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The model suggests that parallel trade – provided that it is a credible threat – reduces the profit of the manufacturer and thus reduces his incentives to invest in R&D. If, however, trade costs are high, parallel trade is a non-credible threat as it is not a worthwhile business activity for the foreign distributor and thus does not have any impact on the profit of the manufacturer.

The model shows that parallel trade has positive welfare properties if the two countries are sufficiently heterogeneous in terms of market size and if trade costs are intermediate and low, respectively. If, however, the countries are virtually homogenous in terms of market size, parallel trade may be detrimental to global welfare for specific levels of trade costs.

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Keywords: parallel trade, pharmaceuticals, R&D incentives, welfare effects, economic analysis of intellectual property rights

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1. Introduction

Parallel imports are also known as gray-market imports.[1] More specifically, a parallel-imported product is a legitimately manufactured product under intellectual property protection that is first placed into circulation in one country. Then, the product is imported to a second country without the consent of the owner of the intellectual property rights (henceforth, IPRs) that are attached to the product in the second country.[2] For instance, parallel imports occur when a trading firm buys quantities of a particular drug in a low-price country such as Portugal and then imports them into a high-price country such as Germany without the approval of the exclusive distributor that owns the licensed patent rights in Germany.[3]

The ability of an owner of IPRs to exclude parallel trade stems from the importing country's treatment of exhaustion of IPRs.[4]

On the one hand, under a regime of national exhaustion IPRs end upon first sale within a country, and right-holders are awarded the right to prevent parallel imports from other countries.[5] Hence, right owners retain full rights for distributing their goods either themselves or through authorized dealers; this also includes the right to exclude imports.[6]

On the other hand, a regime of international exhaustion of IPRs makes parallel imports from other countries legal, as "rights are exhausted upon first sale anywhere".[7] Countries permitting parallel imports do not provide rightful owners with full rights for distributing their goods themselves, effectively invalidating any right to control the import of goods in circulation abroad.

The regulation of parallel imports in the field of pharmaceuticals has become a critical issue in the global trading system, as the welfare effects of parallel imports of pharmaceuticals are generally ambiguous.[8] The main purpose of this paper is to contribute to the ongoing debate about the welfare effects of parallel trade.

In particular, there is tension between two major objectives of public policy.

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[1] See Müller-Langer (2007) for an extensive overview of the prior theoretic literature on the determinants of parallel trade. See also Maskus (2000) on p. 208 and Maskus (2001) on p. 2.
[2] See Maskus (2000) on p. 208.
[3] For instance, see Chard and Mellor (1989) and Danzon (1998). See also Maskus (2001) on p. 1.
[4] See Müller-Langer (2007) for an extensive overview of the legal framework regarding parallel trade.
[5] See Maskus (2001) on p. 3. See also Hilty (2000) and Maskus (2000) on pp. 208.
[6] See Maskus (2000) on pp. 208.
[7] See Maskus (2001) on p. 3.
[8] See Maskus and Chen (2004) and Danzon and Towes (2003). See also Maskus (2001) and Ganslandt and Maskus (2004) on pp. 1036.

On the one hand, a major long-run public policy objective is to stimulate the innovation and development of new medicines by awarding pharmaceutical producers with a patent on new medicines.[9] In particular, pharmaceutical producers shall benefit from the higher prices of medicines protected by a patent, in order to be able to cover high R&D costs.

On the other hand, public policy should also ensure broad access to affordable existing medicines in the short-run.[10] Hence there is a trade-off between access to affordable medicines in the short-run and higher (monopoly) drug prices to stimulate R&D in the long-run.[11]

The research-intensive pharmaceutical sector relies heavily on patents, as Mansfield (1986) has shown.[12] In particular, the value of a patent depends on the monopoly power afforded in terms of "scope for price differentiation",[13] which depends on the existence of barriers to parallel trade. Put differently, the value of patent rights depends, to a certain extent, on "the scope for price discrimination within the area of exhaustion."[14] Furthermore, the narrower the area of exhaustion the greater is the scope for price differentiation, and thus the higher is *ceteris paribus* the value of a patent. Consequently, advocates of strong patent rights for new pharmaceutical products support a global policy of banning parallel imports.[15] For instance, representatives of the pharmaceutical industry argue that if parallel importation of pharmaceuticals were permitted it would cut profits in the pharmaceutical industry, and thus would reduce the incentives to invest in R&D for new drugs.[16]

Nevertheless, policy makers in many developing countries not endowed with the technical and non-technical input factors required for innovation support an open regime of parallel imports.[17] In particular, they place a larger emphasis on the affordability of pharmaceuticals than on promoting R&D abroad, arguing that it is important to be able to purchase pharmaceuticals from the cheapest sources possible.[18]

The remainder of this paper – being a follow-up paper of Müller-Langer (2007) – is organized as follows. In Chapter 2, I develop a simple double marginalization model with complete

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[9] See Ganslandt and Maskus (2004) on p. 1036.
[10] See Ganslandt and Maskus (2004) on p. 1036.
[11] See Maskus (2001) on p. 23.
[12] For instance, Mansfield (1986) in a ranking of industries' reliance on patent protection for innovation showed that the pharmaceutical sector is more than twice as dependent on patent protection as the next sector (chemicals). See also Harhoff (2005) on p. 4, Harhoff and Reitzig (2004) on p. 457, Harhoff et al. (2003), Bale (1998), Zweifel and Breyer (1997), and OECD (2000).
[13] See Ganslandt and Maskus (2004) on p. 1036.
[14] See Ganslandt and Maskus (2004) on p. 1037.
[15] For instance, see Barfield and Groombridge (1998). See also Bale (1998).
[16] See also Danzon (1998).
[17] See Maskus (2000) on p. 211.
[18] See Maskus (2001) on p. 2.

information which is played between a domestic monopolistic manufacturer of pharmaceuticals and a foreign exclusive distributor. Chapter 3 provides an analysis of the impact of parallel trade freedom on the manufacturer's profit, consumer surplus and national welfare. In Chapter 4, I analyze the net effect of parallel trade freedom on global welfare for low, intermediate, and high trade costs and different levels of heterogeneity of the two countries where the manufacturer and the distributor are located. The paper concludes with some ideas for further research.

2. Double Marginalization Game with Complete Information

2.1. The Model

Player One is a monopolistic manufacturing pharmaceutical firm located in country *A*, henceforth *m*. Player Two is a single authorized independent firm located in country *B*, henceforth *r*, and is responsible for the distribution and retail of the manufacturer's product. The manufacturer holds a patent on the pharmaceutical product in both countries. We assume that efficient international distribution of the pharmaceutical product requires the manufacturer to build a market in country *B* through exclusive territorial dealership rights.[19] For instance, suppose that the exclusive distributor in country *B* has already established costly distribution channels.[20] Furthermore, we assume that the two countries differ in per capita income and in price elasticity of demand for a new medicine.

The strategies available to the manufacturer and the distributor are the different prices they might charge. We will assume that negative prices are not feasible, but that any non-negative price can be charged.[21] Moreover, we assume that the payoff functions for the manufacturer and the distributor are simply their profit.

Consider a model with two countries *A* and *B*. Demand for a specific pharmaceutical product in country *A* is

$$D_A(p_A) = \gamma a - b p_A \quad (1)$$

[19] See Maskus and Chen (2002) and Maskus and Chen (2004) who originally formulated the theory of parallel imports in the context of vertical price controls.

[20] See also Maskus (2000) on p. 213 and Gallini and Hollis (1999) on p. 2.

[21] For instance, assume that disposal costs are equal to zero.

Frank Müller-Langer *Analysis of the Welfare Effects of Parallel Trade Freedom* **5**

with $\gamma > 1$. p_A denotes the price in country *A*. For simplicity, we assume that marginal costs of production *c* are equal to zero in both countries.[22] Demand for the pharmaceutical product in the low-income country *B* is

$$D_B(p_B) = a - bp_B. \tag{2}$$

γ is a measure for the homogeneity of the two countries. If γ tends towards 1 the two countries are virtually homogenous. Put differently, the higher is γ the more heterogeneous are the two countries.

As $\gamma > 1$ we can see from (1) and (2) that the price elasticity of demand[23] in country *A*, $E^A(p)$, is lower than the price elasticity of demand in country *B*, $E^B(p)$, for any given price *p* as

$$E^A(p) = \left|\frac{bp}{\gamma a - bp}\right| < \left|\frac{bp}{a - bp}\right| = E^B(p). \tag{3}$$

Thus, standard economic theory tells us that, in the absence of parallel imports, the single manufacturer engages in third-degree price discrimination and sets a price in country *A* that exceeds the price in country *B*. Put differently, the larger is the size of the market in country *A* and the more inelastic is the demand in country *A*, the higher is the price in country *A*. However, consumers in the smaller country *B* where demand is elastic receive the pharmaceutical product at a lower price.[24]

We assume that there is an exclusive distributor in country *B* that is officially approved by the authorities in country *A* for re-importing the quantities of the pharmaceutical product he can buy from the monopolistic manufacturing firm in country *A*. Hence the distributor sells to consumers in country *B* at first, but may also engage in parallel trade from country *B* to country *A*. We also assume that arbitrage by individual consumers between *B* and *A* is legally prohibited.[25] The marginal costs of engaging in parallel trade are denoted by *t*. The costs of parallel trade include distribution cost as well as advertising cost. For instance, the costs of re-packaging and re-labelling are incurred by the parallel-importing distributor as well as other parallel trade-specific transaction costs such as import duties on parallel trade.[26] Furthermore,

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[22] This is a common assumption in models that deal with the strategic decisions of pharmaceutical companies, as the marginal cost of production are negligibly small compared to the cost of research and development. For instance, see Ganslandt and Maskus (2001) on p. 6.
[23] See Schäfer and Ott (2004) on pp. 71 for a definition of the price elasticity of demand.
[24] See Tirole (1988) on p. 137.
[25] See Ganslandt and Maskus (2004) on p. 1041.
[26] See NERA et al. (1999) on pp. 15. See also Maskus and Chen (2004) on p. 566, Li and Maskus (2006) on p. 447, and Arfwedson (2004) on p. 8.

we assume that the parallel import product is a perfect substitute for the product sold by the original pharmaceutical producer in country *A*.[27]

Before we proceed to the analysis of the double marginalization game in which the exclusive distributor in country *B* may engage in parallel trade we will first analyze the case that the manufacturer of the patented product is awarded the right to prevent parallel imports as a benchmark.

2.1.1. Double Marginalization Game without Parallel Imports

Suppose that the manufacturer can itself become involved in the retail of the pharmaceutical product in country *A*, but sells the product in country *B* through an exclusive distributor. Furthermore, we assume that the distributor in country *B* has a monopoly on the retailing business in country *B*. We make the simplifying assumption that retailing in country *B* does not involve any cost, except for the cost incurred by the distributor in buying the units of the pharmaceutical product from the manufacturing firm. Demand for the pharmaceutical product at the retail level is given by the demand curve $D_B(p_B) = a - bp_B$, where p_B is the retail price in country *B*.

In the first stage, the manufacturing firm sets a wholesale price p_B^w for the distributor, and the distributor sets a price p_B for the retail trade in country *B* in the second stage.[28] We will first assume that the manufacturer is awarded the right to prevent parallel imports of the pharmaceutical product from country *B,* i.e. he is awarded an explicit right of importation of the pharmaceutical product.[29] Arbitrage by individual consumers between the two countries is legally prohibited.[30] The distributor is quoted a wholesale price p_B^w, which he must pay per unit at wholesale.

Using backward induction we start with the second stage. In the second stage, the distributor chooses which retail price p_B he will charge his customers in country *B*.

The distributor, facing wholesale price p_B^w, will treat p_B^w as his marginal cost and will set p_B in order to maximize his profit $\pi(p_B)$.[31] Thus

$$\max_{p_B} \left(p_B - p_B^w \right) D_B(p_B). \tag{4}$$

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[27] See also Ganslandt and Maskus (2004) on p. 1041.
[28] See Spengler (1950).
[29] For instance, see Arfwedson (2004) on p. 4.
[30] See Ganslandt and Maskus (2004) on p. 1044.
[31] Note that the manufacturer's profit is denoted by Π and the distributor's profit by π, respectively.

By inserting (2) into (4) and differentiating (4) we obtain

$$p_B = \frac{a + bp_B^w}{2b}. \tag{5}$$

Furthermore, this gives

$$\pi\left(p_B^w\right) = \frac{\left(a - bp_B^w\right)^2}{4b}. \tag{6}$$

In the first stage, the manufacturing firm sets the wholesale price at p_B^w, anticipating that the distributor will purchase $\left(a - bp_B^w\right)/2$.[32] Hence the manufacturer's profit generated in country *B*, $\Pi_B(p_B^w)$, will be

$$\Pi_B(p_B^w) = p_B^w\left(\frac{a - bp_B^w}{2}\right). \tag{7}$$

Differentiating (7) we obtain

$$p_B^{w*} = \frac{a}{2b}. \tag{8}$$

Inserting (8) into (5) and reformulating (5) we obtain

$$p_B = \frac{3}{2}p_B^{w*}. \tag{9}$$

We can see from (9) that the distributor marks up the price of the pharmaceutical product by 50 percent, compared to the wholesale price p_B^{w*}. Finally, by inserting (8) into (6) we obtain the equilibrium profit of the distributor

$$\pi = \frac{a^2}{16b}. \tag{10}$$

Inserting (8) into (7) we obtain the equilibrium profit of the manufacturer generated in country *B*

$$\Pi_B = \frac{a^2}{8b}. \tag{11}$$

The manufacturing firm maximizes profits generated in country *A* according to

$$\max_{p_A}(\gamma a - bp_A)p_A.^{33} \tag{12}$$

By differentiating (12) we obtain the profit maximizing (monopoly) price as given by

$$p_A^* = \frac{\gamma a}{2b}. \tag{13}$$

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[32] To see that this is true insert (5) into (2) and reformulate (2).
[33] See also Ganslandt and Maskus (2004) on p. 1042.

The profit generated in country *A* is given by

$$\Pi_A = (\gamma a)^2 / 4b\,. \tag{14}$$

So far, we have assumed that the manufacturer is awarded the right to prevent parallel imports. In the following section, we relax this assumption and allow for parallel imports, in order to explore the important strategic decision faced by the manufacturer as to at which wholesale price the pharmaceutical product is sold to the distributor in country *B,* anticipating that part of the quantities sold can be re-imported.

2.1.2. *Double Marginalization Game with Parallel Imports*

Suppose that the manufacturer cannot contractually limit or even prohibit parallel trade.[34] The timing of the game is as follows:

In the first stage, the manufacturing firm chooses the wholesale price p_B^w, $p_B^w \in [0,\infty)$, at which he sells the pharmaceutical product to the distributor in country *B*.

In the second stage, the distributor chooses the retail price p_B, $p_B \in [0,\infty)$, in country *B*.

In the third stage, the manufacturer *m* and the exclusive distributor *r* simultaneously choose the price at which they sell the product in country *A* in a Bertrand model of duopoly, e.g. p_A^m, $p_A^m \in [0,\infty)$, and p_A^r, $p_A^r \in [0,\infty)$, respectively. We solve the game starting with the last stage and working backwards to the first stage, in order to look for the sub-game perfect Nash equilibrium.

2.1.2.1. Backward Induction

We start with the last stage where the manufacturer and the distributor play a Bertrand game[35] and simultaneously choose prices for the pharmaceutical product in country *A*.[36] In looking for the Bertrand equilibrium this section will demonstrate different scenarios in terms of the prices the manufacturer and the distributor are charging, as well as in terms of the demand they are serving in country *A*. Prices and demand served must be consistent with the following rules: if the manufacturer and the distributor charge unequal prices, the low-price firm serves the entire market at the low price. Furthermore, the high-price firm gets no sales. However, if

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[34] See Joined cases C-2/01 P and C-3/01 P *Bundesverband der Arzneimittel-Importeure e.V. and Commission of the European Communities vs. Bayer AG*. See also case C-277/87 *Sandoz prodotti farmaceutici SpA vs. Commission of the European Communities*.

[35] See Müller-Langer (2007), footnote 60, with respect to the advantages of Bertrand's approach over the Cournot setup in a model that deals with pricing decisions in the pharmaceutical sector.

[36] See Bertrand (1883). See also Feess (2000) on pp. 411.

Frank Müller-Langer Analysis of the Welfare Effects of Parallel Trade Freedom **9**

the manufacturer and the distributor charge the same price, total market demand is equally divided between them. Let us suppose that the quantity consumers demand from the manufacturer *m* is

$$q_A^m = \begin{cases} \gamma a - b p_A^m & \text{if } p_A^m < p_A^r \\ \dfrac{\gamma a - b p_A^m}{2} & \text{if } p_A^m = p_A^r \\ 0 & \text{if } p_A^m > p_A^r. \end{cases} \tag{15}$$

Similarly, the quantity that consumers demand from the distributor *r* is given by

$$q_A^r = \begin{cases} \gamma a - b p_A^r & \text{if } p_A^r < p_A^m \\ \dfrac{\gamma a - b p_A^r}{2} & \text{if } p_A^r = p_A^m \\ 0 & \text{if } p_A^r > p_A^m. \end{cases} \tag{16}$$

By assumption the manufacturer has fixed cost of zero and marginal cost of zero. Furthermore, we assume that the distributor also has fixed cost of zero. However, by assumption, the distributor treats the sum of the wholesale price p_B^w and the per unit cost of engaging in parallel trade t as his marginal cost of selling the pharmaceutical product in country A in the third stage.

First, note that a firm would never charge a price that is lower than its marginal cost. In this case, the firm could increase its profits by simply reducing the quantities produced. On the one hand, the manufacturer could supply a positive quantity of the product as long as the price is non-negative, as his marginal costs are zero. On the other hand, the distributor would not charge a price smaller than his marginal cost $p_B^w + t$. Hence, the manufacturer can monopolize the market in country A and steal all of the customers from the parallel importing distributor by setting a price that is infinitesimally smaller than the marginal cost of the distributor. Put differently, the manufacturer will always set the price $p_A^m < p_B^w + t$. Consequently, the distributor will not stay in the market in country A and will not engage in parallel trade. At this point we can already formulate the first result of the analysis of the double marginalization game with complete information.

Proposition 1 : Parallel imports will never occur in any sub-game perfect Nash equilibrium in a double marginalization game with complete information and Bertrand price competition in the last stage.

Note that this result holds for any non-negative p_B^w and any positive *t*.

In the second stage, the distributor anticipates that he will be driven out of the market in country *A* in the third stage. Hence the maximization problem of the distributor is identical to the maximization problem we have already discussed before [see (4)–(6)]. For instance, the distributor will choose a price $p_B = (a + bp_B^w)/2b$.

Working backwards to the first stage, the maximization problem of the manufacturer is to maximize the total profit generated in country *A* and country *B,* subject to the constraint stated in $p_A^m \leq p_B^w + t$ [37] and subject to the non-negativity restrictions stated in $p_A^m \geq 0$ and $p_B^w \geq 0$. Mathematically, what the constraint and the non-negativity restrictions do is to narrow the range of the profit function. After the constraints are added we can admit only those values of p_A^m and p_B^w which satisfy the constraints. Note that we have to adopt the Kuhn-Tucker Method to find a maximum, as we are dealing with an optimization problem with inequality constraints. In fact, the Kuhn-Tucker Method is just a generalization of the Lagrange-Multiplier Method for optimization problems with inequality constraints.[38] Adopting the Kuhn-Tucker Method, we first have to identify the maximization problem. Secondly, we will define the Lagrange function by multiplying each constraint with the corresponding Lagrange multiplier and by adding it to the original profit function. And thirdly, we will derive the first-order conditions that a solution for the maximization problem must satisfy.

First, the maximization problem has the following format:

$$max\, \Pi(p_A^m, p_B^w) = \left(\gamma a - bp_A^m\right) p_A^m + p_B^w \left(\frac{a\text{-}bp_B^w}{2}\right)$$

$$\begin{aligned} &\text{subject to} && p_A^m \geq 0 \\ &\text{and} && p_B^w \geq 0 \\ &\text{and} && p_A^m - p_B^w \leq t. \end{aligned} \tag{17}$$

Second, let us write the classical type of the Lagrangian function, *L*, as follows

$$L(p_A^m, p_B^w; \lambda_1, \lambda_2, \lambda_3) = \left(\gamma a - bp_A^m\right) p_A^m + p_B^w \left(\frac{a\text{-}bp_B^w}{2}\right) + \lambda_1 p_A^m + \lambda_2 p_B^w + \lambda_3 \left(t + p_B^w - p_A^m\right). \tag{18}$$

Third, we obtain the following first-order conditions:

$$\frac{\partial L}{\partial p_A^m} = \gamma a - 2bp_A^m + \lambda_1 - \lambda_3 = 0, \tag{19}$$

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[37] Note that the manufacturer always sets a price in country *A* that undercuts the distributor's marginal costs. The manufacturer undercuts the distributor's marginal cost at least by an infinitely small ε.

[38] See Kuhn and Tucker (1951). See also Chiang (1984) on pp. 722 and Eichberger (2004) on pp. 402.

$$\frac{\partial L}{\partial p_B^w} = \frac{a}{2} - bp_B^w + \lambda_2 + \lambda_3 = 0, \tag{20}$$

$$\lambda_1 p_A^m = 0, \tag{21}$$

$$\lambda_2 p_B^w = 0, \tag{22}$$

$$\lambda_3 \left(t + p_B^w - p_A^m\right) = 0. \tag{23}$$

$$p_A^m \geq 0, p_B^w \geq 0, \tag{24}$$

$$t + p_B^w - p_A^m \geq 0. \tag{25}$$

$$\lambda_1 \geq 0, \lambda_2 \geq 0, \lambda_3 \geq 0. \tag{26}$$

We must now find solutions $\left(p_A^m, p_B^w, \lambda_1, \lambda_2, \lambda_3\right)$ that can satisfy all conditions given by (19)–(26). Therefore it is appropriate to discuss various cases that differ as to the extent to which the constraints are binding. For instance, if $\lambda_1 > 0$, it follows from (21) that $p_A^m = 0$. To give another example, if $p_A^m > 0$, it follows from (21) that $\lambda_1 = 0$.[39] As we have three Lagrange multipliers λ_1, λ_2 and λ_3 that are either positive or equal to zero, we have to distinguish between nine different cases.

After checking each of the nine cases with regard to the question as to whether it satisfies all conditions given by (19)–(26) we obtain two solutions: $\left(p_A^{m*}, p_B^{w*}, \lambda_1^*, \lambda_2^*, \lambda_3^*\right)$ and $\left(p_A^{m**}, p_B^{w**}, \lambda_1^{**}, \lambda_2^{**}, \lambda_3^{**}\right)$. The first solution is given by:

$$\begin{pmatrix} p_A^{m*} = \frac{a}{6b}(2\gamma+1) + \frac{1}{3}t, \\ p_B^{w*} = \frac{a}{6b}(2\gamma+1) - \frac{2}{3}t, \\ \lambda_1^* = 0, \\ \lambda_2^* = 0, \\ \lambda_3^* = \frac{a}{3}(\gamma-1) - \frac{2b}{3}t. \end{pmatrix} \tag{27}$$

We can see from (27) that the optimal price the manufacturer sets in country *A* always exceeds the optimal wholesale price the manufacturer charges the distributor in country *B* as $t > 0$. More specifically, the difference between p_A^{m*} and p_B^{w*} is equal to *t*. Furthermore, we can see from (27) that the optimal wholesale price decreases if *t* increases, and that the

[39] The conditions which imply that either the Lagrange multiplier is zero or a constraint binding are called complementary slackness conditions. See also Chiang (1984) on pp. 722.

optimal price the manufacturer sets in country A increases if t increases, respectively. Put differently, the higher the parallel trade cost t for a given γ and thus the less profitable parallel trade the higher is p_A^{m*} and the lower p_B^{w*}.

However, we can also see from (27) that the non-negativity restriction for λ_3^* is only satisfied for specific values of the parameter t. Therefore, let us now determine this threshold for t.

$$\lambda_3^* = \frac{a}{3}(\gamma - 1) - \frac{2b}{3}t \geq 0$$

$$\Leftrightarrow t \leq \frac{a}{2b}(\gamma - 1). \tag{28}$$

Henceforth, we will refer to this threshold given by (28) as the *upper* bound for the trade cost, that is $\bar{t} = a(\gamma - 1)/2b$.

To conclude the discussion with respect to the first solution, the outcome $(p_A^{m*}, p_B^{w*}, \lambda_1^*, \lambda_2^*, \lambda_3^*)$ given by (27) only satisfies each of the eight conditions given by (19)-(26) if $t \leq \bar{t}$.[40] If, however, $t > \bar{t}$, i.e. for high parallel trade cost and a relatively low γ, $(p_A^{m*}, p_B^{w*}, \lambda_1^*, \lambda_2^*, \lambda_3^*)$ is not a solution for the maximization problem given by (17), due to the fact that the non-negativity restriction for λ_3^* would not be satisfied. Thus we have to consider the second solution $(p_A^{m**}, p_B^{w**}, \lambda_1^{**}, \lambda_2^{**}, \lambda_3^{**})$ given by

$$\begin{pmatrix} p_A^{m**} = \frac{\gamma a}{2b}, \\ p_B^{w**} = \frac{a}{2b}, \\ \lambda_1^{**} = 0, \\ \lambda_2^{**} = 0, \\ \lambda_3^{**} = 0. \end{pmatrix} \tag{29}$$

When we compare (29) with (13) and (8), we find that p_A^{m**} is equal to the monopoly price in a double marginalization game in which parallel imports are prohibited, and p_B^{w**} is equal to the profit-maximizing wholesale price in a double marginalization game in which parallel imports are prohibited, respectively. Intuitively, if the two countries are virtually

[40] See **Appendix 1** for the proof that for the non-negativity restriction for p_B^{w*} to be satisfied it is sufficient that the non-negativity restriction for λ_3^* is satisfied.

Frank Müller-Langer Analysis of the Welfare Effects of Parallel Trade Freedom **13**

homogeneous ($\gamma \to 1$) and the parallel trade costs are so high that $t > \bar{t}$, the distributor will not be willing to engage in parallel trade. Put differently, if $t > \bar{t}$, the outcome of the double marginalization game in which parallel imports are permitted is equal to the outcome of the double marginalization game in which the manufacturer is awarded the right to prevent parallel imports.

3. Effects of Parallel Trade Freedom on Profits, Consumer Surplus and National Welfare

3.1. Equilibrium Prices and Quantities

Table 1 provides a summary of the equilibrium prices and quantities in country *A* and country *B* when the manufacturer is awarded the right to prevent parallel trade and when parallel trade is permitted for low trade cost (denoted by subscript *l*), intermediate trade cost (denoted by subscript *i*) and high trade cost (denoted by subscript *h*).

For instance, we obtain the equilibrium retail price under a regime of international exhaustion when parallel trade is allowed and intermediate trade cost denoted by $p^{*}_{(B,i)}$ by plugging the equilibrium wholesale price $p^{w*}_{(B,i)}$ into the reaction function of the distributor given by (5).

Furthermore, we obtain the equilibrium quantities by plugging the relevant equilibrium prices into the relevant demand functions. For instance, we obtain the equilibrium quantity in country *B* under a regime of international exhaustion and intermediate trade cost denoted by $q^{*}_{(B,i)}$ by plugging $p^{*}_{(B,i)}$ into the demand function given by (2).

Table 1 *Equilibrium Prices and Quantities*

	Manufacturer can prevent parallel imports		
	Scenario 1-3 (high, intermediate and low *t*)		
	Parallel imports permitted	**Parallel imports permitted**	
	Scenario 1 **high *t*:** $t > \bar{t}$	**Scenario 2** **intermediate *t*:** $\underline{t} \le t \le \bar{t}$	**Scenario 3** **low *t*:** $t < \underline{t}$
Equilibrium price in country *A*	$p_A^{m**} = p_{(A,h)}^{m*} = \frac{a\gamma}{2b}$	$p_{(A,i)}^{m*} = \frac{a\gamma}{3b} + \frac{a}{6b} + \frac{t}{3}$	$p_{(A,l)}^{m*} = \frac{a\gamma}{3b} + \frac{a}{6b} + \frac{t}{3}$
Equilibrium quantity in country *A*	$q_A^{**} = q_{(A,h)}^{*} = \frac{a\gamma}{2}$	$q_{(A,i)}^{*} = \frac{2a\gamma}{3} - \frac{a}{6} - \frac{bt}{3}$	$q_{(A,l)}^{*} = \frac{2a\gamma}{3} - \frac{a}{6} - \frac{bt}{3}$
Equilibrium wholesale price in country *B*	$p_B^{w**} = p_{(B,h)}^{w*} = \frac{a}{2b}$	$p_{(B,i)}^{w*} = \frac{a\gamma}{3b} + \frac{a}{6b} - \frac{2t}{3}$	Country *B* will not be served
Equilibrium retail price in country *B*	$p_B^{**} = p_{(B,h)}^{*} = \frac{3a}{4b}$	$p_{(B,i)}^{*} = \frac{7a}{12b} + \frac{a\gamma}{6b} - \frac{t}{3}$	Country *B* will not be served
Equilibrium quantity in country *B*	$q_B^{**} = q_{(B,h)}^{*} = \frac{a}{4}$	$q_{(B,i)}^{*} = \frac{5a}{12} - \frac{a\gamma}{6} + \frac{bt}{3}$	Country *B* will not be served

In order to double-check that the results in **Table 1** are correct, note that the equilibrium prices and quantities in country *A* and country *B* in both situations with and without parallel imports are identical if we set $t = \bar{t} = a(\gamma - 1)/2b$ which we will call the upper bound for *t*. If trade costs exceed the upper bound, we will refer to them as high trade costs. Furthermore, we know from the analysis in the previous sections that the equilibrium prices and quantities for

Frank Müller-Langer Analysis of the Welfare Effects of Parallel Trade Freedom **15**

high trade costs are the same in both cases when the manufacturer is awarded the right to prevent parallel imports and when parallel imports are permitted, i.e. $p_B^{w**} = p_{(B,h)}^{w*}$.

There is, however, also a lower bound for t under a regime of international exhaustion of IPRs with parallel trade as we will see in the following.

The distributor will only be willing to sell the product in country *B* as long as he can sell a quantity of the product in country *B* that is equal to or greater than zero and as long as the retail price he can charge is equal to or greater than the wholesale price set by the manufacturer. Put differently,

$$q_{(B,i)}^{*} \geq 0$$

$$\Leftrightarrow t \geq \frac{a}{2b}\left(\gamma - \frac{5}{2}\right). \tag{30}$$

Alternatively, we can derive the participation constraint for the distributor as follows.

$$p_{(B,i)}^{*} \geq p_{(B,i)}^{w*}$$

$$\Leftrightarrow t \geq \frac{a}{2b}\left(\gamma - \frac{5}{2}\right). \tag{31}$$

Henceforth, we will refer to this threshold given by (31) as the *lower* bound for the trade cost, that is $\underline{t} = a\left(\gamma - (5/2)\right)/2b$. Intuitively, if trade costs are very low, i.e. $t < \underline{t}$, potential competition from parallel trade is so fierce that the manufacturer has to charge such a high wholesale price in country *B* in order to deter parallel trade that the distribution of the good in country *B* becomes unprofitable. In this case, the market in country *B* will not be served.

However, we can see from the previous analysis that we have to deal with three different scenarios.

First, parallel trade costs are so high – more specifically $t > \bar{t}$ – that parallel trade is not a worthwhile activity for the distributor and thus a non-credible threat. In other words, for very high trade costs, the equilibrium outcome will be the same no matter whether or not the manufacturer is awarded the right to prevent parallel trade. More specifically, parallel trade does not have any impact on profits, consumer surplus, and welfare in both countries. Consequently, parallel trade does not have any impact on global welfare if trade costs are very high.

However, the analysis of the second scenario with trade costs at an intermediate level – more specifically $\underline{t} \leq t \leq \bar{t}$ – is not trivial. As we will see in the following, for intermediate trade costs, the manufacturer will strategically set prices in order to deter parallel trade under a regime of international exhaustion of IPRs. However, the wholesale price will be sufficiently low so that the distribution of the product in country *B* is still a worthwhile activity.

In the third scenario with very low trade costs – more specifically $t < \underline{t}$ – the manufacturer will charge such a high wholesale price in country *B*, in order to deter parallel trade under a regime of international exhaustion of IPRs that the market in country *B* ends up not being served.

In the following sections, we will analyze the impact of parallel trade freedom on the profit of the manufacturer and on global welfare for intermediate and low trade costs, respectively.

3.2. Effect of Parallel Trade Freedom on the Profit of the Manufacturer

In the following sections, I will show that the following proposition holds.

Proposition 2: The threat of parallel trade – under a regime of international exhaustion of IPRs – leads to lower profits of the manufacturer (i) if trade costs are intermediate and (ii) if trade costs are low, respectively.

3.2.1. Effect of Parallel Trade Freedom on the Manufacturer's Profit for Intermediate Trade Costs

At an intermediate level of *t*, $\underline{t} \le t \le \bar{t}$, the equilibrium profit of the manufacturer if parallel trade is permitted is given by[41]

$$\Pi_i^* = \Pi_{(A,i)}^* + \Pi_{(B,i)}^* = p_{(A,i)}^{m*} q_{(A,i)}^* + p_{(B,i)}^{w*} q_{(B,i)}^*$$

$$\Leftrightarrow \Pi_i^* = \frac{a^2}{24b} - \frac{at}{3} - \frac{bt^2}{3} + \frac{a^2\gamma}{6b} + \frac{at\gamma}{3} + \frac{a^2\gamma^2}{6b}. \qquad (32)$$

However, at an intermediate level of *t*, the equilibrium profit of the manufacturer if he is awarded the right to prevent parallel trade is given by

$$\Pi_i^{**} = \Pi^{**} = \Pi_A^{**} + \Pi_B^{**} = p_A^{m**} q_A^{**} + p_B^{w**} q_B^{**}$$

$$\Leftrightarrow \Pi_i^{**} = \Pi^{**} = \frac{a^2}{8b} + \frac{a^2\gamma^2}{4b}. \qquad (33)$$

Note that $\Pi_i^{**} = \Pi_l^{**} = \Pi_h^{**} = \Pi^{**}$ as the profit of the manufacturer is always the same if he is awarded the right to prevent parallel trade. The question arises as to whether parallel trade – at

[41] Recall that the manufacturer's profit is denoted by *Π* and the distributor's profit by *π*, respectively.

an intermediate level of *t* – has a positive or negative impact on the profit of the manufacturer. In particular, let $\Delta\Pi_i$ denote the difference between the equilibrium profit of the manufacturer if parallel trade is permitted given by (32) and the equilibrium profit of the manufacturer if he has the right to prevent parallel trade given by (33). Hence,

$$\Delta\Pi_i = \Pi_i^* - \Pi_i^{**}$$

$$\Leftrightarrow \Delta\Pi_i = -\frac{a^2}{12b} - \frac{at}{3} - \frac{bt^2}{3} + \frac{a^2\gamma}{6b} + \frac{at\gamma}{3} - \frac{a^2\gamma^2}{12b}. \tag{34}$$

Note that $\Delta\Pi_i$ is a quadratic function of *t* which is an important feature we will elaborate upon in the following. It is straightforward to see that a negative $\Delta\Pi_i$ would indicate that the manufacturer can generate a higher profit if he were awarded the right to prevent parallel trade. In other words, in order to show that, for intermediate trade costs, parallel trade harms the manufacturer it is sufficient to show that $\Delta\Pi_i$ is negative. Intuitively, $\Delta\Pi_i = 0$ if $t = \bar{t}$ as the equilibrium quantities and prices are identical in both situations with and without parallel trade. In order to see that this intuition is correct, set $t = \bar{t} = a(\gamma - 1)/2b$ in (34). Furthermore, note that $\Delta\Pi_i$ has its maximum at $t = \bar{t}$ as

$$\frac{\partial\Delta\Pi_i}{\partial t} = -\frac{a}{3} - \frac{2bt}{3} + \frac{a\gamma}{3} = 0$$

$$\Leftrightarrow t = \frac{a}{2b}(\gamma - 1) \tag{35}$$

and

$$\frac{\partial^2\Delta\Pi_i}{\partial^2 t} = -\frac{2b}{3} < 0 \tag{36}$$

as $b > 0$. To summarize, $\Delta\Pi_i$ is a quadratic function of *t* and has its unique maximum at $\bar{t}$. Furthermore, $\Delta\Pi_i = 0$ at $\bar{t}$. Hence, $\Delta\Pi_i$ is negative for any other value of the parameter *t*. Therefore, for intermediate trade costs, parallel trade freedom harms the manufacturer as it leads to a lower profit [*Proposition 2(i)*].

However, an important point in favor of banning parallel trade is the following. By the time the manufacturer chooses to invest in R&D for a new product, he will be more willing to do so, anticipating that he will be able to raise more money from the new product. In other words, under the assumption that the R&D investment leads with certainty to the development of a new product, the maximum amount that the manufacturer is willing to invest in R&D for the product is just the profit that he can generate.[42] As the profit of the manufacturer if he is awarded the right to prevent parallel trade is higher than his profit under parallel trade freedom, the incentive of the manufacturer to invest in R&D – for intermediate trade costs – is higher if he can prevent parallel trade.[43]

However, let us now turn to the question whether the same reasoning applies to the case with low trade costs in the following.

3.2.2. Effect of Parallel Trade Freedom on the Manufacturer's Profit for Low Trade Costs

In this section, we consider the case of very low trade costs, $t < \underline{t}$. Recall that trade costs are assumed to be positive. Hence, we can see from $t < \underline{t} = a\left(\gamma - (5/2)\right)/2b$ that γ must be greater than 5/2 in this case. For smaller values of the parameter γ we would automatically end up in one of the other two scenarios mentioned above. Intuitively, if γ is very low, i.e. $\gamma \rightarrow 1$, parallel trade may not be a highly attractive business activity for the distributor even if trade costs are very low.

However, if trade costs are very low and $\gamma > 5/2$, the market in country *B* will end up not being served. Hence, the manufacturer will only generate a profit in country *A* if parallel trade is permitted. The profit is given by

$$\Pi_l^* = p_{(A,l)}^{m*} q_{(A,l)}^* = -\frac{a^2}{36b} - \frac{at}{9} - \frac{bt^2}{9} + \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} + \frac{2a^2\gamma^2}{9b}. \qquad (37)$$

However, for low trade cost, the equilibrium profit of the manufacturer if he is awarded the right to prevent parallel trade is given by

$$\Pi_l^{**} = \Pi_i^{**} = \frac{a^2}{8b} + \frac{a^2\gamma^2}{4b}. \qquad (38)$$

The question arises as to whether the threat of parallel trade – for low trade cost – has a positive or negative impact on the profit of the manufacturer. In particular, let $\Delta\Pi_l$ denote the difference between the equilibrium profit of the manufacturer if parallel trade is permitted and the equilibrium profit of the manufacturer if he has the right to prevent parallel trade. Hence,

$$\Delta\Pi_l = \Pi_l^* - \Pi_l^{**} = -\frac{11a^2}{72b} - \frac{at}{9} - \frac{bt^2}{9} + \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} - \frac{a^2\gamma^2}{36b}. \qquad (39)$$

[42] See also Deardorff (1992) on p. 40.
[43] See also Valletti and Szymanski (2006) on p. 504.

We can see from (39) that $\Delta\Pi_l$ is a quadratic function of *t*. Let us now find the maximum of $\Delta\Pi_l$. We obtain the maximum as follows

$$\frac{\partial\Delta\Pi_l}{\partial t} = -\frac{a}{9} - \frac{2bt}{9} + \frac{a\gamma}{9} = 0$$

$$\Leftrightarrow t = \frac{a}{2b}(\gamma - 1) \tag{40}$$

and

$$\frac{\partial^2\Delta\Pi_l}{\partial^2 t} = -\frac{2b}{9} < 0 \tag{41}$$

as $b > 0$. $\Delta\Pi_l$ has its unique maximum at $\bar{t} = a(\gamma - 1)/2b$. Hence, in order to show that $\Delta\Pi_l$ is negative for $t < \underline{t}$ it is sufficient to show that $\Delta\Pi_l$ is negative at $\bar{t}$. Therefore, by plugging $\bar{t} = a(\gamma - 1)/2b$ into $\Delta\Pi_l$ given by (39) we obtain

$$\Delta\Pi_l = -\frac{a^2}{8b} < 0 \tag{42}$$

as $a > 0$ and $b > 0$. From (42), it follows that, for low trade costs, the profit of the manufacturer – if he is awarded the right to prevent parallel trade – is higher than the profit of the manufacturer if parallel trade is permitted. Therefore, for low trade cost, parallel trade freedom harms the manufacturer as it leads to a lower profit [see *Proposition 2* (ii)].[44]

Let us now summarize the results of the analysis of the impact of parallel trade freedom on the manufacturer's profit for intermediate costs (scenario 2) and low trade costs (scenario 3). My model shows that parallel trade freedom harms the manufacturer in both scenarios as it reduces his profit [see *Proposition 2*].[45] Hence, if the unique social objective was to spur R&D for new pharmaceutical products by protecting the manufacturer who holds a patent on the pharmaceutical product in country *A* and country *B*, my model suggested that the manufacturer should be awarded the right to prevent parallel trade.

However, the protection of the manufacturer is clearly not the only social objective. Indeed, we have to take a closer look at the welfare effects of parallel trade freedom. Therefore, a central purpose of the following sections is to explore the question as to whether parallel trade should be permitted or prohibited from a global welfare perspective if trade costs are at an

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[44] See also Crampes et al. (2006) for an analysis of the threat of parallel trade and its impact on prices in the context of bundling, i.e. a firm bundles its main product which is a tradable good with a non-traded service.
[45] See also Scherer and Watal (2002) on pp. 38.

intermediate level and if trade costs are low. Note that permitting parallel trade does not have any impact on global welfare if trade costs are very high.

However, in order to be able to calculate global welfare, we first have to derive the profit of the distributor, consumer surplus, as well as welfare in country *A* and country *B* if trade costs are intermediate and low, respectively.

3.3. Profit of the Distributor

3.3.1. Profit of the Distributor if Parallel Trade is Prohibited

If the manufacturer is awarded the right to prevent parallel trade, the profit of the distributor is the same for high, intermediate and low trade costs and given by

$$\pi^{**} = \pi_h^* = \left(p_B^{**} - p_B^{w**}\right) q_B^{**} = \frac{a^2}{16b}. \tag{43}$$

Note that the profit of the distributor if parallel trade is permitted but trade costs are high, π_h^*, is also given by (43).

3.3.2. Profit of the Distributor for Intermediate Trade Costs if Parallel Trade is Permitted

As already mentioned above, for intermediate trade costs the market in country *B* will be served so that the distributor will make a profit according to

$$\pi_i^* = \left(p_{(B,i)}^* - p_{(B,i)}^{w*}\right) q_{(B,i)}^* = \frac{25a^2}{144b} + \frac{5at}{18} + \frac{bt^2}{9} - \frac{5a^2\gamma}{36b} - \frac{at\gamma}{9} + \frac{a^2\gamma^2}{36b}. \tag{44}$$

By looking at (43) and (44) it becomes apparent that parallel trade freedom is detrimental to the distributor as $\Delta\pi_i = \pi_i^* - \pi^{**} < 0$.[46] The intuition behind this result is the following. If the threat of parallel trade is credible, the manufacturer will charge a higher wholesale price in country *B* – as compared to the wholesale price under a regime in which parallel trade is prohibited – in order to deter parallel trade. Consequently, the distributor will sell less at a higher price resulting in a lower profit under a regime of parallel trade freedom.

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[46] To see that this is true note that $\Delta\pi_i$ has its unique maximum at the lower bound for *t*, $\underline{t}$. Furthermore, $\Delta\pi_i$ is negative at $\underline{t}$ as $-a^2/36b < 0$. Consequently, $\Delta\pi_i$ is also negative for any other value of the parameter *t*.

3.3.3. Profit of the Distributor if Parallel Trade is Permitted and Trade Costs are Low

Recall that neither the distribution of the good in country *B* nor parallel trade is a worthwhile business activity if trade costs are low as the manufacturer strategically charges a prohibitively high wholesale price in country *B* in order to deter parallel trade. Hence, we set the profit of the distributor for low trade costs equal to zero if parallel trade is permitted.

3.4. Consumer Surplus in Country A

3.4.1. Consumer Surplus in Country A if the Manufacturer has the Right to Prevent Parallel Trade

In general, we obtain the consumer surplus by calculating the area between the demand function and the market price. Taking into account that demand in country *A* is given by the linear function (1) and taking into account that $a\gamma/b$ is the intercept of the demand function with the vertical (price) axis, we obtain the consumer surplus in country *A* if the manufacturer has the right to prevent parallel trade as follows.

$$CS_A^{**} = CS_{(A,h)}^{*} = \frac{1}{2} q_A^{**}\left(\frac{a\gamma}{b} - p_A^{m**}\right) = \frac{a^2\gamma^2}{8b}. \qquad (45)$$

Note that the consumer surplus in country *A*, if parallel trade is permitted but trade costs are high, $CS_{(A,h)}^{*}$, is also given by (45).

3.4.2. Consumer Surplus in Country A for Intermediate Trade Costs if Parallel Trade is Permitted

Analogue to the calculation in the previous section, the consumer surplus in country *A* for intermediate trade costs is given by

$$CS_{(A,i)}^{*} = \frac{1}{2}\left(\frac{a\gamma}{b} - p_{(A,i)}^{m*}\right) q_{(A,i)}^{*} = \frac{a^2}{72b} + \frac{at}{18} + \frac{bt^2}{18} - \frac{a^2\gamma}{9b} - \frac{2at\gamma}{9} + \frac{2a^2\gamma^2}{9b}. \qquad (46)$$

3.4.3. Consumer Surplus in Country A for Low Trade Costs if Parallel Trade is Permitted

The consumer surplus in country *A* for low trade costs is given by

$$CS_{(A,l)}^{*} = \frac{a^2}{72b} + \frac{at}{18} + \frac{bt^2}{18} - \frac{a^2\gamma}{9b} - \frac{2at\gamma}{9} + \frac{2a^2\gamma^2}{9b}. \qquad (47)$$

3.5. Consumer Surplus in Country B

3.5.1. Consumer Surplus in Country B if the Manufacturer has the Right to Prevent Parallel Trade

Taking into account that demand in country *B* is given by the linear function (2) and taking into account that a/b is the intercept of the demand function with the vertical (price) axis, we obtain the consumer surplus in country *B* if the manufacturer is awarded the right to prevent parallel trade as follows.

$$CS_B^{**} = CS_{(B,h)}^{*} = \frac{1}{2}\left(\frac{a}{b} - p_B^{**}\right)q_B^{**} = \frac{a^2}{32b}. \tag{48}$$

Note that the consumer surplus in country *B* if parallel trade is permitted but trade costs are high, $CS_{(B,h)}^{*}$, is also given by (48).

3.5.1.1. Consumer Surplus in Country B with Intermediate Trade Costs if Parallel Trade is Permitted

Analogue to the calculation in the previous section, the consumer surplus in country *B* for intermediate trade costs is given by

$$CS_{(B,i)}^{*} = \frac{1}{2}\left(\frac{a}{b} - p_{(B,i)}^{*}\right)q_{(B,i)}^{*} = \frac{25a^2}{288b} + \frac{5at}{36} + \frac{bt^2}{18} - \frac{5a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{a^2\gamma^2}{72b}. \tag{49}$$

3.5.1.2. Consumer Surplus in Country B with Low Trade Costs if Parallel Trade is Permitted

Recall that the distribution of the good in country *B* is not a worthwhile business activity if trade costs are low as the manufacturer charges a prohibitively high wholesale price in country *B* in order to deter parallel trade. Hence, we set consumer surplus in country *B* equal to zero if parallel trade is permitted and trade costs are low.

3.6. Welfare in Country A

3.6.1. Welfare in Country A if Parallel Trade is Prohibited

Welfare in country *A* if the manufacturer has the right to prevent parallel trade is given by the sum of the total profit generated by the manufacturer given by (33) and the consumer surplus in country *A* given by (45). Hence,

$$W_A^{**} = W_{(A,h)}^{*} = \Pi^{**} + CS_A^{**} = \frac{a^2}{8b} + \frac{3a^2\gamma^2}{8b}. \qquad (50)$$

Note that welfare in country *A* if parallel trade is permitted but trade costs are high, $W_{(A,h)}^{*}$, is also given by (50).

3.6.2. Welfare in Country A with Intermediate Trade Costs if Parallel Trade is Permitted

Welfare in country *A* if parallel trade is permitted and trade costs are at an intermediate level is given by the sum of the profit of the manufacturer given by (32) and the consumer surplus in country *A* given by (46). Hence,

$$W_{(A,i)}^{*} = \Pi_i^{*} + CS_{(A,i)}^{*} = \frac{a^2}{18b} - \frac{5at}{18} - \frac{5bt^2}{18} + \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} + \frac{7a^2\gamma^2}{18b}. \qquad (51)$$

3.6.3. Welfare in Country A with Low Trade Costs if Parallel Trade is Permitted

Welfare in country *A* if parallel trade is permitted and trade costs are low is given by the sum of the profit of the manufacturer given by (37) and the consumer surplus given by (47)

$$W_{(A,l)}^{*} = \Pi_l^{*} + CS_{(A,l)}^{*} = -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}. \qquad (52)$$

3.7. Welfare in Country B

3.7.1. Welfare in Country B if Parallel Trade is Prohibited

Welfare in country *B* if the manufacturer has the right to prevent parallel trade is given by the sum of the profit generated by the distributor given by (43) and the consumer surplus in country *B* given by (48)

$$W_B^{**} = W_{(B,h)}^{*} = \pi^{**} + CS_B^{**} = \frac{3a^2}{32b}. \qquad (53)$$

Note that welfare in country *B* if parallel trade is permitted but trade costs are high, $W^*_{(B,h)}$, is also given by (53).

3.7.2. Welfare in Country B with Intermediate Trade Costs if Parallel Trade is Permitted

Welfare in country *B* – if parallel trade is permitted and trade costs are at an intermediate level – is given by the sum of the profit generated by the distributor given by (44) and the consumer surplus in country *B* given by (49)

$$W^*_{(B,i)} = \pi^*_i + CS^*_{(B,i)} = \frac{25a^2}{96b} + \frac{5at}{12} + \frac{bt^2}{6} - \frac{5a^2\gamma}{24b} - \frac{at\gamma}{6} + \frac{a^2\gamma^2}{24b}. \qquad (54)$$

3.7.3. Welfare in Country B with Low Trade Costs if Parallel Trade is Permitted

Welfare in country *B* is equal to zero if trade costs are low, $\underline{t} = a\left(\gamma - (5/2)\right)/2b > t$. Note that we end up in this situation only for relatively high values of the parameter γ, more specifically if $\gamma > 5/2$ as *t* is assumed to be positive.

4. Effect of Parallel Trade Freedom on Global Welfare

4.1. Global Welfare

4.1.1. Global Welfare if Parallel Trade is Prohibited

If the manufacturer is awarded the right to prevent parallel trade, global welfare is given by the sum of welfare in country *A* given by (50) and welfare in country *B* given by (53). More specifically,

$$W^{**} = W^*_h = W^{**}_A + W^{**}_B = \frac{7a^2}{32b} + \frac{3a^2\gamma^2}{8b}. \qquad (55)$$

Note that global welfare, if parallel trade is permitted but trade costs are high, W^*_h, is also given by (55).

4.1.2. Global Welfare if Parallel Trade is Permitted and Trade Costs are Intermediate

By adding welfare in country *A* given by (51) and welfare in country *B* given by (54) we obtain global welfare if trade costs are at an intermediate level and parallel trade is permitted:

$$W_i^* = W_{(A,i)}^* + W_{(B,i)}^* = \frac{91a^2}{288b} + \frac{5at}{36} - \frac{bt^2}{9} - \frac{11a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{31a^2\gamma^2}{72b}. \qquad (56)$$

4.1.3. Global Welfare if Parallel Trade is Permitted and Trade Costs are Low

We already know from the previous analysis that in this case the distribution of the pharmaceutical product in country *B* is not a worthwhile business activity. Put differently, the profit of the distributor, consumer surplus as well as welfare in country *B* are equal to zero if parallel trade is permitted and trade costs are low. Consequently, global welfare is equal to welfare in country *A*. More specifically, welfare in country *A* and thus global welfare in this case is given by (52):

$$W_l^* = W_{(A,l)}^* = -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}. \qquad (57)$$

[47]

In the following sections, I analyze the impact of parallel trade freedom on global welfare for three different scenarios. More specifically, for the cases of high, intermediate, and low trade costs, we derive the net effect of parallel trade freedom on global welfare by subtracting global welfare if the manufacturer has the right to prevent parallel trade from global welfare if parallel trade is permitted.

The intuition behind this is the following. If this difference is negative, parallel trade is detrimental to global welfare and thus the manufacturer should be awarded the right to prevent parallel trade. If, however, this difference is positive, it would indicate that global welfare is higher if parallel trade is permitted.

4.2. Net Effect of Parallel Trade Freedom on Global Welfare if Trade Costs are High

We already know from the analysis in the previous sections that the outcome of the double marginalization game if parallel trade is permitted is equal to the outcome of the double marginalization game without parallel trade if trade costs are high, $t > \bar{t}$. Consequently, the profits of the manufacturer and the distributor, consumer surplus as well as welfare in country *A* and country *B* are equal, regardless of whether parallel trade is prohibited or permitted. Therefore, even if parallel trade were permitted, the (non-credible) threat of parallel trade

[47] See also **Appendix 2** for a summary of the results of my analysis.

would not have any impact on global welfare because parallel trade is not a worthwhile business activity for the distributor due to prohibitively high trade costs.

However, let us now analyze the other two cases with intermediate and low trade costs in which potential competition from parallel trade may arise as parallel trade is a worthwhile business activity for the exclusive distributor.

4.3. Net Effect of Parallel Trade Freedom on Global Welfare if Trade Costs are at an Intermediate Level

4.3.1. Net Effect of Parallel Trade Freedom on Global Welfare for Intermediate Trade Costs and $\gamma \geq 5/2$

In this section, I will show that the following proposition holds.

Proposition 3: Parallel trade freedom increases global welfare if trade costs are intermediate and $\gamma \geq 5/2$.

Let the net effect of parallel trade on global welfare be denoted by ΔW_i if trade costs are at an intermediate level, $\underline{t} \leq t \leq \bar{t}$. In particular, we obtain ΔW_i by subtracting global welfare if parallel trade is prohibited given by (55) from global welfare if parallel trade is permitted and trade costs are at an intermediate level given by (56)

$$\Delta W_i = W_i^* - W^{**} = \frac{7a^2}{72b} + \frac{5at}{36} - \frac{bt^2}{9} - \frac{11a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{a^2\gamma^2}{18b}. \quad (58)$$

Note that ΔW_i is a quadratic function of *t*. The question arises as to whether (58) is positive or negative. If (58) is positive, parallel trade freedom has a positive effect on global welfare. If, however, (58) is negative, parallel trade freedom is detrimental to global welfare. First, note that $\Delta W_i = 0$ at $t = a(\gamma-1)/2b$:

$$\Delta W_i = \frac{7a^2}{72b} + \frac{5a\left(a(\gamma-1)/2b\right)}{36} - \frac{b\left(a(\gamma-1)/2b\right)^2}{9} - \frac{11a^2\gamma}{72b} - \frac{a\gamma\left(a(\gamma-1)/2b\right)}{18} + \frac{a^2\gamma^2}{18b} = 0. \quad (59)$$

In other words, ΔW_i is equal to zero at the upper bound for *t*. Hence, in order to show that ΔW_i and thus the effect of parallel trade freedom on global welfare is positive it is sufficient to show that ΔW_i is a monotonically decreasing function of *t* for $\underline{t} \leq t \leq \bar{t}$. Let us first find out whether ΔW_i has a unique maximum by differentiating (58) with respect to *t*.

$$\frac{\partial \Delta W_i}{\partial t} = \frac{5a}{36} - \frac{2bt}{9} - \frac{a\gamma}{18} = 0$$

$$\Leftrightarrow t_i^{max} = \frac{a}{2b}\left(\frac{5}{4} - \frac{\gamma}{2}\right). \tag{60}$$

Note that t_i^{max} is the unique maximum as $\partial^2 \Delta W_i / \partial^2 t = -2b/9 < 0$ as $b > 0$. As t_i^{max} is the unique maximum, ΔW_i decreases in *t* for any $t > t_i^{max}$. In other words, if $t > a((5/4) - (\gamma/2))/2b$, ΔW_i decreases in *t*. Furthermore, taking into account that $\Delta W_i = 0$ at $t = a(\gamma - 1)/2b$, it follows that $\Delta W_i > 0$ for $t > a((5/4) - (\gamma/2))/2b$. In the following, we show for which values of the parameter γ t_i^{max} is smaller than or equal to the lower bound $\underline{t}$:

$$t_i^{max} = \frac{a}{2b}\left(\frac{5}{4} - \frac{\gamma}{2}\right) \leq \frac{a}{2b}\left(\gamma - \frac{5}{2}\right)$$

$$\Leftrightarrow \gamma \geq \frac{5}{2}. \tag{61}$$

In other words, for $\gamma \geq 5/2$ the unique maximum of ΔW_i is located on the left-hand side of the lower bound for *t*. Furthermore, ΔW_i monotonically decreases in *t* on the interval between the lower bound and the upper bound for *t*. Hence, taking into account that $\Delta W_i = 0$ at the upper bound for *t*, ΔW_i and thus the impact of parallel trade on global welfare is positive if $\gamma \geq 5/2$ as stated in *Proposition 3*.

4.3.2. Net Effect of Parallel Trade Freedom if Trade Costs are at an Intermediate Level and $\gamma < 5/2$

If $\gamma < 5/2$, we cannot apply the same logic as in the previous section in order to answer the question as to whether ΔW_i is positive or negative. Note that – for $\gamma < 5/2$ – the lower bound $\underline{t} = a(\gamma - (5/2))/2b$ would be negative. However, as *t* is assumed to be positive we set the lower bound for *t* equal to zero in this case. Furthermore, note that also for $\gamma < 5/2$, ΔW_i has its unique maximum at $t_i^{max} = a((5/4) - (\gamma/2))/2b$ [(60)] which is positive as

$\gamma < 5/2$. Hence, the question arises as to whether ΔW_i is positive or negative at the lower bound for *t*. For instance, if we can show that ΔW_i is positive at $t = 0$ this would imply that ΔW_i is also positive between the lower bound and the upper bound taking into account that $\Delta W_i = 0$ at the upper bound for *t*. In the following we will show that ΔW_i is positive at $t = 0$ if $7/4 \leq \gamma < 5/2$.

4.3.3. Net Effect of Parallel Trade Freedom on Global Welfare for Intermediate Trade Costs and $7/4 \leq \gamma < 5/2$

In this section, I will show that the following proposition holds.

Proposition 4: Parallel trade freedom increases global welfare if trade costs are at an intermediate level and $7/4 \leq \gamma < 5/2$.

By setting $t = 0$ in (58) we obtain

$$\Delta W_i = \frac{7a^2}{72b} - \frac{11a^2\gamma}{72b} + \frac{a^2\gamma^2}{18b}. \quad (62)$$

Note that ΔW_i given by (62) is greater than or equal to zero if $\gamma \geq 7/4$.[48] Consequently, if $\gamma \geq 7/4$, ΔW_i is positive between zero and the upper bound for *t*. Thus, parallel trade freedom has a positive impact on global welfare if $7/4 \leq \gamma < 5/2$ [see *Proposition 4*].
However, let us now consider the case if $1 < \gamma < 7/4$.

4.3.3.1. Net Effect of Parallel Trade Freedom on Global Welfare for Intermediate Trade Costs and $1 < \gamma < 7/4$

In this section, I will give an example in order to illustrate that the following proposition holds.

Proposition 5: Parallel trade freedom can have negative welfare properties if trade costs are at an intermediate level and γ *is sufficiently low* [$1 < \gamma < 7/4$].

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[48] For instance, we can see from (62) that $7 - 11\gamma + 4\gamma^2 = 0$ if $\gamma = 7/4$ and that $7 + 4\gamma^2 > 11\gamma$ if $\gamma > 7/4$.

We already know from the previous section that $\Delta W_i = 0$ at the upper bound $\bar{t} = a(\gamma - 1)/2b$. However, by looking at (58), it becomes apparent that ΔW_i has another null at

$$t = \frac{a}{2b}\left(\frac{7}{2} - 2\gamma\right) \quad (63)$$

as

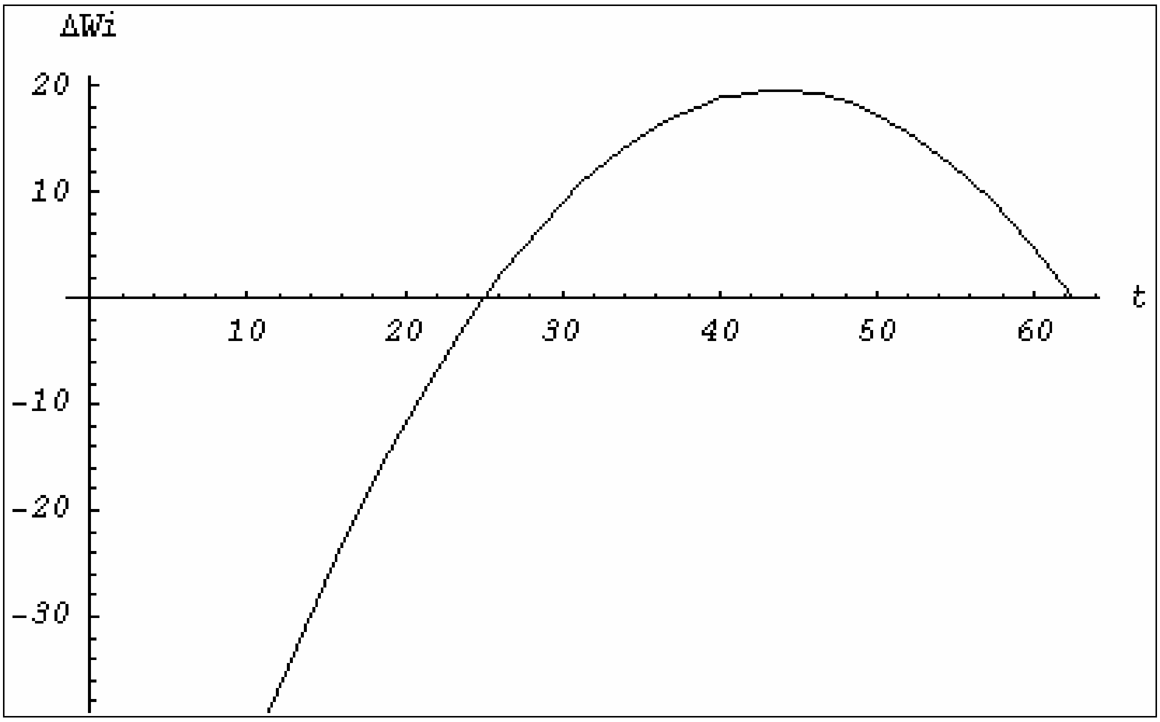
$$\Delta W_i = \frac{7a^2}{72b} + \frac{5a}{36}\frac{a}{2b}\left(\frac{7}{2} - 2\gamma\right) - \frac{b}{9}\frac{a^2}{4b^2}\left(\frac{7}{2} - 2\gamma\right)^2 - \frac{11a^2\gamma}{72b} - \frac{a\gamma}{18}\frac{a}{2b}\left(\frac{7}{2} - 2\gamma\right) + \frac{a^2\gamma^2}{18b} = 0. \quad (64)$$

Note that – in contrast to the previous sections – (63) is positive in this case as $\gamma < 7/4$. However, the following example illustrates that *Proposition 5* holds.

Example 1

We set $a = 100$, $b = 1/2$ and $\gamma = 13/8$. **Figure 1** shows that ΔW_i has one null at $t = 25$ [see (63)] and the other null at $t = 62.5$ which is also the upper bound. Furthermore, ΔW_i has its unique maximum at $t_i^{max} = 43.75$ [see (60)] and the lower bound at $t = 0$.

Figure 1 *Net Welfare Effect of Parallel Trade Freedom ($a = 100$, $b = 1/2$ and $\gamma = 13/8$)*



We can see from **Figure 1** that $\Delta W_i < 0 \;\; \forall t \in (0, 25)$ which suggests that *Proposition 5* holds. The intuition behind this result is the following. As I have shown before, parallel trade freedom harms both the manufacturer as well as the distributor. Parallel trade freedom is also detrimental to consumers in country *B* because it leads to a higher retail price and a lower quantity sold in country *B*. Hence, consumers in country *A* are the only beneficiaries from parallel trade freedom. As long as γ is sufficiently high, $7/4 \leq \gamma$, the positive effect of parallel trade freedom on the consumer surplus in country *A* *ceteris paribus* more than outweighs the sum of the negative effects of parallel trade freedom on the profit of the manufacturer, the profit of the distributor and the consumer surplus in county *B*. If, however, country *A* and *B* are virtually homogeneous, $1 < \gamma < 7/4$, consumers in country *A* will benefit less from parallel trade freedom. In this case, the net effect of parallel trade freedom on global welfare will be negative if trade costs are at an intermediate level.

4.4. Net Effect of Parallel Trade on Global Welfare if Trade Costs are Low

In this section, I shall show that the following proposition holds.

Proposition 6: Parallel trade freedom increases global welfare if trade costs are low and γ is sufficiently high ($\gamma > 5/2$).

If trade costs are low, $\underline{t} > t$, the effect of parallel trade freedom on global welfare, ΔW_l, is given by the difference between global welfare if parallel trade is permitted given by (57) and global welfare if the manufacturer is awarded the right to prevent parallel trade given by (55). Hence,

$$\Delta W_l = W_l^* - W^{**} = -\frac{67a^2}{288b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{5a^2\gamma^2}{72b}. \qquad (65)$$

Note that ΔW_l is a quadratic function of *t*. Moreover, recall that – as *t* is assumed to be positive – γ must be greater than 5/2. For smaller values of the parameter γ we would automatically end up in one of the other scenarios mentioned above.

However, by differentiating (65) we obtain

$$\frac{\partial \Delta W_l}{\partial t} = -\frac{a}{18} - \frac{bt}{9} - \frac{a\gamma}{9} = 0$$

$$\Leftrightarrow t_l^{max} = -\frac{a}{b}\left(\frac{1}{2}+\gamma\right). \tag{66}$$

Note that t_l^{max} is the unique maximum as $\partial^2 \Delta W_l / \partial^2 t = -b/9 < 0$ as $b > 0$. Furthermore, note that $t_l^{max} < 0$ as $a > 0$, $b > 0$ and $\gamma > 0$.

However, by setting $t = 0$ in (65) we obtain

$$\Delta W_l = -\frac{67a^2}{288b} - \frac{16a^2\gamma}{288b} + \frac{20a^2\gamma^2}{288b}. \tag{67}$$

We can see from (67) that – at $t = 0$ – $\Delta W_l > 0$ if $\gamma > 5/2$.[49] Furthermore, by setting $t = \underline{t} = a\left(\gamma - (5/2)\right)/2b$ in (65) it follows that

$$\Delta W_l = -\frac{a^2}{4b} + \frac{a^2\gamma}{8b}. \tag{68}$$

Note that (68) is positive as $\gamma > 5/2$.[50] Consequently, taking into account that ΔW_l is a quadratic function of *t*, $t_l^{max} < 0$, $\Delta W_l > 0$ at $t = 0$, and $\Delta W_l > 0$ at $\underline{t}$, it is straightforward to see that ΔW_l is positive if trade costs are low and γ sufficiently high ($\gamma > 5/2$) [see *Proposition 6*].

5. Conclusion

My model suggests that parallel imports in a double marginalization game with complete information will never occur in the sub-game perfect equilibrium, as it is always beneficial for the manufacturer to monopolize the market in country *A* at the third stage. However, the question arises as to how the manufacturer strategically chooses prices in order to prevent the occurrence of parallel trade.

As I have shown, this depends on the level of the heterogeneity of the two countries in terms of market size – as measured by γ – and the trade costs *t* for given values for *a* and *b*. If $t > \bar{t}$, potential competition from parallel trade does not arise and thus the manufacturer will always charge the monopoly price in country *A* and the optimal wholesale price in country *B*. One tentative interpretation of this outcome is that parallel trade is a non-credible threat if parallel trade cost are high and the two countries are virtually homogeneous, i.e. if $\gamma \to 1$. If,

[49] For instance, note that $20\gamma^2 - 16\gamma - 67 > 0$ if $\gamma > 5/2$.

[50] For instance, note that $\gamma - 2 > 0$ if $\gamma > 5/2$.

however, $t \leq \bar{t}$, potential competition from parallel trade arises and the manufacturer strategically sets the wholesale price in country *B* and the price in country *A*, in order to prevent that parallel trade occurs.

Maskus and Ganslandt (2002) suggest in a non-technical article on parallel trade in pharmaceuticals and its implications for low-income countries that, under plausible circumstances, parallel trade may increase prices in low-income countries and that smaller markets might end up not being served.

Indeed, the analysis of my parallel trade model shows that this assertion is correct if trade costs are very low, $t < \underline{t}$, and γ is sufficiently high, i.e. $\gamma > 5/2$. More specifically, I find that – for low trade costs – potential competition from parallel trade is so fierce that the manufacturer has to charge such a high wholesale price in the low-income country *B* in order to deter parallel trade that the distribution of the pharmaceutical product in country *B* becomes unprofitable. In this case, the market in county *B* will not be served.[51] Consequently, it would be desirable for country *B* to discourage parallel trade and to encourage price discrimination in order to open the otherwise unserved domestic market.[52]

As to the impact of parallel trade on the profit of the manufacturer, I come to the following conclusion. If parallel trade is permitted, the credible threat of parallel trade leads to lower profits of the manufacturer and thus reduces his incentives to invest in R&D [see *Proposition 2*].

As to the welfare properties of parallel trade, parallel trade freedom increases global welfare if γ is sufficiently high, $\gamma > 5/2$ [see *Proposition 3* and *Proposition 6*]. If, however, trade costs are intermediate and γ is sufficiently low, $1 < \gamma < 7/4$, parallel trade freedom can have negative welfare properties [see *Proposition 5*]. In this case, the negative effect of parallel trade freedom on the manufacturer, the distributor as well as on the consumers in country *B* more than outweighs the positive effect of parallel trade freedom on the consumers in country *A*.

As a first idea for further research, I suggest a more elaborate theoretical and empirical analysis of the parameter *t* which is of significant importance for the results of my model. For instance, suppose that *t* is very low. In this case, country *B* is likely to end up not being served at all under parallel trade freedom. As already mentioned, costs of re-packaging and re-labelling are incurred by the parallel-importing distributor as well as other parallel trade-

[51] For instance, see **Table 1**. See also Scherer and Watal (2002) on pp. 41 and Ganslandt et al. (2005) on p. 216.
[52] For instance, see Fink (2005) on p. 178. See also Varian (1985) and Maskus (2001) on p. 41.

specific transaction costs such as import duties on parallel trade. One may argue that the parameter *t* can to some extent be influenced by the manufacturer, i.e. through special labelling, language, warnings etc. that make re-packaging and re-labelling more expensive for the parallel-importing distributor.[53]

Intuitively, on the one hand, the manufacturer may prefer to make parallel trade as costly as possible, in order to prevent parallel trade. Consider again the case of very low parallel trade costs where country *B* ends up not being served. In this case, it may be beneficial for the manufacturer to increase *t* so that he can sell his product in country *B* even under parallel trade freedom.

On the other hand, to increase *t* through special labelling, language and warnings may also be costly for the manufacturer so that a trade-off arises between the costs of increasing *t* and the benefit from preventing parallel trade.

As a second idea for further research, I suggest analyzing the strategic behaviour of foreign governments to protect consumers in their country from excessive pricing, i.e. through price caps or compulsory licensing.

[53] For instance, see Maskus and Ganslandt (2002) on pp. 69. See also REMIT Consultants (1991) and Gallini and Hollis (1999) on pp. 2.

6. Appendix

Appendix 1: Proof with respect to the Non-negativity Restriction for the Equilibrium Wholesale Price in Country B

In the following we show that for the non-negativity restriction for p_B^{w*} to be satisfied it is sufficient that the non-negativity restriction for λ_3^*, $t \le \frac{a}{2b}(\gamma-1)$, is satisfied. Recall that

$$p_B^{w*} = \frac{a}{6b}(2\gamma+1) - \frac{2}{3}t \ge 0$$

$$\Leftrightarrow t \le \frac{a}{4b}(2\gamma+1).$$

Hence, the non-negativity restriction for p_B^{w*} is satisfied if the non-negativity restriction for λ_3^* is satisfied as $\frac{a}{4b}(2\gamma+1) > \frac{a}{2b}(\gamma-1)$ and $1 > -2$.

Appendix 2: Equilibrium Profits, Consumers Surplus and Global Welfare

	Parallel imports prohibited		
	Scenario 1-3 (high, intermediate and low *t*)		
	Parallel imports permitted	**Parallel imports permitted**	
	Scenario 1 (high *t*)	**Scenario 2 (intermediate *t*)**	**Scenario 3 (low *t*)**
Equilibrium profit of the manufacturer	$\Pi^{**} = \Pi_h^* = \Pi_A^{**} + \Pi_B^{**} = \frac{a^2}{8b} + \frac{a^2\gamma^2}{4b}$	$\Pi_i^* = \Pi_{(A,i)}^* + \Pi_{(B,i)}^* = \frac{a^2}{24b} - \frac{at}{3} - \frac{bt^2}{3} + \frac{a^2\gamma}{6b} + \frac{at\gamma}{3} + \frac{a^2\gamma^2}{6b}$	$\Pi_l^* = -\frac{a^2}{36b} - \frac{at}{9} - \frac{bt^2}{9} + \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} + \frac{2a^2\gamma^2}{9b}$

Equilibrium profit of the distributor	$\pi^{**} = \pi_h^* = \frac{a^2}{16b}$	$\pi_i^* = \frac{25a^2}{144b} + \frac{5at}{18} + \frac{bt^2}{9} - \frac{5a^2\gamma}{36b} - \frac{at\gamma}{9} + \frac{a^2\gamma^2}{36b}$	Country *B* will not be served
Consumer surplus in country *A*	$CS_A^{**} = CS_{(A,h)}^* = \frac{a^2\gamma^2}{8b}$	$CS_{(A,i)}^* = \frac{a^2}{72b} + \frac{at}{18} + \frac{bt^2}{18} - \frac{a^2\gamma}{9b} - \frac{2at\gamma}{9} + \frac{2a^2\gamma^2}{9b}$	$CS_{(A,l)}^* = \frac{a^2}{72b} + \frac{at}{18} + \frac{bt^2}{18} - \frac{a^2\gamma}{9b} - \frac{2at\gamma}{9} + \frac{2a^2\gamma^2}{9b}$
Consumer surplus in country *B*	$CS_B^{**} = CS_{(B,h)}^* = \frac{a^2}{32b}$	$CS_{(B,i)}^* = \frac{25a^2}{288b} + \frac{5at}{36} + \frac{bt^2}{18} - \frac{5a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{a^2\gamma^2}{72b}$	Country *B* will not be served
Welfare in country *A*	$W_A^{**} = W_{(A,h)}^* = \Pi^{**} + CS_A^{**} = \frac{a^2}{8b} + \frac{3a^2\gamma^2}{8b}$	$W_{(A,i)}^* = \Pi_i^* + CS_{(A,i)}^* = \frac{a^2}{18b} - \frac{5at}{18} - \frac{5bt^2}{18} + \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} + \frac{7a^2\gamma^2}{18b}$	$W_{(A,l)}^* = -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}$
Welfare in country *B*	$W_B^{**} = W_{(B,h)}^* = \pi^{**} + CS_B^{**} = \frac{3a^2}{32b}$	$W_{(B,i)}^* = \pi_i^* + CS_{(B,i)}^* = \frac{25a^2}{96b} + \frac{5at}{12} + \frac{bt^2}{6} - \frac{5a^2\gamma}{24b} - \frac{at\gamma}{6} + \frac{a^2\gamma^2}{24b}$	Country *B* will not be served
Global welfare	$W^{**} = W_h^* = W_A^{**} + W_B^{**} = \frac{7a^2}{32b} + \frac{3a^2\gamma^2}{8b}$	$W_i^* = W_{(A,i)}^* + W_{(B,i)}^* = \frac{91a^2}{288b} + \frac{5at}{36} - \frac{bt^2}{9} - \frac{11a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{31a^2\gamma^2}{72b}$	$W_l^* = -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}$

In order to double-check that the results in the second and third column of the table are correct, note that the equilibrium profits and the levels of consumer surplus and welfare in country *A* and country *B* as well as global welfare in both situations with and without parallel imports are identical for the case that $t = a(\gamma - 1)/2b$ which is the upper bound for *t*.

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Frank Müller-Langer Analysis of the Welfare Effects of Parallel Trade Freedom **37**

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