Pharmaceutical cost-sharing and market integration through parallel trade

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Abbreviated Version

Abstract

This paper investigates the interaction of cost-sharing in health care systems, when markets are integrated by parallel trade. Two forms of cost-sharing, a co-insurance rate and a fixed amount reimbursement, are compared in terms of prices, quantities and welfare.

Market integration through parallel trade causes spillovers between markets and thus, the cost-sharing schemes of the origin and destination country of parallel imports affect each other. In a two-country model of two integrated markets with a vertical distributor relationship in the foreign market, parallel trade arises as a by-product of vertical control structures and is mainly determined by the wholesale price the manufacturer chooses and the vertical product differentiation between the authorized version of the drug and the parallel import. Whereas in a scheme of co-insurance, spillovers work in both directions, the fixed amount reimbursement results in one-way spillovers only. In this case, the fixed grant in the destination country of the parallel imports affects the origin country of the parallel imports.

JEL Classification: F12, F15, I11, I18
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1 Introduction

In the European Union, Article 168 of the Treaty on the Functioning of the European Union (TFEU) specifies that health care systems are determined on a national level by member states. However, market integration, e.g. through parallel trade, may result in spillovers.

This paper examines the interaction between one element of national health care systems, cost-sharing, and parallel imports in a two-country model of imperfect competition. The main issue investigated is how changes in the cost-sharing devices in one country affect drug prices, consumption and welfare in the other country. The paper shows that market integration through parallel trade results in two-way spillovers if patients pay a fraction of the effective drug price and one-way spillovers if health insurances reimburses a fixed amount and patients pay the difference to the effective price.

Parallel imports are goods placed legimately onto the market in one country, but subsequently imported into another country without the authorization of the respective patent owner (Ganslandt & Maskus 2007). The underlying principle with respect to the admissibility of parallel trade is the exhaustion doctrine. The European Union has adopted regional exhaustion, which implies that parallel trade is

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legal within the European Union, but parallel imports from non-member states are excluded (Ganslandt & Maskus 2007). Essentially, the purpose of parallel trade is arbitrage between markets with different prices. Price differentials that exceed the cost of cross-border trade may result from vertical control structures when goods are distributed with the help of intermediaries abroad. The intermediary, either retailer or wholesaler, obtains the good for a lower price than the price for which the manufacturer sells the product and can thus act as a competitor in the manufacturer's home market. In the pharmaceutical sector, parallel trade benefits from the price divergence as member states set or control prices (EU Commission 2003). The European Court of Justice has repeatedly confirmed that medicial products and services are not exempted from the rules of the internal market (EU Commission 2003).

Basically, cost-sharing in the health system has two main objectives: First, it aims at discouraging "inappropriate" use of health by making individuals more aware of costs of health care services and detering people from using services that are not really necessary (those, where marginal private cost exceeds expected marginal private benefit) (Robinson 2002). Hence, it reduces the utilization of medical services overall and reduces the share of national resources devoted to health care (Mossialos & Le Grand 1999). A part of the financial burden borne by the health insurance is assigned to the patient. The health insurance is relieved, while the patient is exposed to the cost (Knappe 2003). Second, cost-sharing relieves pressure on public budget through raising revenue. The latter aim is in partial conflict with the role in discouraging the use of services and restraining demand (Mossialos & Le Grand 1999).

The main forms of direct cost sharing are co-payments (flat fee or charge per service), co-insurance (a percentage of the total charge), deductibles (a payment covering the first x dollars before insurance coverage begins) and fixed grants (a fixed amount is reimbursed) (Robinson 2002).

Co-insurance, i.d. a co-payment in terms of percentage of the sales price, is considered to be very effective in restraining demand according to the price elasticity of demand. The price structure becomes "visible" and more expensive services will be reduced more. The disadvantage of co-insurance is that even moderate co-insurance rates can put a higher financial burden on households than with what those may be able to cope (Knappe 2003). A co-payment in absolute terms however, may avoid financial disstress of households. The demand restraining effect is very high for low amounts, but as soon as a certain amount is exceeded, the control mechanism is no longer applicable (Knappe 2003). Von Schulenburg & Greiner 2007 argue that for given prices and at same the absolute effective financial burden, fixed grants and co-insurance rates reduce the quantity demanded by the same amount , whereas a deductible would reduce demand less (von der Schulenburg, Greiner 2007). If suppliers are able to set prices freely, the favorable form of cost-sharing is the one where demand responds most price elastic, which is the case for fixed grants (von der Schulenburg, Greiner 2007).

In the European Union, pharmaceuticals constitute the major area of cost-sharing. All EU-15 Member States apply some form cost-sharing in relation to this sector, in most cases co-insurance with a rate varying between different classes of products is applied (Robinson 2002). In the UK and for some drugs in Belgium and Italy, a flat rate co-payment applies, Ireland uses a maximum quarterly expenditure, i.e. a deductible, whereas Germany, the Netherlands, Sweden and Spain use reference pricing, which includes an element of fixed grants (Robinson 2002).

The model explains parallel trade as a by-product of vertical control structures and thus follows Maskus & Chen 2002 and Chen & Maskus 2005. The model assumes a manufacturer selling in two markets. In the home market, consumers purchases the good directly from the manufacturer, in the foreign market the manufacturer markets the good through intermediaries. In imperfectly competitive markets, the vertical seperation creates a double marginalization problem. The manufacturer tries to solve this inefficiency by adopting a two part tariff, specifying a wholesale price and a franchise fee. For seperated markets, the manufacturer's optimal strategy is to set a low wholesale price and extract the retailer's profit via the fixed fee to avoid the double marginalization problem. However, in the presence

of parallel trade, a low wholesale price would induce more parallel trade and thus the manufacturer may want to set the wholesale price higher in order to limit competition from parallel trade. The optimal wholesale price reflects the tradeoff between an aggravated double marginalization problem in the foreign market for a high wholesale price and increased competition in the home market due to a low wholesale price.

This paper is organized as follows. In section 2 the model is presented, in section 3 equilibrium prices, quantities and profits are derived for co-insurance rates and in section 4 equilibrium prices, quantities and profits are derived for indemnity or fixed grant reimbursement. In section 5 spillovers are investigated. Section 7 concludes.

2 The Model

Consider a domestic manufacturer M, which sells a brand-name drug b in two countries, its home country H and a foreign country F. In country H, consumers purchases the good directly from the manufacturer; in country F, the manufacturer M distributes its product with the help of a retailer R. In addition to selling in market F, the retailer R can engage in parallel trade and sell the drug b as parallel import (hereafter noted as β) to consumers in H.

Compared to the authorized product sold directly by the manufacturer, consumers associate a lower quality with the parallel import, which is captured by a discount factor in consumer valuation. The perception of parallel imports as qualitative inferior results from differences in appearing and packaging. In addition, in health economics, following Schmalensee 1982, uncertainty regarding product characteristics can be translated into quality differentials. In addition, there is evidence that price may serve as a quality indicators, thus due to the lower price, the parallel import is associated with lower quality.

Consumers in both countries are heterogeneous with respect to the gross valuation of drug treatment, represented by a parameter θ which is uniformly distributed on the interval $[0, 1]$. The total mass of consumers is 1 in both countries.

Each consumer demands either one or zero units of the most preferred drug. The utility derived from no drug consumption is zero, while a consumer who buys one unit of drug i obtains a net utility

$$U(\theta, \tau, c_i) = \begin{cases} \theta - c_{i,j} & if\ i = b \\ \theta(1-\tau) - c_{i,j} & if\ i = \beta \end{cases} \tag{1}$$

where $\tau \in (0, 1)$ reflects the perceived quality difference between both versions b and β of the drug[1] and $c_{i,j}$ is the patient co-payment for drug i in country j ($j = H, F$).

Consumers will choose the most preferred drug version by trading off perceived drug quality against drug co-payment. The higher the gross valuation of drug treatment θ, the more the consumer is willing to pay in order to purchase the (high-quality) authorized drug.

In country H, a consumer who is indifferent between purchasing the authorized version b from the manufacturer and purchasing the parallel import β has a gross valuation θ^*_H, given by $\theta^*_H - c_{b,H} = \theta^*_H(1-\tau) - c_{\beta,H}$, yielding

$$\theta^*_H = \frac{c_{b,H} - c_{\beta,H}}{\tau}, \tag{2}$$

while a consumer who is indifferent between buying the parallel import and not buying has a gross

[1] For $\tau = 1$, consumers associate no value at all with the parallel import, for $\tau = 0$, both products are associated with the same quality and are thus considered perfect substitutes.

valuation θ_H^{**}, given by $\theta_H^{**}(1-\tau) - c_{\beta,H} = 0$, yielding

$$\theta_H^{**} = \frac{c_{\beta,H}}{(1-\tau)}. \tag{3}$$

Hence, in country H demand for the authorized product b and for the parallel import β is given by

$$q_{b,H} = 1 - \frac{c_{b,H} - c_{\beta,H}}{\tau} \text{ and } q_{\beta,H} = \frac{c_{b,H} - c_{\beta,H}}{\tau} - \frac{c_{\beta,H}}{(1-\tau)}.$$

In country F, a consumer who is indifferent between purchasing the authorized version from the retailer b and not purchasing has a gross valuation θ_F^*, given by $\theta_F^* - c_{b,F} = 0$, yielding

$$\theta_F^* = c_{b,F}. \tag{4}$$

Hence, in country F demand for the authorized product b is given by

$$q_{b,F} = 1 - c_{b,F}. \tag{5}$$

Production technologies exhibit constant marginal costs, which are normalized to zero for simplicity.

The structure of the model can be summarized by the following three-stage game: In the first stage, governments choose simultaneously their cost-sharing instruments, either co-insurance rates or fixed amount reimbursement. In the second stage, the manufacturer specifies a wholesale price w and fixed fee ϕ. In the third and final stage, the retailer sets $p_{b,F}$ and $p_{\beta,H}$ while the manufacturer sets $p_{b,H}$.

3 Co-insurance Rates

In the case of co-insurance rates, the insurer bears a fraction of $0 < \kappa < 1$ of pharmaceutical cost, the remaining fraction $1 - \kappa = \gamma$ is paid by the patient. The effective price of the drug to the insured thus equals the proportion γ of the price set by the pharmaceutical company (Zweifel et al. 2009). For the decision between the authorized version of the drug and the parallel import, the fraction γ of the price difference is crucial.

For the case of co-insurance rates patient co-payments are given as

$$c_{i,H} = \gamma_H p_{i,H} \text{ and } c_{i,F} = \gamma_F p_{i,F}. \tag{6}$$

3.1 Segmented Markets

As a benchmark for comparison, consider the case of segmented markets, when parallel trade is forbidden legally and the manufacturer M enjoys monopoly pricing power in market H.

The manufacturers profit is given as

$$\pi_M = \underbrace{p_{b,H}\left(1 - \gamma_H p_{b,H}\right)}_{\pi_{b,H}} + \underbrace{w\left(1 - \gamma_F p_{b,F}\right)}_{\pi_{w_b}} + \phi, \tag{7}$$

where $\pi_{b,H}$ denotes the monopoly profit from direct sale in country H, π_{w_b} the wholesale profit from the retailer's sales in market F, and ϕ the franchise fee, which is used to extract the retailer's profit.

The retailer's total profit is given as

$$\pi_R = \underbrace{\left(p_{b,F} - w\right)\left(1 - \gamma_F p_{b,F}\right)}_{\pi_{b,F}} - \phi, \tag{8}$$

where π_r denotes the profit from sales in country F and ϕ the franchise fee.

In market H, the manufacturer M maximizes (7) with respect to $p_{b,H}$. The first order condition to this problem is $1 - 2\gamma_H p_{b,H} = 0$, yielding the monopoly price

$$p_{b,H} = \frac{1}{2\gamma_H}. \tag{9}$$

In market F, the retailer R maximizes (8) with respect to $p_{b,F.}$ The first order condition to this problem is $1 + w\gamma_F - 2p_{b,F}\gamma_F = 0$, yielding the price

$$p_{b,F} = \frac{1 + w\gamma_F}{2\gamma_F}. \tag{10}$$

Turning to the second stage of the game, the manufacturer M sets Φ to

$$\phi = \pi_{b,F} = \frac{(1 - w\gamma_F)^2}{4\gamma_F}. \tag{11}$$

In the absence of parallel trade, the manufacturer's optimal strategy is to set the wholesale price equal to the marginal cost of production, i.e. $w = 0$, which can also be obtained by substituting (11) and equilibrium prices into (7) and maximizing with respect to w.

The resulting price in market F is

$$p_{b,F} = \frac{1}{2\gamma_F}. \tag{12}$$

Equilibrium quantities are

$$q_{b,H} = \frac{1}{2} = q_{b,F}. \tag{13}$$

Substituting the wholesale price of zero into equilibrium prices and (11) into (7) yields the equilibrium profit

$$\pi_M = \underbrace{\frac{1}{4\gamma_H}}_{\pi_{b,H}} + \underbrace{0}_{\pi_{w_b}} + \underbrace{\frac{1}{4\gamma_F}}_{\phi} = \frac{\gamma_H + \gamma_F}{4\gamma_H\gamma_F}. \tag{14}$$

Consumer surplus is given as

$$CS_H = \int_{\theta_H^*}^{1} (\theta - \gamma_H p_{b,H})d\theta = \frac{1}{8} = CS_F = \int_{\theta_F^*}^{1} (\theta - \gamma_F p_{b,F})d\theta. \tag{15}$$

Note that indifferent consumers are located at $\theta_H^* = \frac{1}{2}$ and $\theta_F^* = \frac{1}{2}$.

Expenditure for health insurance in country j is defined as

$$E_j = (1 - \gamma_j)p_{i,j,}q_{i,j}. \tag{16}$$

In country j expenditure amounts to

$$E_j = \frac{(1 - \gamma_j)}{4\gamma_j}. \tag{17}$$

3.2 Integrated Markets

If markets are integrated by parallel trade, the manufacturer faces a duopoly in H. Its total profit is given as

$$\pi_M = \underbrace{p_{b,H}\left(1 - \frac{\gamma_H(p_{b,H} - p_{\beta,H})}{\tau}\right)}_{\pi_b} + \underbrace{w\left(1 - \gamma_F p_{b,F}\right)}_{\pi_{w_b}} + \underbrace{w\left(\frac{\gamma_H(p_{b,H} - p_{\beta,H})}{\tau} - \frac{\gamma_H p_{\beta,H}}{(1-\tau)}\right)}_{\pi_{w_\beta}} + \phi, \quad (18)$$

where π_b denotes the profit from direct sale in H, π_{w_b} the wholesale profit from the retailer's sales in market F, π_{w_β} the wholesale profit from the retailer's sales as parallel imports in market H, and ϕ the franchise fee, which is used to extract the retailer's profit. Note that as there is competition from parallel trade in market H also additional wholesale profit from the retailer's sales as parallel imports is created.

The retailer's total profit is given as

$$\pi_R = \underbrace{(p_{b,F} - w)\left(1 - \gamma_F p_{b,F}\right)}_{\pi_{b,F}} + \underbrace{(p_{\beta,H} - w)\left(\frac{\gamma_H(p_{b,H} - p_{\beta,H})}{\tau} - \frac{\gamma_H p_{\beta,H}}{(1-\tau)}\right)}_{\pi_{\beta,H}} - \phi, \quad (19)$$

where $\pi_{b,F}$ denotes the profit from sales in F, $\pi_{\beta,H}$ the profit from sales as parallel imports in market H, and ϕ the fixed fee.

In market H, the manufacturer M maximizes (18) with respect to $p_{b,H}$. The first order condition to this problem is $1 + \frac{\gamma_H(p_{\beta,H} - 2p_{b,H} + w)}{\tau} = 0$, which yields M's best response function

$$p_{b,H} = \frac{\tau}{2\gamma_H} + \frac{1}{2}\left(p_{\beta,H} + w\right). \quad (20)$$

In country H, the retailer maximizes (19) with respect to $p_{\beta,H}$, which yields the first order condition $\frac{\gamma_H}{\tau}\left(\frac{w - 2p_{\beta,H}}{1-\tau} + p_{b,H}\right) = 0$ and the best response function

$$p_{\beta,H} = \frac{1}{2}\left(w + p_{b,H}\left(1 - \tau\right)\right). \quad (21)$$

Solving for equilibrium prices results in

$$p_{b,H} = \frac{2\tau + 3w\gamma_H}{\gamma_H\left(3 + \tau\right)} \text{ and } p_{\beta,H} = \frac{\tau\left(1 - \tau\right) + w\gamma_H\left(3 - \tau\right)}{\gamma_H\left(\tau + 3\right)}. \quad (22)$$

In market F, the retailer maximizes (19) with respect to $p_{b,F}$. The first order condition to this maximization problem is $w\gamma_F - 2p_{b,F}\gamma_F + 1 = 0$, yielding

$$p_{b,F} = \frac{1 + w\gamma_F}{2\gamma_F}. \quad (23)$$

In the second stage of the game, the manufacturer chooses the wholesale price w and the fixed fee ϕ. For segmented markets, the manufacturer's optimal strategy would be to set the wholesale price equal to marginal cost, i.e. $w = 0$ and to extract the retailer's profit via the franchise fee to avoid the double marginalization problem, resulting from vertical seperation in imperfectly competitive market. However, in the presence of parallel trade, the manufacturer would want to set w higher than marginal cost to limit competition from parallel trade in market H. The optimal wholesale price w reflects the tradeoff between an intensified double marginalization problem in market F due to a high wholesale price and increased competition in market H due to a low wholesale price.

With

$$\phi = \pi_{b,F} + \pi_{\beta,H} = \frac{(1 - w\gamma_F)^2}{4\gamma_F} + \frac{\tau\,(1 - 2w\gamma_H - \tau)^2}{\gamma_H\,(1-\tau)\,(3+\tau)^2} \tag{24}$$

the manufacturer extracts the retailer's total profit.

Substituting (24) and equilibrium prices into (18) and maximizing with respect to w gives

$$w = \frac{2\,(1-\tau)\,(9-5\tau)}{4\gamma_H\,(9-5\tau) + \gamma_F\,(1-\tau)\,(3+\tau)^2}. \tag{25}$$

As markets are integrated through parallel trade, the manufacturer sets the wholesale price w to balance the trade-off between increased competition market H from parallel imports and an increased double mark-up problem in market F. The wholesale price w decreases with the vertical differentiation parameter τ. A larger τ, i.e. increased product differentiation in market H, reduces the competitive pressure from parallel trade, as the two versions of the drug are more remote substitutes. When setting the wholesale price w then, the impact of w on market H is less relevant and therefore the double marginalization in market F gains importance. From this it follows that the wholesale price can be set lower, as increased product differentiation decreases competitive pressure from parallel trade and allows the manufacturer to focus on the double marginalization problem in the foreign market. Thus, a higher vertical differentiation parameter in market H reduces the double marginalization problem and thus the price of the drug in market F.

Equilibrium prices in market H are

$$p_{b,H} = \frac{2\gamma_H\,(9-5\tau) + 2\tau\gamma_F\,(3+\tau)\,(1-\tau)}{\gamma_H[4\gamma_H\,(9-5\tau) + \gamma_F\,(1-\tau)\,(3+\tau)^2]} \tag{26}$$

and

$$p_{\beta,H} = \frac{2\gamma_H\,(1-\tau)\,(9-5\tau) + \tau\gamma_F\,(3+\tau)\,(1-\tau)^2}{\gamma_H[4\gamma_H\,(9-5\tau) + \gamma_F\,(1-\tau)\,(3+\tau)^2]}. \tag{27}$$

The price of the authorized drug sold by the manufacturer directly ($p_{b,H}$) is always higher than the price of the parallel imported drug ($p_{\beta,H}$), reflecting the perceived vertical differentiation between both versions of the drug. If both products are considered to be of the same quality, i.e. $\tau = 0$, the two versions of the drug will be priced equally, due to the perfect competition between the manufacturer and the retailer.

Compared to the situation in which markets are segmented, market integration through parallel trade results in reductions of the price for the authorized drug sold in the home country ($p_{b,H}$) due to competition from parallel trade. The price of the authorized version increases with the vertical product differentiation, i.e. τ. For $\tau = 1$, prices are identical under parallel trade and segmented markets, since no value is associated with the parallel import and hence demand for it will be zero, providing the manufacturer with monopoly pricing power.

The parameter τ then not only determines the degree of vertical product differentiation between the authorized version of the drug, but also the extent of competition the manufacturer is exposed to in market H, with $\tau = 0$ and $\tau = 1$ denoting the two extremes of perfect competition and monopoly pricing power respectively. In the further course of this section, referring to the $\tau = 1$-case, which establishes equivalence of the situation of segmented markets and the situation of integrated markets, is abstained from. Also the price for the drug in the foreign country, quantities, consumer surplus and expenditure in both countries as well as the manufacturer's profit will be identical under parallel trade and segmented markets for $\tau = 1$.

The effect of an increase of the product differentiation parameter τ on the price of the parallel import

depends on the level of τ. For a low τ, the price-increasing strategic effect dominates the price-decreasing direct effect and the price-decreasing effect from a lower wholesale price; for a high τ, the two price-decreasing effects exceed the price-increasing strategic effect.

The equilibrium price in market F is

$$p_{b,F} = \frac{4\gamma_H (9-5\tau) + \gamma_F (1-\tau)\left(27-4\tau+\tau^2\right)}{2\gamma_F[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2]}. \tag{28}$$

In the foreign country, parallel trade causes the price for the drug ($p_{b,F}$) to rise, as the wholesale price and thus the markup rises.

Resulting equilibrium quantities in country H are

$$q_{b,H} = \frac{2[\gamma_H (9-5\tau) + \gamma_F (3+\tau)(1-\tau)]}{4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2} \tag{29}$$

and

$$q_{\beta,H} = \frac{\gamma_F (3+\tau)(1-\tau)}{4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2}. \tag{30}$$

Under market integration, the quantity sold directly by the manufacturer in the home market is higher than in the case of segmented markets. Needless to say, the total quantity sold in market H, the quantity sold as authorized version by the manufacturer and as parallel import by the retailer is higher than in the segmented-market-monopoly. Thus, the lower drug prices in the destination country of the parallel import improve access to the pharmaceutical, both to the authorized version and to the drug in general, i.e. in either version.

The equilibrium quantity country F is given as

$$q_{b,F} = \frac{4\gamma_H (9-5\tau) - \gamma_F (1-\tau)\left(9-16\tau-\tau^2\right)}{2[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2]}. \tag{31}$$

In the foreign country, the quantity of the drug sold by the retailer is lower under market integration than under segmented markets. The higher wholesale price, the higher markup and the thereby higher drug price worsen access to the drug in the origin country of the parallel import.

Substituting (25) into (24) and into (18) yields the manufacturer's equilibrium profit

$$\pi_M = \frac{4\gamma_H^2 (9-5\tau) + \gamma_F[\gamma_H \left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right) + 4\tau\gamma_F (1-\tau)(5-\tau)]}{4\gamma_H\gamma_F[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2]}. \tag{32}$$

Market integration through parallel trade results in a lower profit for the manufacturer compared to the case of segmented markets. Both additional competition from parallel trade in the home country and the double marginalization problem due to the higher wholesale price have a negative impact on the manufacturer's profit. If possible, the manufacturer would prefer to be able to segment markets.

Consumer surplus in country H is given as

$$\begin{aligned} CS_H &= \int_{\theta_H^*}^{1} (\theta - \gamma_H p_{b,H})d\theta + \int_{\theta_H^{**}}^{\theta_H^*} (\theta(1-\tau) - \gamma_H p_{\beta,H})d\theta \\ &= \frac{(9-5\tau)\left[4\gamma_H^2 (9-5\tau) + 4\gamma_H\gamma_F (1-\tau)\left(9-\tau^2\right) + \gamma_F^2 (3+\tau)^2 (1-\tau)^2\right]}{2[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2]^2}. \end{aligned} \tag{33}$$

Note that indifferent consumers are located at $\theta_H^* = \frac{2\gamma_H\tau(9-5\tau)+\tau\gamma_F(1-\tau)(3+4\tau+\tau^2)}{\tau[4\gamma_H(9-5\tau)+\gamma_F(1-\tau)(3+\tau)^2]}$ and $\theta_H^{**} = \frac{2\gamma_H(1-\tau)(9-5\tau)+\tau\gamma_F(3+\tau)(1-\tau)^2}{(1-\tau)[4\gamma_H(9-5\tau)+\gamma_F(1-\tau)(3+\tau)^2]}$. Parallel trade increases consumer surplus in the destination

country of the parallel import. Consumers benefit from lower drug prices and improved access to pharmaceuticals as compared to the situation in which parallel trade does not take place. Consumer surplus decreases with the vertical differentiation parameter τ, since increased product differentiation decreases competition from parallel trade in country H. A higher τ causes the price of the authorized version to rise and the quantity of both versions of the drug to decrease.

Consumer surplus in country F is given as

$$\begin{aligned} CS_F &= \int_{\theta_F^*}^{1} (\theta - \gamma_F p_{b,F}) d\theta \\ &= \frac{[4\gamma_H (9-5\tau) - \gamma_F (1-\tau)\left(9-16\tau-\tau^2\right)]^2}{8[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(3+\tau)^2]^2}. \end{aligned} \tag{34}$$

Note that the indifferent consumer is located at $\theta_F^* = \frac{4\gamma_H(9-5\tau)+\gamma_F(1-\tau)(27-4\tau+\tau^2)}{2[4\gamma_H(9-5\tau)+\gamma_F(1-\tau)(3+\tau)^2]}$. In the foreign country, market integration reduces consumer surplus, as consumers suffer from a higher drug price due to a higher markup and a lower quantity sold. Consumer surplus in the origin country of the parallel import increases with the vertical differentiation parameter τ, as a higher τ lowers the wholesale price w and thus the price of the drug and thereby improves access to pharmaceuticals. Hence from a patient's perspective, parallel trade can be considered desirable in the destination country, but unattractive in the origin country.

In country H, health insurance expenditure amounts to

$$E_H = \frac{(1-\gamma_H)\left[4\gamma_H^2 (9-5\tau)^2 + \gamma_F (1-\tau)(3+\tau)^2 \left[2\gamma_H (9-5\tau) + \tau\gamma_F (1-\tau)(5-\tau)\right]\right]}{\gamma_H [4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(\tau+3)^2]^2}. \tag{35}$$

Parallel trade results in lower expenditure in the destination country due to the competition effect. Lower drug prices reduce health insurance expenditure, with this effect exceeding the expenditure-increasing effect of a higher volume being consumed. Expenditure increases with τ, since the effect from advance in the authorized version's price surmounts the expenditure-decreasing quantity reduction.

In country F health insurance expenditure amounts to

$$E_F = \frac{(1-\gamma_F)\left[4\gamma_H (9-5\tau) + \gamma_F (1-\tau)\left(27-4\tau+\tau^2\right)\right]\left[4\gamma_H (9-5\tau) - \gamma_F (1-\tau)\left(9-16\tau-\tau^2\right)\right]}{4\gamma_F \left(4\gamma_H (9-5\tau) + \gamma_F (1-\tau)(\tau+3)^2\right)^2}. \tag{36}$$

In the foreign country, parallel trade also reduces health insurance expenditure. The expenditure-reducing effect of a lower volume dominates the effect of a higher drug price. As τ increases and the wholesale price w is lowered by the manufacturer, the impact on expenditure-increasing quantity growth is stronger than the expenditure-decreasing price drop and health insurance expenditure increases. For health insurances in both countries, parallel trade constitutes an instrument of cost containment, in the destination country the competition effect is decisive, in the the origin country the effect from double marginalization.

This section can be summarized in proposition 1.

Proposition 1 *In the destination country, competition from parallel trade results in lower prices, with the considered qualitative inferior parallel import priced below the authorized version, and higher consumption. In the origin country, parallel trade causes a double marginalization problem, which results in a higher drug price and a lower volume sold. In the destination (origin) country, consumers benefit (suffer) from improved (worsened) access to pharmaceuticals due to lower (higher) drug prices. In both countries, health insurance benefits from lower expenditure. The manufacturer loses from both competition in the*

destination country and the double marginalization problem in the origin country.
Proof. *See Appendix.* ■

4 Fixed Grant Reimbursement

Fixed grants or indemnity insurance describes a form of lump-sum payment in the event of illness. Reimbursement is not tied to the effectively accrued cost of the drug (Zweifel et al. 2009). For the choice between the authoriozed version and the parallel import, the full price difference has to be taken into account.

Patient co-payments are given as

$$c_{i,H} = p_{i,H} - \delta_H \text{ and } c_{i,F} = p_{i,F} - \delta_F. \tag{37}$$

4.1 Segmented Markets

Again, as a benchmark for comparison, consider the case of segmented markets, when parallel trade is forbidden legally and the manufacturer M enjoys monopoly pricing power in market H.

The manufacturers profit is given as

$$\pi_M = \underbrace{p_{b,H}\left(1 - (p_{b,H} - \delta_H)\right)}_{\pi_{b,H}} + \underbrace{w\left(1 - (p_{b,F} - \delta_F)\right)}_{\pi_{w_b}} + \phi, \tag{38}$$

where $\pi_{b,H}$ denotes the monopoly profit from direct sale in H, π_{w_b} the wholesale profit from the retailer's sales in market F and ϕ the fixed fee, which is used to extract the retailer's profit.

The retailer's total profit is given as

$$\pi_R = \underbrace{\left(p_{b,F} - w\right)\left(1 - (p_{b,F} - \delta_F)\right)}_{\pi_{b,F}} - \phi, \tag{39}$$

where π_r denotes the profit from sales in F and ϕ the fixed fee.

In market H, the manufacturer M maximizes (38) with respect to $p_{b,H}$. The first order condition to this problem is $1 - 2p_{b,H} + \delta_H = 0$, yielding the monopoly price

$$p_{b,H} = \frac{1 + \delta_H}{2}. \tag{40}$$

In market F, the retailer R maximizes (39) with respect to $p_{b,F}$. The first order condition to this problem is $w - 2p_{b,F} + \delta_F + 1 = 0$, yielding the price

$$p_{b,F} = \frac{1 + w + \delta_F}{2}. \tag{41}$$

Turning to the second stage of the game, the manufacturer M sets F to

$$\phi = \pi_{b,F} = \frac{\left(\delta_F - w + 1\right)^2}{4}. \tag{42}$$

In the absence of parallel trade, the manufacturer's optimal strategy is to set the wholesale price equal to the marginal cost of production, i.e. $w = 0$, which can also be obtained by substituting (42) and equilibrium prices into (38) and maximizing with respect to w.

The resulting price in market F then is

$$p_{b,F} = \frac{1+\delta_F}{2}. \tag{43}$$

Equilibrium quantities are

$$q_{b,H} = \frac{1+\delta_H}{2} \text{ and } q_{b,F} = \frac{1+\delta_F}{2}. \tag{44}$$

Substituting the wholesale price into equilibrium prices and (52) into (38) yields the equilibrium profit

$$\pi_M = \underbrace{\frac{(\delta_H+1)^2}{4}}_{\pi_b,H} + \underbrace{0}_{\pi_{w_b}} + \underbrace{\frac{(\delta_F+1)^2}{4}}_{\phi} = \frac{(\delta_H+1)^2+(\delta_F+1)^2}{4}.$$

For market H, consumer surplus is given as

$$CS_H = \int_{\theta_H^*}^{1} (\theta - \gamma_H p_{b,H}) d\theta = \frac{(\delta_H+1)^2}{8}$$

and for market F as

$$CS_F = \int_{\theta_F^*}^{1} (\theta - \gamma_F p_{b,F}) d\theta = \frac{(\delta_F+1)^2}{8}$$

Note that indifferent consumers are located at $\theta_H^* = \frac{1-\delta_H}{2}$ and $\theta_F^* = \frac{1-\delta_F}{2}$.

Expenditure for health insurance in country j is defined as

$$E_j = \delta_j q_{i,j}. \tag{45}$$

Note that expenditure does not depend on drug prices, since for each unit consumed, a fixed amount is reimbursed independent of the effective price paid and version of the drug purchased.

In country j expenditure amounts to

$$E_j = \frac{\delta_j (1+\delta_j)}{2}. \tag{46}$$

4.2 Integrated Markets

If markets are integrated, the manufacturer faces a duopoly in H and its total profit is given as

$$\pi_M = \underbrace{p_{b,H}\left(1 - \frac{(p_{b,H} - p_{\beta,H})}{\tau}\right)}_{\pi_b} + \underbrace{w\left(1 - (p_{b,F} - \delta_F)\right)}_{\pi_{w_b}} + \underbrace{w\left(\frac{(p_{b,H} - p_{\beta,H})}{\tau} - \frac{p_{\beta,H} - \delta_H}{(1-\tau)}\right)}_{\pi_{w_\beta}} + \phi, \tag{47}$$

where π_b denotes the profit from direct sale in H, π_{w_b} the wholesale profit from the retailer's sales in market F, π_{w_β} the wholesale profit from the retailer's sales as parallel imports in market H, and ϕ the fixed fee, which is used to extract the retailer's profit.

The retailer's total profit is given as

$$\pi_R = \underbrace{(p_{b,F} - w)\left(1 - (p_{b,F} - \delta_F)\right)}_{\pi_{b,F}} + \underbrace{(p_{\beta,H} - w)\left(\frac{(p_{b,H} - p_{\beta,H})}{\tau} - \frac{p_{\beta,H} - \delta_H}{(1-\tau)}\right)}_{\pi_{\beta,H}} - \phi, \tag{48}$$

where $\pi_{b,F}$ denotes the profit from sales in F, $\pi_{\beta,H}$ the profit from sales as parallel imports in market H, and ϕ the fixed fee.

In market H, the manufacturer M maximizes (47) with respect to $p_{b,H}$. The first order condition to this problem is $1 + \frac{1}{\tau}\left(p_{\beta,H} - 2p_{b,H} + w\right) = 0$, which yields M's best response function

$$p_{b,H} = \frac{1}{2}\left(p_{\beta,H} + w + \tau\right). \tag{49}$$

In country H, the retailer maximizes (48) with respect to $p_{\beta,H}$, which yields the first order condition $\frac{1}{\tau(1-\tau)}\left(p_{b,H}\left(1-\tau\right) - 2p_{\beta,H} + w + \tau\delta_H\right) = 0$ and the best response function

$$p_{\beta,H} = \frac{1}{2}(w + \tau\delta_H + p_{b,H}\left(1-\tau\right)). \tag{50}$$

Solving for equilibrium prices results in

$$p_{b,H} = \frac{3w + 2\tau + \tau\delta_H}{3+\tau} \text{ and } p_{\beta,H} = \frac{w\left(3-\tau\right) + \tau\left(1-\tau\right) + 2\tau\delta_H}{3+\tau}.$$

In market F, the retailer maximizes (48) with respect to $p_{b,F}$. The first order condition to this maximization problem is $w - 2p_{b,F} + \delta_F + 1 = 0$, yielding

$$p_{b,F} = \frac{1 + w + \delta_F}{2}. \tag{51}$$

In the second stage of the game,by setting the franchise fee to

$$\phi = \pi_{b,F} + \pi_{\beta,H} = \frac{\left(1 + \delta_F - w\right)^2}{4} + \frac{\tau\left(1 + 2\delta_H - 2w - \tau\right)^2}{\left(1-\tau\right)\left(3+\tau\right)^2} \tag{52}$$

the manufacturer extracts the retailer's total profit.

Substituting (52) and equilibrium prices into (47) and maximizing with respect to the wholesale price w gives

$$w = \frac{2\left(1-\tau\right)\left[9(1+\delta_H) - \tau\left(5+\delta_H\right)\right]}{\left(1-\tau\right)\left(3+\tau\right)^2 + 4\left(9-5\tau\right)}. \tag{53}$$

The wholesale price w, again reflecting the trade-off between increased competition in market H and an aggravated double mark-up problem in market F, only depends on elements of the health care system in the destination country of the parallel import (δ_H), but not on elements of the health care system in the origin country. The inexistent impact of the fixed grant in the foreign country on the wholesale price is reason for only one-way spillovers under indemnity insurance. By the same argumentation as for co-insurance rates, a higher vertical product differentiation in the home market results in a lower wholesale price.

Equilibrium prices in market H are

$$p_{b,H} = \frac{2\left(9 - 2\tau - 2\tau^2 - \tau^3\right) + \delta_H\left(18 - 11\tau - 2\tau^2 - \tau^3\right)}{\left(1-\tau\right)\left(3+\tau\right)^2 + 4\left(9-5\tau\right)} \tag{54}$$

and

$$p_{\beta,H} = \frac{\left(1-\tau\right)\left(18 - 7\tau - 2\tau^2 - \tau^3\right) + 2\delta_H\left(9 - \tau - 3\tau^2 - \tau^3\right)}{\left(1-\tau\right)\left(3+\tau\right)^2 + 4\left(9-5\tau\right)}{}^{2}. \tag{55}$$

Again, the parallel import will be priced below the authorized version due to vertical product differenti-

[2]Note that the amount reimburseable may not exceed a certain value, if patients are required to bear a portion of the drug prices. For authorized version only, the condition for positive patient co-payment reads $\delta_H < \frac{2\left(9-2\tau-2\tau^2-\tau^3\right)}{\left(27-12\tau-3\tau^2\right)}$ and for the purchase of either the authorized version or the parallel import, the condition for positive patient co-payment reads $\delta_H < \frac{(1-\tau)\left(18-7\tau-2\tau^2-\tau^3\right)}{\left(27-21\tau+\tau^2+\tau^3\right)}$. See Appendix B for details.

ation. If there is no perceived quality difference between the two versions, i.e. $\tau = 0$, both will be priced equally, as a result of perfect copetion between the manufacturer and the retailer.

As in the case of co-insurance reimbursement, the price of the authorized version is lower under parallel trade. It increases with the vertical differentiation parameter τ, as a higher quality discount for the parallel import constitutes a competitive advantage for the manufacturer. However, if no value is associated with the parallel import, the authorized version's price does not correspond to the monopoly price under market segmentation, as it is the case for co-insurance rates. For fixed grant reimbursement, the price is lower under parallel trade than under monopoly, since demand for $\tau = 1$ under parallel trade does not translate into demand under market segmentation, as it does not include the impact of the fixed grant and hence is more price elastic.

The price for the parallel import decreases with vertical product differentiation as the direct effect and the wholesale price effect dominate the strategic effect.

The equilibrium price in market F is

$$p_{b,F} = \frac{63 - 51\tau + 5\tau^2 - \tau^3 + 2\delta_H (1-\tau)(9-\tau) + \delta_F \left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)}{2\left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)}^{3}. \tag{56}$$

As for co-insurance rates, the price for the drug in the foreign country is higher if markets are integrated by parallel trade, as the wholesale price and hence the markup are higher. As these decrease with a higher degree of product differentiation in market H, the price decreases with τ. For $\tau = 1$, demand and thus drug prices are identical under parallel trade and market segmentation.

Resulting equilibrium in market H quantities are

$$q_{b,H} = \frac{2\left(12 - 7\tau - \tau^2\right) + \delta_H \left(9 - 4\tau - \tau^2\right)}{(1-\tau)(3+\tau)^2 + 4(9-5\tau)} \tag{57}$$

and

$$q_{\beta,H} = \frac{3 - 5\tau + \tau^2 + \tau^3 + 2\delta_H \left(9 - 4\tau - \tau^2\right)}{(1-\tau)\left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)}. \tag{58}$$

Under parallel trade, the volume of the manufacturer's direct sales is either higher or lower than for segmented markets, depending on the fixed grant in market H and the degree of product differentiation. The manufacturer sells more under parallel trade, if the fixed grant is relatively low for a given degree of vertical differentiation or if the the degree of vertical differentiation is relatively low for a given fixed grant. The quantity sold by manufacturer and retailer together in the home market is higher than the monopoly quantity under segemented markets, as competition from parallel imports lowers prices. As τ increases, the manufacturer's sales decrease. The quantity sold of the parallel import either decreases or increases, depending on δ_H and τ. For a higher fixed grant at a given degree of vertical differentiation, the quantity sold of the parallel import increases.

The equilibrium quantity in market F is

$$q_{b,F} = \frac{27 + 5\tau - 15\tau^2 - \tau^3 - 2\delta_H (1-\tau)(9-\tau) + \delta_F \left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)}{2\left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)} \tag{59}$$

[3] Note that the amount reimburseable may not exceed a certain amount, if patients are required to bear a portion of the drug price. The condition for positive patient co-payment reads $\delta_F < \frac{63-51\tau+5\tau^2-\tau^3+2\delta_H(1-\tau)(9-\tau)}{\left((1-\tau)(3+\tau)^2+4(9-5\tau)\right)}$ and reduces to $\delta_F < \frac{45-34\tau+\tau^2}{3\left(9-4\tau-\tau^2\right)}$, if positive co-payment is required for the authorized version only, and to $\delta_F < \frac{45-55\tau+19\tau^2-\tau^3}{27-21\tau+\tau^2+\tau^3}$, if positive co-payment is required for either the authorized version or the parallel import. See Appendix B for details.

Under market integration the quantity sold in market F is smaller than if markets are segmented due to the higher drug price. Higher product differentiation in market H increases the quantity sold in market F, as it lowers the wholesale price and hence the drug price.

Substituting (53) into (52) and into (47) yields the manufacturer's equilibrium profit

$$\begin{aligned}\pi_M &= \frac{(1-\tau)\left[(81-23\tau-29\tau^2+3\tau^3)+\delta_F\left(\delta_F+2\right)\left((1-\tau)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)\right]}{4\left(1-\tau\right)\left((1-\tau)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)} \\ &+\frac{4\delta_H[2\left(1-\tau\right)\left(9-\tau-4\tau^2\right)+\delta_H(9-\tau-5\tau^2+\tau^3)]}{4\left(1-\tau\right)\left((1-\tau)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)}. \end{aligned} \tag{60}$$

The manufacturer's profit either increases or decreases with market integration, depending on δ_H and τ. For a high degree of vertical product differentiation and a high amount reimburseable in market H, the manufacturer's profit is higher, when parallel trade takes place.

Consumer surplus in country H is given as

$$\begin{aligned} CS_H &= \int_{\theta_H^*}^{1}(\theta-(p_{b,H}-\delta_H))d\theta+\int_{\theta_H^{**}}^{\theta_H^*}(\theta\left(1-\tau\right)-(p_{\beta,H}-\delta_H))d\theta \\ &= \frac{\left(1-\tau\right)\left(9-5\tau\right)\left(81-68\tau-6\tau^2+8\tau^3+\tau^4\right)}{2\left(1-\tau\right)\left(\left(1-\tau\right)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)^2} \\ &+\frac{\delta_H\left(9-4\tau-\tau^2\right)\left[2\left(1-\tau\right)\left(81-51\tau-7\tau^2+\tau^3\right)+\delta_H\left(9-5\tau\right)\left(9-4\tau-\tau^2\right)\right]}{2\left(1-\tau\right)\left(\left(1-\tau\right)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)^2} \end{aligned} \tag{61}$$

Note that indifferent consumers are located at $\theta_H^*=\frac{\left(21-9\tau-3\tau^2-\tau^3\right)-\delta_H\left(9-4\tau-\tau^2\right)}{\left((1-\tau)(3+\tau)^2+4(9-5\tau)\right)}$ and $\theta_H^{**}=\frac{(1-\tau)\left(18-7\tau-2\tau^2-\tau^3\right)-\delta_H\left(27-21\tau+\tau^2+\tau^3\right)}{(1-\tau)\left((1-\tau)(3+\tau)^2+4(9-5\tau)\right)}$. Under market integration, consumer surplus in the destination country of the parallel import is higher than under market segmentation, as consumers benefit from lower drug prices and improved access to pharmaceuticals. Whether consumer surplus increases or decreases with the vertical product differentiation parameter τ, depends on the level of reimbursement and the degree of product differentiation.

Consumer surplus in country F is given as

$$\begin{aligned} CS_F &= \int_{\theta_F^*}^{1}(\theta-(p_{b,F}-\delta_F))d\theta \\ &= \frac{[27+5\tau-15\tau^2-\tau^3-2\delta_H\left(1-\tau\right)\left(9-\tau\right)+\delta_F\left(\left(1-\tau\right)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)]^2}{8\left(\left(1-\tau\right)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)^2} \end{aligned} \tag{62}$$

Note that the indifferent consumer is located at $\theta_F^*=\frac{63-51\tau+5\tau^2-\tau^3+2\delta_H(1-\tau)(9-\tau)-\delta_F\left(45-23\tau-5\tau^2-\tau^3\right)}{2\left((1-\tau)(3+\tau)^2+4(9-5\tau)\right)}$. Parallel trade idecreases the consumer surplus in market F. Consumers suffer from a higher price and a lower quantity originating from the double marginalization problem. Consumer surplus increases with τ, as increased product differentiation eases the double marginalization problem, lowers the wholesale price and the drug price and thereby increases the quantity.

In country H health insurance expenditure amounts to

$$E_H=\frac{\delta_H[(1-\tau)\left(27-16\tau-3\tau^2\right)+\delta_H\left(3-\tau\right)\left(9-4\tau-\tau^2\right)]}{\left(1-\tau\right)\left(\left(1-\tau\right)\left(3+\tau\right)^2+4\left(9-5\tau\right)\right)}. \tag{63}$$

In the destination country of the parallel import, health insurance expenditure is higher under market integration, as consumption increases. Note that for indemnity insurance, expenditure only depends on volume (and the level of reimbursement) so that prices decreases due to competition from parallel imports do not translate into savings for health insurance. Increased product differentiation results in expenditure decreases or increases, depending on δ_H and τ.

In country F health insurance expenditure amounts to

$$E_F = \frac{\delta_F[27 + 5\tau - 15\tau^2 - \tau^3 - 2\delta_H (1-\tau)(9-\tau) + \delta_F \left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)]}{2\left((1-\tau)(3+\tau)^2 + 4(9-5\tau)\right)}. \tag{64}$$

In the origin country of the parallel import, market integration causes expenditure to decrease as consumption is lower. Increased product differentiation decreases the drug price, increases consumption and thus results in higher expenditure.

This section can be summarized in proposition 2.

Proposition 2 *In the destination country, competition from parallel trade results in lower prices, with the considered qualitative inferior parallel import priced below the authorized version, and higher consumption. In the origin country, parallel trade causes a double marginalization problem, which results in a higher drug price and a lower volume sold. In the destination (origin) country, consumers benefit (suffer) from improved (worsened) access to pharmaceuticals due to lower (higher) drug prices. In the destination (origin) country, health insurance expenditure increases (decreases). Depending on the vertical differentiation parameter τ and the level of reimbursement in market H (δ_H), the manufacturer may either lose or benefit from parallel trade.*

Proof. *See Appendix.* ■

5 Spillovers

As governments change parameters of the national health systems to reduce health expenditure or to relieve patients, not only prices and quantities as well as welfare measures in the respective market, but also in the other market may be affected. In this section, spillovers between the destination country and the origin country of the parallel import under the two forms of cost-sharing will be examined.

5.1 Co-insurance rates

Consider first an increase of the co-insurance rate in market H. A higher co-insurance rate translates into higher price elasticity of demand in the destination country of the parallel import. It also implies that a larger fraction of the price difference between the parallel import and the authorized version is crucial for the consumer's choice between the two versions. Increased price elasticity causes both the manufacturer and the retailer to lower their prices. Both prices are not decreased enough to keep the quantity sold unchanged and therefore the volume of the authorized version as well as the volume of the parallel import decline. Consumer surplus decreases. Though consumers benefit from lower drug prices, they have to bear a higher fraction of the price. In addition, they suffer from a reduction in quantity. For health insurance, an increase of the co-insurance results in lower expenditure due to lower prices and consumption. Moreover, a lower proportion of the drug price is financed by the health insurance.

A higher co-insurance rate in country H increases the fraction of the price difference that is decisive for the choice between the two versions of the drug. The qualitative difference between the two versions thus becomes more significant, as patients trade off perceived drug quality against drug co-payment. From

this follows that for a given level of vertical product differentiation, a higher co-insurance constitutes a competitive disadvantage for the parallel import. This eases the competition problem in the destination country for the manufacturer, which then is able to focus on the double marginalization problem and lowers the wholesale price. A lower wholesale price translates into a lower drug price in market F and, as further market conditions remain the same, consumption increases. Consumers in the foreign market then benefit from an increase of the co-insurance rate in the home market. A lower drug price and a higher quantity sold result in an increase of consumer surplus. However, the increase of the co-insurance rate with the aim to reduce expenditure in market H leads to a growth of expenditure in market F, as the effect of quantity growth exceeds the expenditure-reducing price decrease. The manufacturer's profit decreases as the negative impact of lower prices in both countries and lower quantities in the home market dominates the positive impact of a lower wholesale price and a higher quantity sold in origin country of the parallel import.

Proposition 3 outlines the effects of an increase of the co-insurance rate in market H.

Proposition 3 *Due to higher price elasticity, drug prices and consumption decrease in the destination country of the parallel import, leading to lower expenditure at the expense of lower consumer surplus. A competitive disadvantage for the parallel import for a given level of vertical product differentiation leads to a lower wholesale price, which results in a lower drug price and higher consumption in the origin country of the parallel import. An increase of consumer surplus goes with higher expenditure for health insurance. The manufacturer's profit decreases.*

Proof. *See Appendix.* ■

Consider an increase of the co-insurance rate in market F. As a direct effect in the origin country of the parallel import, increased price elasticity forces the retailer to lower the price. It is optimal for the retailer to accept a decline in quantity sold rather than to lower the price enough to sell the same quantity as before. Whether consumer surplus increases or decreases depends on the level of reimbursement in both countries and the degree of vertical product differentiation in the destination country of the parallel import. Consumer surplus decreases, if either a low degree of product differentiation in connection with a co-insurance rate in market F considerably lower than the co-insurance rate in the destination country can be found or high degree of product differentiation is accompanied by a co-insurance rate in the origin country higher than the co-insurance rate in market H. Health insurance expenditure decreaes as the drug price and consumption are lower and as a larger fraction of the price is shifted to the financial responsibility of the consumers. In an environment of increased price elasticity the double marginalization problem becomes more important, and the wholesale price is lowered accordingly to avoid the competitive disadvantage of high markups. A lower wholesale price enhances competition from parallel imports in market H. The decrease of the wholesale price then translates into a decrease of the price of the parallel import and by the strategic effect, the authorized version's price decreaes as well. Lower drug prices result in increased consumption of both versions of the drug. Consumer surplus increases as a result of the increase of the co-insurance rate in the foreign market, as consumers benefit from lower drug prices and higher quantities. As the positive impact of lower prices dominates the negative impact of increased consumption, health insurance expenditure in destination country decreases. The manufacturer's profit decreases as a result of increased price elasticity in market F and stronger competition in market H.

The effects of an increase of the co-insurance rate in market F can be summarized in proposition 4.

Proposition 4 *Higher price elasticity causes drug prices and consumption decrease in the origin country of the parallel import, resulting in the desired decrease of expenditure. The impact on consumer surplus depends on the level of reimbursement in both countries and the degree of vertical product differentiation. As competitive pressure in the origin country of the parallel import results in a decrease of the wholesale*

price, competition from parallel imports the destination country increases and leads to lower drug prices and improved access to pharmaceuticals. Higher consumer surplus and lower health insurance expenditure result. The manufacturer's profit decreases.

Proof. *See Appendix.* ■

5.2 Fixed grant reimbursement

Consider now an increase of the fixed grant in market H. A higher fixed grant corresponds to a higher subsidy for drug purchase and decreases price elasticity of demand in the home market. The choice between the parallel import and the authorized version is not affected by an increase of the fixed grant, as the full price difference, independent of reimbursement, is crucial for the consumer choice. Decreased price elasticity allows both the manufacturer and the retailer to raise their prices. Both prices are not increased by the full amount to sell the same quantity as before and thus the volume of both versions increases.

The impact on consumer surplus depends on the degree of vertical product differentiation. For a low τ, the positive impact of increased consumption and a larger amount reimbursed exceeds the negative impact of higher prices and consumer surplus increases. As a higher quantity is consumed and a larger amount is financed by the health insurance, expenditure increases. Decreased price elasticity makes selling in market H more profitable for the manufacturer and it becomes more important to protect market H from competition from parallel import. For that, the manufacturer raises the wholesale price, causing the price to increase in the origin country of the parallel import. As demand remains unchanged in the foreign market, consumption decreases. Consumer surplus decreases, since consumers suffer from a higher drug price and a lower quantity. Health insurance expenditure decreases, as consumption decreases. The manufacturer's profit increases as price increases and the quantity growth in market H offset the decrease in consumption in the foreign market.

Proposition 5 outlines the effects of an increase of the reimbursement amount in market H.

Proposition 5 *Lower price elasticity allows the manufacturer and retailer to increase prices in the destination country of the parallel import, consumption increases and results in higher health insurance expenditure. The impact on consumer surplus depends on degree of vertical product differentiation. Increased profitability of the home market results in an increase of the wholesale price to deter parallel trade. The higher wholesale price translates into a higher price and lower consumption in the origin country of the parallel import, causing consumer surplus and health insurance expenditure to decrease. The manufacturer's profit increases.*

Proof. *See Appendix.* ■

Consider now an increase of the amount reimburseable in market F. Decreased price elasticity in the foreign market allows the retailer to raise the drug price. Consumption increases. Consumers benefit from a higher quantity and a larger amount reimbursed and thus consumer surplus increases. Higher consumption leads to higher health insurance expenditure. As the wholesale price is independent of the indemnity insurance in the origin country of the parallel import, the wholesale price and thus all variables in the destination country of the parallel import remain unaffected by the increase of the fixed grant in market F. The manufacturer's profit increases.

The effects of an increase of the fixed grant in market F can be summarized in proposition 4.

Proposition 6 *Lower price elasticity allows retailer to increase the price in the origin country of the parallel import, consumption increases and results in higher health insurance expenditure. Consumer surplus increases. As the wholesale price is independent of the elements of the health care system in the*

foreign country, a change of the level of reimbursement does not result in spillovers. The manufacturer's profit increases.

Proof. *See Appendix.* ■

6 Conclusions

In this model, a manufacturer is selling in two countries, in its home country directly to consumers and in the foreign country with the help of a retailer, which may engage in parallel trade. Market integration through parallel trade causes spillovers between markets and thus, the cost-sharing schemes of the origin and destination country of parallel imports affect each other. These spillovers result from the parallel trade flows, which are mainly determined by the wholesale price the manufacturer chooses and the vertical product differentiation between the authorized version of the drug and the parallel import. Whereas in a scheme of co-insurance, spillovers work in both directions, the fixed amount reimbursement results in one-way spillovers only. In this case, the fixed grant in the destination country of the parallel imports affects the origin country of the parallel imports.

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7 Appendix

Available upon request.