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An Analysis of the Ambiguous Welfare Effects of Parallel Trade Freedom*

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Abstract:

The regulation of parallel trade has become a critical issue in the global trading system, as the welfare effects of parallel trade freedom are generally ambiguous. In this paper we investigate the welfare effects of parallel trade freedom for low, intermediate, and high trade costs and different levels of market size. By analyzing a game played between a domestic monopolistic manufacturer of pharmaceuticals and a foreign exclusive distributor we, first, show that parallel trade reduces the profit of the manufacturer and his incentives to invest in R&D. In addition to this first finding, we show, secondly, that the question as to whether parallel trade freedom has positive or negative welfare properties depends on the level of trade cost and the heterogeneity of countries in terms of market size. In particular, we find that parallel trade freedom has a positive effect on global welfare if countries are sufficiently heterogeneous in terms of market size and if trade costs are intermediate and low, respectively. Surprisingly, this result even holds in a situation where parallel trade freedom implies the closure of the smaller market. If, however, countries are virtually homogenous in terms of market size, parallel trade freedom may be detrimental to global welfare for specific levels of trade costs.

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1 Introduction

The regulation of parallel trade in the field of pharmaceuticals has become a critical issue in the global trading system, as the welfare effects of parallel trade of pharmaceuticals are generally ambiguous.[1] For instance, Maskus and Ganslandt (2002) suggest in a non-technical article on parallel trade in the pharmaceutical industry that parallel trade freedom may increase prices in low-income countries and that small markets may end up not being served. We will show that this assertion is correct for specific combinations of parallel trade cost and heterogeneity of countries in terms of market size. However, we will also show that parallel trade freedom still has a positive effect on global welfare in this case even though small markets remain unserved. To the best of our knowledge, this specific conclusion has not been drawn before in the prior theoretic literature on the welfare effects of parallel trade freedom. For instance, Malueg and Schwartz (1994) find that global welfare under uniform pricing associated with parallel trade freedom will be lower than under international price discrimination if parallel trade freedom implies that some markets are dropped.[2]

The research-intensive pharmaceutical sector relies heavily on patents.[3] In particular, the value of a patent depends on the monopoly power afforded in terms of scope for price differentiation,[4] 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".[5] 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 trade.[6] For instance, representatives of the pharmaceutical industry argue that

1 See Grossman and Lai (2008) on p. 390ff, Maskus and Chen (2004), and Danzon and Towes (2003). See also Maskus (2001) and Ganslandt and Maskus (2004) on p. 1036ff. See Valletti and Szymanski (2006) for a comprehensive analysis of the impact of parallel trade freedom on global welfare in the presence of 'generic' products.

2 See also Jelovac and Bordoy (2005) and Barfield and Groombridge (1999).

3 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 and Reitzig (2004) on p. 457 and Harhoff et al. (2003).

4 See Ganslandt and Maskus (2004) on p. 1036.

5 See Ganslandt and Maskus (2004) on p. 1037.

6 For instance, see Barfield and Groombridge (1998).

if parallel trade 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.[7] 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 trade.[8] 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.[9]

The main purpose of this paper is to contribute to the ongoing debate about the welfare effects of parallel trade. It is organized as follows. In section 2, we give an overview of the determinants of parallel trade. In section 3, we develop a double marginalization model with complete information which is played between a domestic monopolistic manufacturer of pharmaceuticals and a foreign exclusive distributor. In section 4, we investigate the impact of parallel trade freedom on the manufacturer's profit, consumer surplus, and national welfare. In section 5, we 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 Legal and Economic Determinants of Parallel Trade

Parallel imports are also known as gray-market imports.[10] 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.[11]

The ability of an owner of IPRs to exclude parallel trade stems from the importing country's

[7] See Danzon (1998). However, see also Grossman and Lai (2008) for an opposing view on this topic.
[8] See Maskus (2000a) on p. 211.
[9] See Maskus (2001) on p. 2.
[10] See Müller-Langer (2007) for an overview of the prior theoretic literature on the determinants of parallel trade. See also Maskus (2000a) on p. 208 and Maskus (2001) on p. 2.
[11] For instance, see Chard and Mellor (1989) and Danzon (1998). See also Maskus (2001) on p. 1.

treatment of exhaustion of IPRs.[12] 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 trade from other countries.[13] Hence, right owners retain full rights for distributing their goods either themselves or through authorized dealers; this also includes the right to exclude imports. On the other hand, a regime of international exhaustion of IPRs makes parallel trade from other countries legal, as "rights are exhausted upon first sale anywhere".[14] Countries permitting parallel trade 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. At present, countries are free to determine their preferred exhaustion regime for each form of intellectual property rights under the law of the World Trade Organization (WTO).[15] Put differently, countries can freely decide on whether to allow or ban parallel trade.

There are several economic theories on the causes of parallel trade.

First, in many circumstances efficient international distribution of goods and services requires multinational enterprises that typically build markets through exclusive territorial dealership rights, in order to vertically control the operations of their official licensees. Nevertheless, in foreign markets it may be difficult to enforce private contractual provisions prohibiting sales outside the authorized distribution chain, so that parallel trade may occur.[16]

Second, in some industries such as the pharmaceutical industry national governments intervene in private markets by regulating prices in order to achieve particular social objectives, i.e. to make medicines affordable for low-income consumers and to limit public health budgets. As these government interventions result in significant international price differences there is a potential for arbitrage between markets: parallel importing firms purchase a certain product in more regulated (lower-price) markets and re-sell the product in less regulated (higher-price)

12 See Müller-Langer (2009) on p. 144ff for an overview of the legal framework regarding parallel trade.

13 See Maskus (2000a) on p. 208ff.

14 See Maskus (2001) on p. 3.

15 For instance, Article 6 of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) - being the only provision in the various multilateral agreements of the WTO that explicitly addresses the treatment of parallel trade - simply prescribes: "*For the purposes of dispute settlement under this Agreement, subject to the provisions of Articles 3 and 4, nothing in this Agreement shall be used to address the issue of the exhaustion of intellectual property rights.*"

16 See Maskus (2000b) on p. 1277. See also Maskus and Chen (2004).

markets.[17] For instance, Ganslandt and Maskus (2004) take into account international differences between the regulatory regimes in the pharmaceuticals area. They explore the effect of the entry of parallel traders on the prices of pharmaceutical producers in Sweden from 1994 to 1999. Prior to Sweden's entry into the European Union on 1 January 1995 parallel trade of pharmaceuticals was prohibited. However, after its entry Sweden had to adopt the EU-wide principle of exhaustion of patent distribution rights and thus permitted parallel trade. Therefore, the Swedish market provides a natural example for testing and estimating the effect of the exogenous shock to the patented pharmaceutical market, due the introduction of parallel trade. Ganslandt and Maskus (2004) find that the prices of pharmaceutical products subject to competition from parallel trade fell relative to other pharmaceutical products over the period 1994-1999. They conclude that parallel trade significantly reduces prices, by 12-19 per cent, relative to other pharmaceutical products not subject to competition from parallel trade. Arguably, parallel trade represents a significant form of competition in Sweden.[18]

A third determinant for parallel trade is that parallel importing firms have the incentive to free ride on investments in marketing as well as on the before- and after-sales services of official licensees and authorized distributors.[19]

3 Double Marginalization Game with Complete Information

3.1 The Model

We consider a simple model with two countries A and B and two firms. In Country A there is a monopolistic manufacturer, henceforth m. In Country B there is a single authorized independent firm, henceforth r, which is responsible for the distribution and retail of the manufacturer's product. The manufacturer holds a patent on his product in both countries. We assume that

[17] For instance, see Brekke, Grasdal and Holmås (2009) and Grossman and Lai (2008). See also Jelovac and Bordoy (2005), Richardson (2002), and Danzon (1997).

[18] However, Ganslandt and Maskus (2004) do not consider the dynamic effects of parallel trade on R&D for new pharmaceutical products. For instance, see Grossman and Lai (2008), Li and Robles (2007), Valletti and Szymanski (2006), Szymanski and Valletti (2005), Valletti (2006), and Li and Maskus (2006) with respect to the dynamic aspects of parallel trade in the context of R&D for new products.

[19] See Chard and Mellor (1989) and Barfield and Groombridge (1998). See also Maskus (2000a) on p. 212ff, Maskus (2000b) on p. 1275ff, and Fink (2005) on p. 176ff.

efficient international distribution of the product requires the manufacturer to build a market in Country B through exclusive territorial dealership rights. For instance, suppose that the exclusive distributor in Country B has already established costly distribution channels.[20] Furthermore, we assume that the countries differ in market size and in price elasticity of demand. The strategies available to the manufacturer and the distributor are the different prices they might charge.[21] Demand for the product in Country A is

$$D_A(p_A) = \gamma a - bp_A$$

with $\gamma > 1$. p_A denotes the price in Country A. Let Π denote the profit of the manufacturer and π the profit of the distributor, respectively. For simplicity, we assume that marginal costs of production c are equal to zero in both countries.[22] Demand for the product in Country B is

$$D_B(p_B) = a - bp_B.$$

γ is a measure for the homogeneity of the two countries. If $\gamma \longrightarrow 1$, the two countries are virtually homogenous. Put differently, the higher γ the more heterogeneous are the two countries in terms of markets size. As $\gamma > 1$ the price elasticity of demand in Country A is lower than the price elasticity of demand in Country B. Thus, standard economic theory tells us that, in the absence of parallel trade, the single manufacturer engages in third-degree price discrimination and sets a price in Country A that exceeds the price in Country B. 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 product he can buy from the monopolistic manufacturer. 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. 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.

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

[21] For instance, assume that disposal costs are equal to zero. Negative prices are not feasible, but any non-negative price can be charged.

[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 (2004) on p. 1040.

For instance, the costs of re-packaging and re-labeling are incurred by the parallel-importing distributor as well as other parallel trade-specific transaction costs such as import duties on parallel trade.[23] Furthermore, we assume that the parallel import product is a perfect substitute for the product sold by the original producer in Country A.

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 trade as a benchmark.

3.1.1 Double Marginalization Game without Parallel Trade

Suppose that the manufacturer can itself become involved in the retail of the 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 product from the manufacturing firm.

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. We will first assume that the manufacturer is awarded the right to prevent parallel trade of the product from Country B, i.e. he is awarded an explicit right of importation of the product. Arbitrage by individual consumers between the two countries is legally prohibited.

Using backward induction we obtain the following quantities, prices and profits:

[23] See Maskus and Chen (2004) on p. 566, Li and Maskus (2006) on p. 447, and Arfwedson (2004) on p. 8.

quantities:	
quantity supplied in Country A	$q_A^* = \frac{a\gamma}{2}$
quantity supplied in Country B	$q_B^* = \frac{a}{4}$
prices:	
retail price in Country A	$p_A^* = \frac{a\gamma}{2b}$
wholesale price in Country B	$p_B^{w*} = \frac{a}{2b}$
retail price in Country B	$p_B^* = \frac{3a}{4b}$
profits:	
profit of the Manufacturer	$\Pi^* = \frac{a^2}{8b}(2\gamma^2 + 1)$
profit of the Distributor	$\pi^* = \frac{a^2}{16b}$
Table 1. Equilibrium Quantities, Prices and Profits	

Note that the distributor marks up the price of the product, p_B^*, by 50 percent, compared to the wholesale price p_B^{w*}.

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

3.1.2 Double Marginalization Game with Parallel Trade

Suppose that the manufacturer cannot contractually limit or even prohibit parallel trade. 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 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. In particular, we will show that the following proposition holds.

Proposition 3.1 *Parallel trade 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.*

Backward Induction We start with the last stage where the manufacturer and the distributor play a Bertrand game[24] and simultaneously choose prices for the product in Country A. Prices and demand served must be consistent with the following rules:

$$q_A^m = \begin{cases} a\gamma - bp_A^m \text{ if } p_A^m < p_A^r \\ \frac{1}{2}\left(a\gamma - bp_A^m\right) \text{ if } p_A^m = p_A^r \\ 0 \text{ if } p_A^m > p_A^r. \end{cases}$$

Similarly,

$$q_A^r = \begin{cases} a\gamma - bp_A^r \text{ if } p_A^r < p_A^m \\ \frac{1}{2}\left(a\gamma - bp_A^r\right) \text{ if } p_A^r = p_A^m \\ 0 \text{ if } p_A^r > p_A^m. \end{cases}$$

The manufacturer has fixed cost of zero and marginal cost of zero. The distributor also has fixed cost of zero. However, 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 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 a 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 [*Proposition 3.1*]. Note that this result holds for any non-negative p_B^w and any positive t.

Nevertheless, 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

[24] 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.

is identical to the maximization problem we have already discussed in the previous section. 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 $p_A^m \leq p_B^w + t$[25] and subject to the non-negativity restrictions stated in $p_A^m \geq 0$ and $p_B^w \geq 0$. Adopting the Kuhn-Tucker Method, the maximization problem has the following format:

$$\begin{aligned} \max \Pi \left(p_A^m, p_B^w\right) &= \left(\gamma a - b p_A^m\right) p_A^m + \frac{1}{2} \cdot p_B^w \left(a - b p_B^w\right) \qquad (1) \\ \text{subject to} \quad p_A^m &\geq 0 \\ \text{and} \quad p_B^w &\geq 0 \\ \text{and} \quad p_A^m - p_B^w &\leq t. \end{aligned}$$

Let us write the classical type of the Lagrangian function, L, as follows

$$L\left(p_A^m, p_B^w; \lambda_1, \lambda_2, \lambda_3\right) = \left(\gamma a - b p_A^m\right) p_A^m + \frac{1}{2} \cdot p_B^w \left(a - b p_B^w\right) + \lambda_1 p_A^m + \lambda_2 p_B^w + \lambda_3 \left(t + p_B^w - p_A^m\right)$$

We obtain the following first-order conditions:

$$\begin{aligned} \frac{\partial L}{\partial p_A^m} &= \gamma a - 2 b p_A^m + \lambda_1 - \lambda_3 = 0, \\ \frac{\partial L}{\partial p_B^w} &= \frac{1}{2} \cdot a - b p_B^w + \lambda_2 + \lambda_3 = 0, \\ \lambda_1 p_A^m &= 0, \\ \lambda_2 p_B^w &= 0, \\ \lambda_3 \left(t + p_B^w - p_A^m\right) &= 0. \\ p_A^m &\geq 0, \; p_B^w \geq 0, \\ t + p_B^w - p_A^m &\geq 0. \\ \lambda_1 &\geq 0, \; \lambda_2 \geq 0, \; \lambda_3 \geq 0. \end{aligned}$$

We must now find solutions $(p_A^m, p_B^w, \lambda_1, \lambda_2, \lambda_3)$ that satisfy all first-order conditions. As we have three Lagrange multipliers 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 first-order conditions we obtain two solutions: $(p_A^{m*}, p_B^{w*}, \lambda_1^*, \lambda_2^*, \lambda_3^*)$

[25] 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.

and $(p_A^{m**}, p_B^{w**}, \lambda_1^{**}, \lambda_2^{**}, \lambda_3^{**})$. The first solution is given by:

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

Note 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, $p_A^{m*} - p_B^{w*} = t$. Furthermore, we can see that the optimal wholesale price decreases if t increases, and that the 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 that the non-negativity restriction for λ_3^* is only satisfied for specific values of the parameter t. More specifically, from $\lambda_3^* \geq 0$ follows

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

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

To summarize, $(p_A^{m*}, p_B^{w*}, \lambda_1^*, \lambda_2^*, \lambda_3^*)$ only satisfies all first-order conditions if $t \leq \bar{t}$.[26] 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 (1), due to the fact that the non-negativity restriction for λ_3^* would not be satisfied. Thus we have to consider the second solution given by

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

By comparing these results with the results from the previous section (see Table 1), we find that p_A^{m**} is equal to the monopoly price in a double marginalization game in which parallel trade is prohibited, and p_B^{w**} is equal to the profit-maximizing wholesale price in a double marginalization game in which parallel trade is prohibited, respectively. Intuitively, if the two countries are

[26] 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.

virtually 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 trade is permitted is equal to the outcome of the double marginalization game in which the manufacturer is awarded the right to prevent parallel trade.

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

4.1 Equilibrium Prices and Quantities

Table 2 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 (PT) 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).

	Manufacturer can prevent PT (high, intermediate and low t)		
	PT permitted	PT permitted	PT permitted
	High t:	Intermediate t:	Low t:
	$t > \bar{t}$	$\underline{t} \leq t \leq \bar{t}$	$t < \underline{t}$
Price and Quantities in Country A:	$p_A^{m**} = p_{(A,h)}^{m*} = \frac{a\gamma}{2b}$	$p_{(A,i)}^{m*} = \frac{a\gamma}{3b} + \frac{a}{6b} + \frac{t}{3}$	$p_{(A,l)}^{m*} = \frac{a\gamma}{3b} + \frac{a}{6b} + \frac{t}{3}$
	$q_A^{**} = q_{(A,h)}^{*} = \frac{a\gamma}{2}$	$q_{(A,i)}^{*} = \frac{2a\gamma}{3} - \frac{a}{6} - \frac{bt}{3}$	$q_{(A,l)}^{*} = \frac{2a\gamma}{3} - \frac{a}{6} - \frac{bt}{3}$
Prices and Quantities 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
	$p_B^{**} = p_{(B,h)}^{*} = \frac{3a}{4b}$	$p_{(B,i)}^{*} = \frac{7a}{12b} + \frac{a\gamma}{6b} - \frac{t}{3}$	Country B will not be served
	$q_B^{**} = q_{(B,h)}^{*} = \frac{a}{4}$	$q_{(B,i)}^{*} = \frac{5a}{12} - \frac{a\gamma}{6} + \frac{bt}{3}$	Country B will not be served

Table 2. Equilibrium Prices and Quantities

Note that the equilibrium prices and quantities in Country A and Country B in both situations

with and without parallel trade are identical if $t > \bar{t}$, with $\bar{t}$ being the *upper* bound for t. 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, from $p^*_{(B,i)} \geq p^{w*}_{(B,i)}$ (and $q^*_{(B,i)} \geq 0$) follows

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

Henceforth, we will refer to this threshold as the *lower* bound for the trade cost, that is $\underline{t}= \frac{a}{2b}\left(\gamma - \frac{5}{2}\right)$. 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.

To summarize, we have to consider 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 as well as national and global welfare. 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.

4.2 Effect of Parallel Trade Freedom on the Profit of the Manufacturer

Appendix 2 shows that the following proposition holds.

Proposition 4.1 *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.*

The intuition behind this result is the following. First, the equilibrium profit of the manufacturer will be the same no matter whether or not the manufacturer is awarded the right to prevent parallel trade if trade cost are very high. In this case, parallel trade is not a credible threat and does not erode the manufacturer's ability to discriminate prices which is the first-best outcome from the manufacturer's perspective. If, however, trade costs are intermediate or low, parallel trade is a credible threat and the manufacturer strategically sets prices in order to deter it. Consequently, a credible threat of parallel trade erodes the manufacturer's ability to discriminate prices and thus reduces his profit as compared to a situation where he is awarded the right to prevent parallel trade.

Nevertheless, 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 development of a 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. 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 low and intermediate trade costs – is higher if he can prevent parallel trade.[27]

To summarize, *Proposition 4.1* suggests that the manufacturer can never be better off under

[27] See also Valletti and Szymanski (2006) on p. 504.

parallel trade freedom. Hence, if the unique social objective were to spur R&D for new products by protecting the manufacturer who holds a patent on the product in Country A and Country B, our 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 got 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 intermediate level and if trade costs are low.

However, in order to be able to calculate global welfare, we first 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.

4.3 Profit of the Distributor

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

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

Note that the distributor generates the same profit if parallel trade is permitted but trade costs are high, π_h^*.

If, however, trade costs are intermediate and parallel trade is permitted, the distributor will make a profit according to

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

Parallel trade freedom is detrimental to the distributor in this case as $\Delta\pi_i = \pi_i^* - \pi^{**} < 0$.[28] 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.

[28] 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 $-\frac{a^2}{36b} < 0$. Consequently, $\Delta\pi_i$ is also negative for any other value of the parameter t.

Consequently, the distributor will sell less at a higher price resulting in a lower profit under a regime of parallel trade freedom.

Finally, 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, the profit of the distributor for low trade costs is equal to zero if parallel trade is permitted.

4.4 Consumer Surplus in Country A

We obtain the consumer surplus in Country A if the manufacturer has the right to prevent parallel trade as follows:

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

Note that the consumer surplus in Country A if parallel trade is permitted but trade costs are high, $S_{(A,h)}^{*}$, is equal to S_A^{**}.

Furthermore, the consumer surplus in Country A for intermediate trade costs if parallel trade is permitted is given by

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

Finally, we obtain the consumer surplus in Country A for low trade costs if parallel trade is permitted as follows

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

4.5 Consumer Surplus in Country B

We obtain the consumer surplus in Country B if the manufacturer is awarded the right to prevent parallel trade as follows:

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

Note that the consumer surplus in Country B if parallel trade is permitted but trade costs are high, $S_{(B,h)}^{*}$, is equal to S_B^{**}.

Analogue, the consumer surplus in Country B for intermediate trade costs if parallel trade is

permitted is given by

$$S^*_{(B,i)} = \frac{1}{2} q^*_{(B,i)} \left(\frac{a}{b} - p^*_{(B,i)} \right) = \frac{25a^2}{288b} + \frac{5at}{36} + \frac{bt^2}{18} - \frac{5a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{a^2\gamma^2}{72b}.$$

Finally, 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, consumer surplus in Country B is equal to zero if parallel trade is permitted and trade costs are low.

4.6 National and Global Welfare

By adding the relevant profits and the corresponding consumer surpluses we obtain national welfare as well as global welfare levels for high, intermediate and low trade costs if the manufacturer has the right to prevent parallel trade and if it is permitted, respectively. Table 3 summarizes the results.

	Manufacturer can prevent PT (high, intermediate and low t)		
	PT permitted	PT permitted	PT permitted
	High t:	Intermediate t:	Low t:
	$t > \bar{t}$	$\underline{t} \leq t \leq \bar{t}$	$t < \underline{t}$
Welfare in Country A:	$W^{**}_A = W^*_{(A,h)}$	$W^*_{(A,i)} = \Pi^*_i + S^*_{(A,i)}$	$W^*_{(A,l)} = \Pi^*_l + S^*_{(A,l)}$
	$= \Pi^{**} + S^{**}_A$	$= \frac{a^2}{18b} - \frac{5at}{18} - \frac{5bt^2}{18}$	$= -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18}$
	$= \frac{a^2}{8b} + \frac{3a^2\gamma^2}{8b}$	$+ \frac{a^2\gamma}{18b} + \frac{at\gamma}{9} + \frac{7a^2\gamma^2}{18b}$	$- \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}$
Welfare in Country B:	$W^{**}_B = W^*_{(B,h)}$	$W^*_{(B,i)} = \pi^*_i + S^*_{(B,i)}$	$W^*_{(B,l)} = 0$
	$= \pi^{**} + S^{**}_B = \frac{3a^2}{32b}$	$= \frac{25a^2}{96b} + \frac{5at}{12} + \frac{bt^2}{6}$	
		$- \frac{5a^2\gamma}{24b} - \frac{at\gamma}{6} + \frac{a^2\gamma^2}{24b}$	
Global Welfare:	$W^{**} = W^*_h$	$W^*_i = W^*_{(A,i)} + W^*_{(B,i)}$	$W^*_l = W^*_{(A,l)}$
	$= W^{**}_A + W^{**}_B$	$= \frac{91a^2}{288b} + \frac{5at}{36} - \frac{bt^2}{9}$	$= -\frac{a^2}{72b} - \frac{at}{18} - \frac{bt^2}{18}$
	$= \frac{7a^2}{32b} + \frac{3a^2\gamma^2}{8b}$	$- \frac{11a^2\gamma}{72b} - \frac{at\gamma}{18} + \frac{31a^2\gamma^2}{72b}$	$- \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{4a^2\gamma^2}{9b}$
	Table 3. National and Global Welfare Levels		

In the following sections, we analyze the impact of parallel trade freedom on global welfare for

the cases of high, intermediate, and low trade costs.

5 Effect of Parallel Trade Freedom on Global Welfare

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.

5.1 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, $t > \bar{t}$. Therefore, even if parallel trade were permitted, the (non-credible) threat of parallel trade 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.

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

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

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

Proposition 5.1 *Parallel trade freedom increases global welfare if trade costs are intermediate and* $\gamma \geq 5/2$.

Let the net effect of parallel trade freedom on global welfare be denoted by ΔW_i if trade costs

are at an intermediate level. We obtain ΔW_i as follows:

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

Note that ΔW_i is a quadratic function of t. If ΔW_i is positive, parallel trade freedom has a positive effect on global welfare. If, however, it is negative, parallel trade freedom is detrimental to global welfare. First, note that $\Delta W_i = 0$ at the upper bound for t, $\bar{t} = \frac{a}{2b}(\gamma - 1)$. 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. From $\frac{\partial \Delta W_i}{\partial t} = \frac{5a}{36} - \frac{2bt}{9} - \frac{a\gamma}{18} = 0$ follows:

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

Note that $t_i^{\max}$ is the unique maximum as $\frac{\partial^2 \Delta W_i}{\partial^2 t} = -\frac{2}{9}b < 0$ 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 $t > \frac{a}{2b}\left(\frac{5}{4} - \frac{\gamma}{2}\right)$, ΔW_i decreases in t. Furthermore, taking into account that $\Delta W_i = 0$ at $t = \frac{a}{2b}(\gamma - 1)$, it follows that $\Delta W_i > 0$ for $t > \frac{a}{2b}\left(\frac{5}{4} - \frac{\gamma}{2}\right)$. In the following, we consider for which values of the parameter γ $t_i^{\max}$ is smaller than or equal to the lower bound $\underline{t}$. It is straightforward to see that $t_i^{\max} \leq \underline{t}$ if $\gamma \geq \frac{5}{2}$. In other words, for $\gamma \geq \frac{5}{2}$ 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 $\gamma \geq \frac{5}{2}$ as stated in *Proposition 5.1*.

5.2.2 Net Effect of Parallel Trade Freedom if Trade Costs are at an Intermediate Level and $\gamma < \frac{5}{2}$

If $\gamma < \frac{5}{2}$, 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 $\gamma < \frac{5}{2}$ – the lower bound $\underline{t} = \frac{a}{2b}\left(\gamma - \frac{5}{2}\right)$ would be negative. However, as t is positive we set the lower bound for t equal to zero in this case. Furthermore, note that - for $\gamma < \frac{5}{2}$ - ΔW_i has its unique maximum at $t_i^{\max} = \frac{a}{2b}\left(\frac{5}{4} - \frac{\gamma}{2}\right)$ which is positive as $\gamma < \frac{5}{2}$. 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 $\frac{7}{4} \leq \gamma < \frac{5}{2}$.

5.2.3 Net Effect of Parallel Trade Freedom on Global Welfare for Intermediate Trade Costs and $\frac{7}{4} \leq \gamma < \frac{5}{2}$

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

Proposition 5.2 *Parallel trade freedom increases global welfare if trade costs are at an intermediate level and* $\frac{7}{4} \leq \gamma < \frac{5}{2}$.

By setting $t = 0$ in (2) we obtain

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

Note that ΔW_i is greater than or equal to zero if $\gamma \geq \frac{7}{4}$.[29] Consequently, if $\gamma \geq \frac{7}{4}$, ΔW_i is positive between zero and the upper bound for t. Thus, parallel trade freedom has a positive impact on global welfare if $\frac{7}{4} \leq \gamma < \frac{5}{2}$ [see *Proposition 5.2*]. However, let us now consider the case if $1 < \gamma < \frac{7}{4}$.

Net Effect of Parallel Trade Freedom on Global Welfare for Intermediate Trade Costs and $1 < \gamma < 7/4$ In this section, we will give an example in order to illustrate that the following proposition holds.

Proposition 5.3 *Parallel trade freedom can have negative welfare properties if trade costs are at an intermediate level and* γ *is sufficiently low [*$1 < \gamma < \frac{7}{4}$*].*

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

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

Note that – in contrast to the previous sections – t is positive in this case as $\gamma < 7/4$. However, the following example illustrates that *Proposition 5.3* holds.

[29] For instance, we can see that $7 - 11\gamma + 4\gamma^2 = 0$ if $\gamma = \frac{7}{4}$ and that $7 + 4\gamma^2 > 11\gamma$ if $\gamma > \frac{7}{4}$.

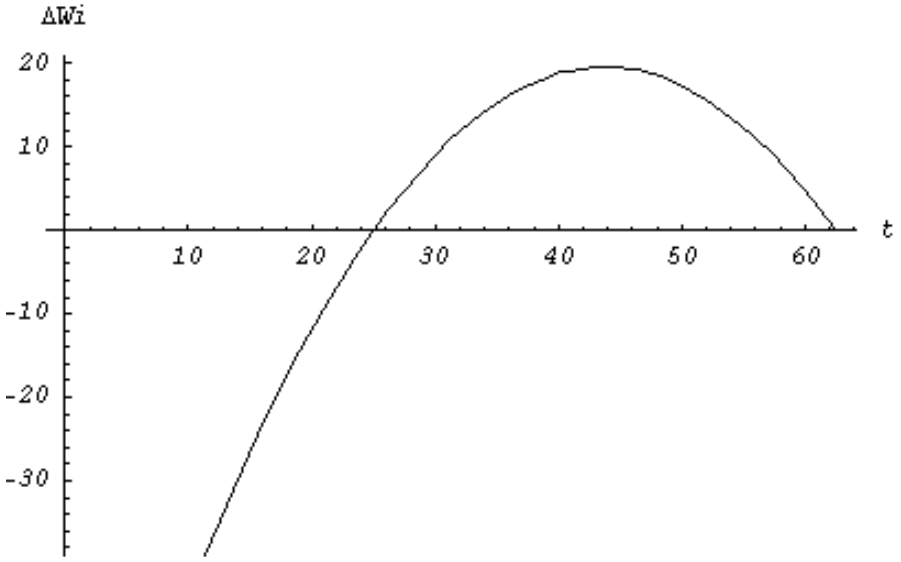

Figure 1. Net Welfare Effect of Parallel Trade Freedom ($a = 100$, $b = \frac{1}{2}$ and $\gamma = \frac{13}{8}$)

Example 5.1 *We set* $a = 100$*,* $b = \frac{1}{2}$ *and* $\gamma = \frac{13}{8}$.

Figure 1 shows that ΔW_i has one null at $t = 25$ and the other null at $t = 62.5$ which is also the upper bound. Furthermore, ΔW_i has its unique maximum at $t_i^{\max} = 43.75$ and the lower bound at $t = 0$.

We can see from Figure 1 that $\Delta W_i < 0 \ \forall t \in (0, 25)$ which suggests that *Proposition 5.3* holds. The intuition behind this result is the following. As we 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, $\frac{7}{4} \leq \gamma$, 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, $1 < \gamma < \frac{7}{4}$, 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.

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

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

Proposition 5.4 *Parallel trade freedom increases global welfare if trade costs are low and γ is sufficiently high ($\gamma > \frac{5}{2}$).*

If trade costs are low, $\underline{t} > t$, the effect of parallel trade freedom on global welfare is given by:

$$\Delta W_l = W_l^* - W^{**} = -\frac{67a^2}{288b} - \frac{at}{18} - \frac{bt^2}{18} - \frac{a^2\gamma}{18b} - \frac{at\gamma}{9} + \frac{5a^2\gamma^2}{72b}. \tag{3}$$

Note that ΔW_l is a quadratic function of t. Moreover, recall that – as t is positive – γ must be greater than $\frac{5}{2}$. For smaller values of the parameter γ would automatically end up in one of the other scenarios mentioned above. However, by differentiating (3) we obtain

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

Note that t_l^{max} is the unique maximum as $\frac{\partial^2 \Delta W_l}{\partial^2 t} = -\frac{1}{9}b < 0$ as $b > 0$. Furthermore, note that $t_l^{max} < 0$ as $a > 0$, $b > 0$ and $\gamma > 0$. However, by setting $t = 0$ in (3) we obtain

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

We can see that – at $t = 0$ – $\Delta W_l > 0$ if $\gamma > \frac{5}{2}$.[30]. Furthermore, by setting $t = \underline{t} = \frac{a}{2b}\left(\gamma - \frac{5}{2}\right)$ in (3) it follows that

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

Note that ΔW_l is positive as $\gamma > \frac{5}{2}$.[31] 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 ($\gamma > \frac{5}{2}$) [see *Proposition 5.4*]. In other words, parallel trade freedom still has a positive effect on global welfare in this case even though the market in Country B remains unserved. Intuitively, if γ is sufficiently high the positive effect of parallel trade freedom on the consumer surplus in Country A *ceteris paribus* more than outweighs the negative effect of parallel trade freedom on the profit of the manufacturer and the closure of the market in Country B.

[30] For instance, note that $20\gamma^2 - 16\gamma - 67 > 0$ if $\gamma > \frac{5}{2}$.
[31] For instance, note that $\gamma - 2 > 0$ if $\gamma > \frac{5}{2}$.

6 Conclusion

Our model suggests that parallel trade 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. However, the question arises as to how the manufacturer strategically chooses prices in order to prevent the occurrence of parallel trade. As we 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 parallel trade cost are high, $t > \bar{t}$, 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. Intuitively, 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, however, parallel trade cost are low, $t \leq \bar{t}$, 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 our parallel trade model shows that this assertion is correct if trade cost are low and γ is sufficiently high, i.e. $\gamma > \frac{5}{2}$. More specifically, we find that – for low trade costs – potential competition from parallel trade is so fierce that the manufacturer charges such a high wholesale price in Country B in order to deter parallel trade that the distribution of the product in Country B becomes unprofitable. In this case, the market in Country B will not be served. 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.[32] As to the impact of parallel trade freedom on the profit of the manufacturer, we 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

[32] For instance, see Fink (2005) on p. 178. See also Varian (1985) and Maskus (2001) on p. 41.

his incentives to invest in R&D [*Proposition 4.1*].

As to the welfare properties of parallel trade, parallel trade freedom increases global welfare if γ is sufficiently high, $\gamma > \frac{5}{2}$ [*Proposition 5.1* and *Proposition 5.4*]. If, however, trade costs are intermediate and γ is sufficiently low, $1 < \gamma < \frac{7}{4}$, parallel trade freedom can have negative welfare properties [*Proposition 5.3*]. 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, we suggest a more elaborate theoretical and empirical analysis of the parameter t which is of significant importance for the results of our 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-labeling are incurred by the parallel-importing distributor as well as other parallel trade-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 labeling, language, warnings etc. that make re-packaging and re-labeling more expensive for the parallel-importing distributor.[33] 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 labeling, 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, we suggest analyzing the strategic behavior of foreign governments to protect consumers in their country from excessive pricing, i.e. through price caps or compulsory licensing.

[33] For instance, see Maskus and Ganslandt (2002) on p. 69ff and Gallini and Hollis (1999) on p. 2ff.

7 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^*, $t \leq \frac{a}{2b}(\gamma - 1)$, is satisfied. Recall that

$$\begin{aligned} p_B^{w*} &= \frac{a}{6b}(2\gamma + 1) - \frac{2}{3}t \geq 0 \\ &\Leftrightarrow \quad t \leq \frac{a}{4b}(2\gamma + 1). \end{aligned}$$

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

Appendix 2: Proof of Proposition 4.1

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

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

$$\Pi_i^* = \Pi_{(A,i)}^* = \Pi_{(B,i)}^* = p_{(A,i)}^{m*} q_{(A,i)}^* + p_{(B,i)}^{w*} q_{(B,i)}^* = \frac{a^2}{24b} - \frac{at}{3} - \frac{bt^2}{3} + \frac{a^2\gamma}{6b} + \frac{at\gamma}{3} + \frac{a^2\gamma^2}{6b}.$$

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

$$\Pi_i^{**} = \Pi^{**} = \Pi_A^{**} + \Pi_B^{**} = p_A^{m**} q_A^{**} + p_B^{w**} q_B^{**} = \frac{a^2}{8b} + \frac{a^2\gamma^2}{4b}.$$

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 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 and the equilibrium profit of the manufacturer if he has the right to prevent parallel trade. Hence,

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

Note that $\Delta\Pi_i$ is a quadratic function of t. We will elaborate in the following upon this important

feature. 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 $t = \bar{t} = \frac{a}{2b}(\gamma - 1)$ in $\Delta\Pi_i$. Furthermore, note $\Delta\Pi_i$ that has its maximum at $t = \bar{t}$ as

$$\begin{aligned} \frac{\partial \Delta\Pi_i}{\partial t} &= -\frac{a}{3} - \frac{2bt}{3} + \frac{a\gamma}{3} = 0 \\ &\Leftrightarrow \quad t = \frac{a}{2b}(\gamma - 1) \end{aligned}$$

and

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

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 4.1 (i)*].

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

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 positive. Hence, we can see from $t < \underline{t} = \frac{a}{2b}\left(\gamma - \frac{5}{2}\right)$ that γ must be greater than $\frac{5}{2}$ 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. $\gamma \longrightarrow 1$, 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 $\gamma > \frac{5}{2}$, 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

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

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

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

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. 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,

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

Note 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

$$\begin{aligned} \frac{\partial\Delta\Pi_l}{\partial t} &= -\frac{a}{9} - \frac{2bt}{9} + \frac{a\gamma}{9} = 0 \\ &\iff t = \frac{a}{2b}(\gamma - 1) \end{aligned}$$

and

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

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

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

as $a > 0$ and $b > 0$. 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 4.1 (ii)*].

8 References

Arfwedson, J. (2004), Parallel trade in pharmaceuticals, IPI Policy Report No. 182, Lewisville: Institute for Policy Innovation.

Barfield, C. E. and M. A. Groombridge (1998), "The economic case for copyright owner control

over parallel imports", Journal of World Intellectual Property, 1(6), 903-939.

Barfield, C. E. and M. A. Groombridge (1999), "Parallel trade in the pharmaceutical industry: implications for innovation, consumer welfare, and health policy", Fordham Intellectual Property, Media and Entertainment Law Journal, 10(1), 185-266.

Brekke, K. R., A. L. Grasdal, and T. H. Holmås (2009), "Regulation and pricing of pharmaceuticals: reference pricing or cap regulation?", European Economic Review, 53, 170-185.

Chard, J. S. and C. J. Mellor (1989), "Intellectual property rights and parallel imports", World Economy, 12(1), 69-83.

Danzon, P. M. (1997), Pharmaceutical price regulation, Washington, D.C.: American Enterprise Institute Press.

Danzon, P. M. (1998), "The economics of parallel trade", PharmacoEconomics, 13(3), 293-304.

Danzon, P. M. and A. Towes (2003), "Differential pricing for pharmaceuticals: reconciling access, R&D and patents", International Journal of Health Care Finance and Economics, 3(3), 183-205.

Fink, C. (2005), "Entering the jungle of intellectual property rights exhaustion and parallel importation" in Fink C. and K. E. Maskus (ed.), Intellectual property and development: lessons from recent economic research, 171-188, World Bank and Oxford University Press.

Gallini, N. T. and A. Hollis (1999), "A contractual approach to the gray market", International Review of Law and Economics, 19(1), 1-21.

Ganslandt, M. and K. E. Maskus (2004), "Parallel imports and the pricing of pharmaceutical products: evidence from the European Union", Journal of Health Economics, 23(5), 1035-1057.

Grossman, G. M. and E. L.-C. Lai (2008), "Parallel imports and price controls", RAND Journal of Economics, 39(2), 378-402.

Harhoff, D. and M. Reitzig (2004), "Determinants of opposition against EPO patent grants - the case of biotechnology and pharmaceuticals", International Journal of Industrial Organization, 22(4), 443-480.

Harhoff, D., F. M. Scherer, and K. Vopel (2003), "Citations, family size, opposition and the value of patent rights", Research Policy, 32(8), 1343-1363.

Jelovac, I. and C. Bordoy (2005), "Pricing and welfare implications of parallel imports in the pharmaceutical industry", International Journal of Health Care Finance and Economics, 5(1), 5-21.

Li, C. and K. E. Maskus (2006), "The impact of parallel imports on investments in cost-reducing research and development", Journal of International Economics, 68(2), 443-455.

Li, C. and J. Robles (2007), "Product innovation and parallel trade", International Journal of Industrial Organization, 25, 417-429.

Malueg, D. A. and M. Schwartz (1994), "Parallel imports, demand dispersion, and international price discrimination", Journal of International Economics, 37(3/4), 167-195.

Mansfield, E. (1986), "Patents and innovation: an empirical study", Management Science, 32(2), 173-181.

Maskus, K. E. (2000a), Intellectual property rights in the global economy, Washington, DC: Institute for International Economics.

Maskus, K. E. (2000b), "Parallel imports", World Economy, 23(9), 1269-1284.

Maskus, K. E. (2001), Parallel imports in pharmaceuticals: implications for competition and prices in developing countries, Geneva: Final Report to the World Intellectual Property Organization.

Maskus, K. E. and Y. Chen (2004), "Vertical price control and parallel imports: theory and evidence", Review of International Economics, 12(4), 551-570.

Maskus, K. E. and M. Ganslandt (2002), "Parallel trade in pharmaceutical products: implications for procuring medicines for poor countries" in Granville, B. (ed.), The economics of essential medicines, 57-80, London: Royal Institute of International Affairs.

Müller-Langer, F. (2007), A game theoretic analysis of parallel trade and the pricing of pharmaceutical products, German Working Papers in Law and Economics, vol. 2007, art. 6, Berkeley Electronic Press.

Müller-Langer, F. (2009), Creating R&D incentives for medicines for neglected diseases: an economic analysis of parallel imports, patents, and alternative mechanisms to stimulate pharmaceutical research, Wiesbaden: Gabler.

Richardson, M. (2002), "An elementary proposition concerning parallel imports", Journal of International Economics, 56(1), 233-245.

Szymanski, S. and T. M. Valletti (2005), "Parallel trade, price discrimination, investment and price caps", Economic Policy, 20(44), 705-749.

Valletti, T. M. (2006), "Differential pricing, parallel trade, and the incentive to invest", Journal of International Economics, 7(1), 314-324.

Valletti, T. M. and S. Szymanski (2006), "Parallel trade, international exhaustion and intellectual property rights: a welfare analysis", Journal of Industrial Economics, 54(4), 499-526.

Varian, H. R. (1985), "Price discrimination and social welfare", American Economic Review, 75(4), 870-875.