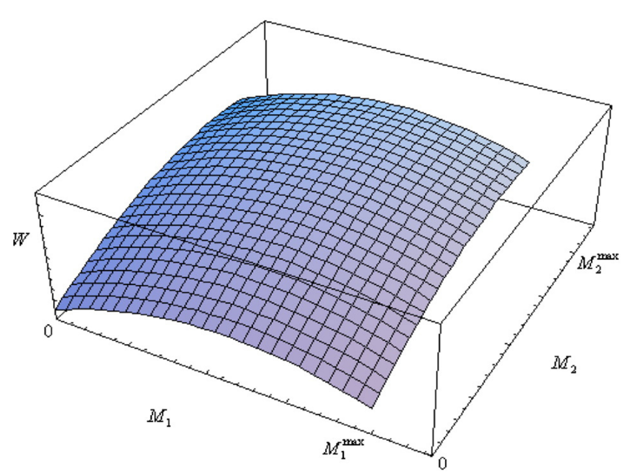

Fig. 2. Impact of import quotas on welfare of the two regions.

[8] Formally, trade from region 1 to region 2 is possible ($q_{12} > 0$) only if $p_w > \frac{1}{3}(2g + \alpha g + 2c)$. In this case, optimal import quotas level chosen for each region is defined by (11). For each region i the following conditions must be met $p_i^* \geq p_w$, which occurs when $p_w > \frac{2}{3}(g+c) + \frac{1}{3}\alpha g$. The solution of the model gives identical prices in both regions, namely: $p_i^* = 3p_w - (1+\alpha)g - c$. Condition $p_i^* \geq p_w$ which implies $p_w \geq 1/2g + 1/2(\alpha g + c)$ is verified given that $p_w > 2/3(g+c) + 1/3\alpha g$. Under this condition, the production cost asymmetry must be such that $\alpha < g^{-1}[3p_w - 2(g+c)]$.

[9] See at http://www.actionplan.gc.ca/en/page/ceta-aecg/agreement-overview (Accessed October 29, 2013).

[10] See at http://www.international.gc.ca/trade-agreements-accords-commerciaux/agr-acc/tpp-ptp/index.aspx?lang=eng. Accessed August 08, 2015.

[11] See at http://ec.europa.eu/trade/policy/in-focus/ttip/. Accessed August 08, 2015.

global welfare, the gain of "controlling" the negative impact of increasing import quotas on producers' surplus outweighs the positive effect on consumer surplus and permit holders' rent.

4. Exporting from the most efficient to the least efficient region

Now, we examine the situation where the producer from region 2 acts like a monopoly on the market of its region and competes *à la* Cournot on the market of region 1. Therefore, $q_{11} > 0$, $q_{12} = 0$, $q_{21} > 0$ and $q_{22} > 0$. This situation is observable if condition (2) of Proposition 2 is not met, that is: $p_w \le \frac{2}{3}(g+c) + \frac{1}{3}\alpha g$. The solution to the problem of maximizing the producer's profit determines the sales solutions:

$$\text{For region 1}: \begin{cases} q^*_{11} = (a(a-2g+(\alpha g+c))-M_1)/3 \\ q^*_{12} = 0 \end{cases}, \tag{14}$$

$$\text{For region 2}: \begin{cases} q^*_{21} = (a(a-2(\alpha g+c)+g)-M_1)/3 \\ q^*_{22} = (a\gamma(a-\alpha g)-M_2)/2 \end{cases}. \tag{15}$$

New conditions on sales according to import quotas are as follows:

$$\text{For region 1}: \begin{cases} q_{11} \ge 0 \text{ if } M_1 \le a(a-2g+(\alpha g+c)) \\ q_{12} = 0 \text{ if } M_2 > a\gamma(a-2(g+c)+\alpha g) \end{cases}, \tag{16}$$

$$\text{For region 2}: \begin{cases} q_{21} \ge 0 \text{ if } M_1 \le a(a-2(\alpha g+c)+g) \\ q_{22} \ge 0 \text{ if } M_2 \le a\gamma(a-\alpha g) \end{cases}. \tag{17}$$

The solutions to the problem must satisfy conditions (16) and (17), which give the conditions for which there is unilateral interregional trade from region 2 to region 1, whereas the inverse is not true. This result is explained in Proposition 4.

Proposition 4. *Exporting from the region with the lowest costs to that with the highest costs exists* ($q_{21} > 0$), *whereas the inverse is impossible* ($q_{12} = 0$) *only if the productive efficiency of region 2 relative to that of region 1 is such that* $(g)^{-1}\left[\frac{3}{2}p_w - \frac{1}{2}(g+c)\right] < \alpha < (g)^{-1}[3p_w - 2(g+c)]$.

Fig. 1.a and b in Section 2 present the zones in which the region with the lowest production costs exports to the region with the highest costs, according to the transaction costs and world price respectively. Fig. 1.a clearly indicates that to overcome a higher transaction cost, the most efficient region has to decrease its production cost. Fig. 1.b shows that the constraint of production cost is less restrictive for a high world price.

Solving the first-order conditions of the maximization problem of total welfare of the two regions gives us the optimal solutions of M_1 and M_2:

$$M^*_1 = a(a+4(c+(1+\alpha)g)-9p_w), \tag{18}$$

$$M^*_2 = a\gamma(a+3\alpha g-4p_w). \tag{19}$$

The optimal import quotas of both regions are therefore:

$$\overline{M}^* = a(4c-(9+4\gamma)p_w + a(1+\gamma) + (4(1+\alpha)+3\alpha\gamma)g). \tag{20}$$

This will be effective for $p^*_i \ge p_w$ (see Appendix 3). In addition, Proposition 5 below shows that according to the world price and cost asymmetry, the largest region, even if it is also the most efficient, can receive a greater portion of import quotas. The intuition is that low prices and/or relatively high production costs justify consumer sourcing through imports. The proof of Proposition 5 is presented in Appendix 4.

Proposition 5. Let $\theta \equiv \frac{4(g+c)+\alpha g-5p_w}{a+3\alpha g-4p_w} > 0$ and γ be the size asymmetry parameter between the regions. The largest and most efficient region is the one that:

(i) receives the smallest share of import quotas if $\gamma \in]1, 1+\theta[$
(ii) receives the same import quotas share as the other region if $\gamma = 1+\theta$
(iii) receives the highest share of import quotas if $\gamma \in]1+\theta, +\infty[$.

From the definition of parameter θ, the greater the transaction costs, the more a large size difference will be necessary for the larger region to receive a larger share of import permits ($\partial\theta/\partial c > 0$). *All things being equal*, the larger region does not find it profitable to export a portion of its production toward the smaller region. For the larger region, an increase of transaction costs decreases its exports but also increases its sales in the local market. Therefore, the largest and most efficient region needs fewer shares of the import quota; and *vice versa* for the smaller region.

5. Optimal import quotas without interregional trade

In this situation with no interregional trade, each producer acts like a monopoly on the market of its region. Therefore, $q_{11} > 0$, $q_{12} = 0$, $q_{21} = 0$ et $q_{22} > 0$. Optimal solutions must uniquely satisfy the conditions on the existence of trade on each local market. The condition on the absence of trade between the regions becomes:

$$\text{For region 1}: q_{12} = 0 \text{ if } p_w \le \frac{2}{3}(g+c) + \frac{1}{3}\alpha g, \tag{21}$$

$$\text{For region 2}: q_{21} = 0 \text{ if } p_w \le \frac{1}{3}g + \frac{2}{3}(\alpha g + c). \tag{22}$$

The most constraining condition is given by Eq. (22), which concerns the inability of the least efficient region to supply the market of the most efficient region. In the case where $g < \alpha g + c$ and $g < p_w \le \frac{1}{3}g + \frac{2}{3}(\alpha g + c)$, we have $q_{11} > 0$, $q_{12} = 0$, $q_{21} = 0$ and $q_{22} > 0$. The condition $g < \alpha g + c$ implies that the lowest marginal production cost in region 2 does not suffice to compensate for the costs associated with transport costs, whereas the second condition takes global market conditions into account. This result is summarized in Proposition 6.

Proposition 6. For the import quotas allocated to each region not to give rise to interprovincial trade, the cost asymmetry between the two regions must satisfy the following condition: $\alpha \ge (g)^{-1}[3p_w - 2(g+c)]$.

Fig. 1.a and b present the zone in which there is no trade between the regions, according to transaction costs and world price respectively.[12] We obtain the following solutions to the problem of maximizing the producer profit in each region:

$$\text{For region 1}: \begin{cases} q^*_{11} = (a(a-g)-M_1)/2 \\ q^*_{12} = 0 \end{cases}, \tag{23}$$

$$\text{For region 2}: \begin{cases} q^*_{21} = 0 \\ q^*_{22} = (a\gamma(a-\alpha g)-M_2)/2 \end{cases}. \tag{24}$$

For having local sales the following conditions on import quotas must be met: $M_1 \le a(a-g)$ for region 1 and $M_2 \le a\gamma(a-\alpha g)$ for region 2. From the first-order conditions, the solutions of M_1 and M_2 that maximize the total welfare are:

$$M^*_1 = a(a+3g-4p_w), \tag{25}$$

$$M^*_2 = a\gamma(a+3\alpha g-4p_w), \tag{26}$$

and the optimal import quotas of the set of both regions is:

$$\overline{M}^* = a(a(1+\gamma) - 4p_w(1+\gamma) + 3g(1+\alpha\gamma)). \tag{27}$$

Eqs. (25) and (26) imply that when the production costs of both regions are symmetrical ($\alpha = 1$), the region with the greatest market size receives a higher volume of imports. In the case of symmetrical demand ($\gamma = 1$), the region with the lowest marginal cost will have a smaller share of imports.

[12] Optimal import quotas of each region is effective because $p^*_i \ge p_w$ (see Appendix 5).

6. Concluding remarks

The prevalence of import quotas in several countries and different economic sectors has generated rich literature. Canada, European Union and United States are examples of countries using this mechanism. This justifies the will of some WTO member nations to increase importations allowed under import quotas. In addition, bilateral trade agreements concluded or in discussion like the Comprehensive Economic Trade Agreement (Canada and European Union), the Trans-Pacific Partnership (several Pacific Rim countries) and the Transatlantic Trade and Investment Partnership (European Union and the United States) address the issue of increasing import quotas.

This paper analyzes the impact of import quotas on the welfare of different regions belonging to a single country. Regions compete with one another using Cournot conjectures. International trade is hindered by restrictive import quotas. The model features two regions and one product. We derive the conditions under which it is optimal to observe interregional trade and those under which trade does not exist. Under optimal import quotas, local sales in a given region and interregional trade are function of world price and transaction costs. The practical implication is that it is possible to define interregional trade zones according to the value of these parameters: trade in both directions, trade in only one direction and finally no trade. Also, we show that exporting from the region with the highest costs to the region with the lowest costs is possible only if cost asymmetry between the two regions is markedly lower than the difference between the international price and the cost of supplying good from the less efficient region to the most efficient one. When only the most efficient region exports to the least efficient one, world price, production cost asymmetry and transaction costs play important roles in the issuing of import permits.

Regarding the issue of increasing import quotas, our results show that, there is a world price for which the interests of import permit holders coincide with the objective of maximizing total welfare. A low world price increases the probability of the quotas that maximize import permit holders' rent being higher than the quotas that maximize global welfare. This is explained by the higher negative effect of increasing imports quotas on the producer surplus, which outweighs the positive effect of the increase in import quotas on the consumer surplus and permit holders' rent. In contrast, a higher world price increases the probability of welfare-maximizing import quotas being higher than the import quotas that maximizes import permit holders' rent. In this case, for global welfare, the gain of “controlling” the negative impact of increasing import quotas on producers' surplus outweighs the positive effect on consumer surplus and permit holders' rent. This issue has practical implications since, in some cases, import permits holders are from partner countries.

In addition, we show that according to the world price and cost asymmetry, the largest region, even if it is also the most efficient, can receive a greater portion of import quotas. The intuition is that low prices and/or relatively high production costs justify consumer sourcing through imports. The greater the transaction costs, the more a large size difference will be necessary for the larger region to receive a larger share of import permit. For the larger region, an increase of transaction costs decreases its exports but also increases its sales in the local market. Therefore, the largest and most efficient region needs fewer shares of the import quota. These results may provide a support for decision makers to determine the optimal quotas and the best way to allocate import permits between regions

The results of our model depend on market structure and the administration of import quotas. Indeed, a generalization of our work may be to consider the conjectural variation model, in which Cournot competition is a special case where the results depend on the parameter of the conjectural variation. Another possible extension is to consider the Stackelberg leader–follower model in which each region is a leader in its home market and a follower abroad. In our model, the country determines the optimal import quotas of each region, which determines the country's optimal quota. Import licenses are distributed by taking into account the size and the efficiency of each region. However, if the management method is based on first come first served, the country first determines the optimal national quotas, which would then be distributed among the importers of different regions according to their ranking. Finally, it could be interesting to see how our theoretical results fit with empirical data using simulation in a spatial equilibrium modeling approach.

Appendix 1. Proof of Proposition 1

According to this case, there is no corner solution: all sales are observed. Optimal quota solutions must satisfy the conditions of (13), which let us obtain the following conditions:

For region 1:

$$q_{11} \geq 0 \quad \text{if} \quad pw \geq \frac{2}{3}g + \frac{1}{3}(\alpha g + c) \tag{28}$$

$$q_{12} \geq 0 \quad \text{if} \quad pw \geq \frac{2}{3}(g + c) + \frac{1}{3}\alpha g \tag{29}$$

For region 2:

$$q_{21} \geq 0 \quad \text{if} \quad pw \geq \frac{1}{3}g + \frac{2}{3}(\alpha g + c) \tag{30}$$

$$q_{22} \geq 0 \quad \text{if} \quad pw \geq \frac{1}{3}(g + c) + \frac{2}{3}\alpha g \tag{31}$$

Condition (29) is the most restrictive. If it is satisfied then $q_{11} > 0$, $q_{12} > 0$, $q_{21} > 0$ and $q_{22} > 0$. The optimal import quotas chosen for each region M_i^* $(i = 1, 2)$, are defined by Eq. (11) and they are effective for $p_i^* \geq pw$. Further, the solution of the model gives identical prices in both regions, namely: $p_i^* = 3pw - (1 + \alpha)g - c$. Condition: $p_i^* \geq pw$, which implies $pw \geq \frac{1}{2}g + \frac{1}{2}(\alpha g + c)$ because condition $pw > \frac{2}{3}(g + c) + \frac{1}{3}\alpha g$ is the most restrictive.

Appendix 2. Proof of proposition 3

Import permit holders in region 1 maximize their rent:

$$\max_{M_1} (p_1^* - p_w) M_1,$$

$$\max_{M_1} (a(a + c + g - 3pw + \alpha g) - M_1) M_1 / 3a.$$

The maximum rent for a value of imports to region 1 that verifies the following equation:

$$M_1 : (a(a + c + g - 3pw + \alpha g) - 2M_1)/3a = 0.$$

This gives the solution:

$$M_1^R = \frac{1}{2}a(a + c + g(1 + \alpha) - 3pw).$$

We therefore have:

$$M_1^R > 0 \ \text{if} \ pw < (a + c + g + \alpha g)/3. \tag{32}$$

The import quota that maximizes total welfare is:

$$M_1^* = a\gamma_1(a + 4(c + (1 + \alpha)g) - 9p_w),$$

$$M_1^* > 0 \ \text{if} \ \text{pw} < (a + 4(c + (1 + \alpha)g))/9. \tag{33}$$

Condition (33) is more restrictive than condition (32):

$$9p_w - 4(c + (1+\alpha)g) > 3pw - c - g - \alpha g \Rightarrow pw > \frac{1}{2}(g + \alpha g + c). \quad (34)$$

Condition (34) is less restrictive than condition $p_w > \frac{1}{3}(2g + \alpha g + 2c)$, which is defined in Proposition 1: $\frac{1}{2}(g + \alpha g + c) < \frac{1}{3}(2g + \alpha g + 2c) \Rightarrow \alpha g < g + c$.

Let us now calculate the difference, $M_1^* - M_1^R$:

$$\Delta M_1^R = M_1^* - M_1^R = \frac{a}{2}(a + 7c + 7g - 15pw + 7\alpha g).$$

We can conclude that:

$$\begin{cases} \Delta M_1^R \geq 0 \text{ if } p_w \in \left]0, \ \frac{1}{15}(a + 7(c + (1+\alpha)g))\right[\\ \Delta M_1^R < 0 \text{ if } p_w \in \left]\frac{1}{15}(a + 7(c + (1+\alpha)g)), \ \frac{1}{9}(a + 4(c + (1+\alpha)g))\right[. \\ \Delta M_1^R = 0 \text{ if } p_w = \frac{1}{15}(a + 7(c + (1+\alpha)g)) \end{cases}$$

Appendix 3. Condition of efficiency of optimal import quota when the most efficient region exports to the least efficient region

The price in region 1 is: $p_1^* = 3p_w - (1+\alpha)g - c \; p_1^* \geq p_w$ which implies that $\frac{1}{2}g + \frac{1}{2}(\alpha g + c) \leq p_w$. This condition is satisfied for $g > \alpha g + c$ because $1/2g + 1/2(\alpha g + c) < 2/3g + 1/3(\alpha g + c)$ and in the case where $g < \alpha g + c$ because $1/2g + 1/2(\alpha g + c) < 1/3g + 2/3(\alpha g + c)$. Therefore, we can conclude that the import quota of region 1 is effective regardless of $g \geq (<) \alpha g + c$. In region 2, the equilibrium price is $p_2^* = 2p_w - \alpha g \; p_2^* \geq p_w$ which implies that $\alpha g \leq p_w$. This condition is satisfied when $g > \alpha g + c$ because $\alpha g < 2/3g + 1/3(\alpha g + c)$ and in the case where $g < \alpha g + c$ because $\alpha g < 1/3g + 2/3(\alpha g + c)$. It is therefore possible to conclude that the import quota of region 2 is effective regardless of $g \geq (<) \alpha g + c$.

Appendix 4. Proof of proposition 5

Let us define by ΔM the difference between the optimal import quota for region 1 and that of region 2:

$$\Delta M = M_1^* - M_2^* = a(a(1-\gamma) + 4c + (4\gamma - 9)p_w + g(4(1+\alpha) - 3\alpha\gamma)). \quad (35)$$

Based on (35), it is possible to show that $M_1^* \geq M_2^*$ only when $\gamma \leq 1 + \theta$ with $\theta \equiv \frac{4(g+c)+\alpha g - 5p_w}{a + 3\alpha g - 4p_w} \geq 0$. Accordingly, $4(g + c) + \alpha g - 5p_w \geq 0$ and $a + 3\alpha g - 4p_w > 0$ because $4(g + c) + \alpha g - 5p_w \geq 0$, which implies that $p_w \leq 4/5(g + c) + 1/5\alpha g$. However, the condition $p_w \leq 2/3(g + c) + 1/3\alpha g$ is more restrictive: $2/3(g + c) + 1/3\alpha g < 4/5(g + c) + 1/5\alpha g$ which implies that $g + c > \alpha g$. The optimal access in region 2, M_2^*, must be strictly positive: $M_2^* > 0$, which implies that $a + 3\alpha g - 4p_w > 0$.

Appendix 5. Condition of efficiency of optimal import quota when there is no trade between regions

The price in region 1 is $p_1^* = 2p_w - g$ and we have $p_1^* \geq p_w$, which implies that $g \leq p_w$ because $g < p_w \leq 1/3g + 2/3(\alpha g + c)$. In region 2, the equilibrium price is $p_2^* = 2p_w - \alpha g$ and $p_2^* \geq p_w$, which implies that $\alpha g \leq p_w$ because $\alpha g < g$ and $g < p_w \leq 1/3g + 2/3(\alpha g + c)$.

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