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PHARMACEUTICAL COST-SHARING SYSTEMS AND SAVINGS FOR HEALTH CARE SYSTEMS FROM PARALLEL TRADE

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Pharmaceutical cost-sharing systems and savings for health care systems from parallel trade

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Abstract

This paper analyzes the consequences of parallel trade on health care systems in a two-country model with a vertical distributor relationship. In particular, two cost-sharing systems – coinsurance and indemnity insurance – are compared with respect to changes in copayments and public health expenditure. Under both cost-sharing systems, parallel trade generates a price-decreasing competition effect in the destination country and a price-increasing double marginalization effect in the source country. In the destination country, copayments for patients decrease to a larger extent under indemnity insurance, whereas reductions of public health expenditure occur only under coinsurance. In the source country, copayments increase less under coinsurance, whereas health expenditure is reduced more under indemnity insurance. This illustrates that a harmonization of health care systems would not make sense.

JEL classification: F12, I11, I18

Keywords: cost-sharing, parallel trade, coinsurance rates, indemnity insurance

1 Introduction

This paper studies the consequences of parallel trade, i.e. trade outside the manufacturer's authorized distribution channel, on health care systems. In particular, a coinsurance scheme (consumers pay a percentage of the drug price out-of-pocket) and an indemnity insurance scheme (reimbursement is independent of the drug price) are compared with respect to changes in copayments, i.e. out-of-pocket expenditure for patients, and public health expenditure.

This analysis is motivated by the observation that the institutional setting, in which parallel trade takes place, is highly relevant for the consequences of parallel trade. More precisely, the design of the cost-sharing system, i.e. rules of copayment and reimbursement, are an important

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factor in determining consequences of price changes. Although the price effects induced by parallel trade are independent of the cost-sharing system, the cost-sharing system determines the magnitude of price changes and whether savings accrue and for whom.

Savings for health care systems are a highly relevant issue. Over the last decades, spending for health care has risen sharply in many OECD countries, even outpacing GDP growth[1]. The main objective of pharmaceutical regulation has been the reduction of public expenditure, as public insurance schemes bear the majority of these expenses (Maynard & Bloor, 2003; Danzon, 1997). Expenditure for pharmaceuticals represents a substantial and increasing proportion of health expenditure, varying roughly between 11.8% in the United Kingdom and 20.5% in Spain (OECD Health Data, 2010). In addition to influencing pharmaceutical prices directly, e.g. via direct price regulation or regulation of wholesale margins, promoting the substitution of higher-priced brand-name drugs by less expensive equivalents is an instrument to contain pharmaceutical expenditure. This might include generic versions of brand-name drugs, which may differ in terms of binders, fillers, preservatives and density of packing (bioequivalence[2]). Alternatively, parallel imported drugs are de facto identical, lower-priced versions of (locally sourced) brand-name drugs, which are imported from other countries without the permission of the manufacturer. In the European Economic Area, parallel imports are legal within the European Economic Area, but excluded if coming from non-member states (Maskus (2000); Ganslandt & Maskus, 2007)[3]. Tremendous price differences of up to 300% percent between member states give rise to this kind of arbitrage. For instance, a package of the drug Betaferon costs € 1429 in Germany, but is available for only € 817 in Italy (EU Commission Drug Price Report, 2009). These price differences may emerge from pharmaceutical manufacturers price-discriminating between different countries, different national pharmaceutical regulations in the individual member states – both maximum prices and copayments – and/or divergent wholesale prices (NERA, 1999; EU Commission, 2003; Enemark et al., 2006). Pharmaceutical parallel trade, the exploitation of these price differences, had a volume of € 4.8 bn in the European Union in 2007 (Glynn, 2009). Destination countries are high-price countries, such as Germany, the United Kingdom, the Netherlands, Sweden and Denmark, where pricing is relatively free; source countries are characterized by strict price regulation, e.g. in Spain, France, Portugal, Greece and Italy (Kanavos & Costa-Font, 2005).

Whereas the exploitation of these arbitrage opportunities is intended to contain (public) pharmaceutical expenditure in the destination countries of parallel imports, empirical evidence on this is ambiguous. Three recent studies have presented contradictory results with respect to the ability of parallel trade to generate savings for health insurance funds and patients. On the one hand, a study by Kanavos et al. (2004) (commonly referred to as the LSE-study) finds no evidence of savings created by parallel imports[4]. On the other hand, a study by West &

[1] On average, expenditure for health care has grown by 4.2%, whereas GDP has increased by 2.2% in the OECD countries (OECD Health Data 2010).

[2] Differences in bioequivalence may imply also differences in bioavailability, which refers to the rate, at which the active ingredient is absorbed.

[3] The European Union has adopted regional exhaustion of intellectual property rights (Maskus 2000).

[4] The LSE-study examines six product categories (19 products accounting for 21% of the market) in Denmark,

Mahon (2003) (commonly referred to as the York-study) concludes that parallel trade generates considerable savings[5]. A third study, conducted at the University of Southern Denmark by Enemark et al. (2006) also concludes that parallel trade gives rise to significant savings, both direct to patients and health insurances[6]. The different results not only reflect differences in methodology and in the range of products covered, but also different stakeholder interests: The LSE-study was sponsored by Johnson & Johnson, whereas the York-study was financed by the European Association of Euro-Pharmaceutical Companies. Nevertheless these studies agree on one thing: The effects of parallel trade, that is, the level of savings and cross-countries differences in savings or the split of savings between health insurances and patients depend to a large extent on the copayment structure (Kanavos et al., 2004; Enemark et al., 2006).

For patients, the cost-sharing system and copayment rules constitute the direct channel through which they may benefit from purchasing parallel imports (Kanavos et al., 2004). Patients will only chose parallel imports over locally sourced drugs if they benefit financially, i.e. save on out-of-pocket expenditure from doing so. Consequently, the cost-sharing system provides incentives for patients to buy parallel imports (Enemark et al., 2006). For example, a flat fee copayment, a charge per service, fails to sensitize patients for price differences between locally sourced and parallel imported drugs and there is no incentive to buy lower priced parallel imports. A copayment in the form of a coinsurance (patients pay a percentage of the total price) however, makes patients benefit from choosing a cheaper drug. Patients are encouraged to buy parallel imports. Similarly, this applies to cost-sharing systems including deductibles (patients pay the first x Euros before insurance coverage begins) or indemnity insurance (a fixed amount independent of the price is reimbursed) (Robinson, 2002). The extent of the copayment and the price elasticity of demand are important in determining incentives to choose lower-priced drugs. In other words, patients are more likely to purchase parallel imports, the more they are exposed to the price difference between locally sourced drugs and parallel imports.

For health insurances, the cost-sharing design determines the level of savings. In particular, the link between reimbursement and drug prices is relevant, as it allows health insurances to benefit from lower drug prices. If patients pay a percentage of the total price (coinsurance) and the remaining fraction of total expenditure is reimbursed by health insurances, lower drug

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Germany, the Netherlands, Norway, Sweden, and the UK. It finds only modest direct savings accruing to health insurances (a total of € 45 m.) and no (measurable) patient benefits and suggests that parallel traders are the main beneficiaries of parallel trade. Moreover, Kanavos et al. (2004) do not observe any evidence of price competition or price convergence.

[5] The York-study includes the top-selling products plus a random sample of 150 products in Denmark, Germany, the Netherlands, and the UK. It estimates total direct savings from parallel trade accruing to both health insurances and patients at € 635 m. West & Mahon (2003) also find evidence of indirect competitive effects in the parallel importing countries.

[6] Enemark et al. (2006) estimate savings of € 466 m based on an analysis of the 50 top-selling products in Denmark, Germany, Sweden, and the UK.

Other empirical investigations of the effects of parallel trade are limited (to Sweden and Finland) in coverage. Based on a sample of 6 drugs in Sweden, Persson et al. 2001 estimate savings of parallel trade to € 13 m (quoted in Enemark et al. 2006). Linoosma et al. 2003 document savings of € 4.9 m for 169 drugs in Finland. Ganslandt & Maskus 2004 find for 50 top-selling drugs in Sweden that parallel trade gives rise to price reductions of up to 19%.

prices - both lower prices for parallel imports and lower prices of locally sourced versions due to competitive effects - then translate to lower public pharmaceutical expenditure. Furthermore, as copayment rules provide incentives for patients to buy parallel imports, cost-sharing determines the competitive pressure by parallel trade. Accordingly, also public health expenditure is reduced by more, if competition from parallel trade is strong and the market share of parallel imports is high. Consequently, the cost-sharing system is both a driver of parallel trade, as it determines cross-country price differences, and, more importantly, an important factor in determining savings from parallel trade.

In the European Union, all 28 member states apply some form of cost-sharing in relation to pharmaceuticals, mostly in the form of coinsurance, where patients pay a percentage of the price (Mossialos & Le Grand, 1999). In the United Kingdom a flat rate copayment per package applies. Denmark, Sweden and Norway[7] use a combination of deductibles and coinsurance (Robinson, 2002; Kanavos et al., 2004). In addition, the reference price system, in which the regulator sets a ceiling for the amount reimbursable (reference price) for a group of pharmaceuticals (cluster), can be found in Belgium, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, and the United Kingdom (Puig-Junoy, 2010). By making reimbursement independent of drug choice, reference pricing is similar to indemnity insurance, where patients are reimbursed a price-independent amount and pay the difference between the drug price and the reimbursement amount out-of-pocket. But whereas reference pricing can be considered to impose an avoidable copayment (avoidable if a drug priced at the reference price is chosen), indemnity insurance is a form of mandatory cost-sharing, as reimbursement amounts are lower than drug prices. That is, in the European Union, member states apply different cost-sharing systems, which differ in their impact on savings generated by parallel trade. However, not all textbook examples of copayments can also be found in reality due to inherent structural weaknesses, as this paper shows.

The importance of cost-sharing systems for the consequences of parallel trade has been emphasized in the empirical literature, but it has not attracted much attention in the theoretical literature on parallel trade. Only Bordoy & Jelovac (2005) and Köksal (2009) examine the effect of cost-sharing structure on parallel trade[8]. Bordoy & Jelovac (2005) investigate the implications of cross-country differences in coinsurance rates for the welfare effects of parallel trade in a vertical differentiation model with horizontal arbitrage. If parallel trade is driven by differences in

[7]Norway is not part of the European Union, but of the European Economic Area, for which the principle of free movement of goods applies.

[8]In addition, the influence of parallel trade on pharmaceutical price regulation has been examined in the literature. On the one hand, parallel trade may restrict policy choices, as Rey (2003) suggests. By leading to a price convergence towards lower prices, parallel imports thwart a government's efforts to contribute more to R&D by granting higher prices. On the other, parallel trade may strengthen the manufacturer's position in price negotiations. Pecorino (2002) shows that if parallel trade to an unregulated market is possible, a manufacturer will make less concessions in drug price bargaining in a potential source country of parallel imports. Königbauer (2004) and Grossman & Lai (2006) find that the possibility of parallel trade limits the scope for international free riding on R&D contributions by providing weaker patent protection and imposing price caps. Parallel trade may even mitigate the negative impact of price controls on pharmaceutical innovation and result in more highly innovative and less me-too drugs (Schlaepfer, 2008).

coinsurance rates, it reduces welfare, as it reallocates drugs from patients with a higher valuation of drug consumption to patients with a lower valuation. On the contrary, parallel trade increases welfare, if it is based on differences in health needs. Based on the Bordoy & Jelovac (2005)-model, Köksal (2009) compares price effects caused by parallel trade under coinsurance and reference pricing. Under reference pricing, price reductions from parallel trade in the destination country are higher than under coinsurance. Furthermore, reference pricing does not affect the drug price in the exporting country.

This paper differs from Köksal (2009) in the object of study. Köksal compares coinsurance as an instrument of cost-sharing and reference pricing, which can rather be characterized as an instrument of pharmaceutical price regulation. Apart from the Netherlands, all European countries applying reference pricing also use coinsurance as a cost-sharing system. That is, reference pricing rather constitutes a supplementary instrument to contain drug prices than to reduce moral hazard. Consequently, the two instruments studied by Köksal (2009) are not policy substitutes, but rather complements.

This paper compares coinsurance and indemnity insurance, which are both (pure) cost-sharing instruments. Coinsurance and indemnity insurance can be considered policy alternatives, among which policymakers may choose from. Indemnity insurance is a textbook example of a cost-sharing instrument, but cannot be found in any member state of the European Union. This paper considers indemnity insurance as a policy alternative to commonly applied coinsurance and may provide an explanation for coinsurance being preferred to indemnity insurance, if minimizing health expenditure is the prevailing health policy objectives.

In addition, whereas Bordoy & Jelovac (2005) and Köksal (2009) consider parallel trade as retail-level horizontal arbitrage, where parallel traders buy the drugs at market prices in the source country, this paper explains parallel trade as a by-product of vertical control structures: Indirect sales through an intermediary are the trigger for parallel trade, as an intermediary may resell a drug in other ways than intended by the manufacturer. Accordingly, parallel trade amounts to vertical arbitrage and is mainly determined by the wholesale price set by the manufacturer. Commonly, pharmaceutical manufacturers sell not directly, but through independent wholesalers (Taylor; Mrazek & Mossialos, 2004). In addition, this approach separates the *cause* for from the *consequences* of parallel trade. Horizontal arbitrage is triggered by retail price differences and accordingly, differences in the cost-sharing system or the extent of the copayment, which contributes to retail price differences. That is, in Bordoy & Jelovac (2005) and Köksal (2009) the design of the cost-sharing system is the determining factor for whether parallel trade occurs (cost-sharing as a trigger), but also for what consequences parallel trade has (impact of cost-sharing). Vertical arbitrage however, assumes vertical restraints as the driver of parallel trade. Even for identical cost-sharing systems and/or identical copayments, arbitrage would be profitable and parallel trade would occur. Accordingly, under vertical arbitrage, parallel trade flows are not contigent on assumptions of differences in cost-sharing systems or instruments. Thus, taking vertical arbitrage as a starting point, the design of the cost-sharing system is only the determining factor for the *consequences* of parallel trade and not its *cause*. This allows the analysis of the interaction between cost-sharing systems and parallel trade also for identical cost-sharing systems.

Against this background, this paper explores the role of cost-sharing for the effects of parallel trade in a two-country model following Maskus & Chen (2002) and Chen & Maskus (2005). It assumes a manufacturer which sells an innovative drug in two markets. In the home market, consumers purchases the drug directly from the manufacturer. In the foreign market the manufacturer markets the drug through an intermediary, which may engage in parallel trade and re-sell the drug in the home market. Thus, parallel trade occurs as a by-product of the vertical control structure and flows from the foreign country, source country, to the home country, destination country. When there is no parallel trade, the manufacturer's optimal strategy is to set a low wholesale price and extract the wholesaler's profit via a fixed fee to avoid the double marginalization problem arising from the intermediary's market power. However, in the presence of parallel trade, a low wholesale price induces more parallel trade. Consequently, the manufacturer may want to set the wholesale price higher in order to limit competition from parallel trade. The optimal wholesale price reflects the trade-off between an intensified double marginalization problem in the foreign market for a high wholesale price and increased competition from parallel trade in the home market due to a low wholesale price.

Independent of the cost-sharing scheme, parallel trade generates a competition effect in the destination country, resulting in lower drug prices and a higher quantity sold. Due to the higher wholesale price, as compared to segmented markets, a double-marginalization effect occurs in the source country. In the destination country, savings for patients occur under both systems, with savings being relatively higher under indemnity insurance. However, savings for health insurance occur only under coinsurance. Indemnity insurance fails to link reimbursement to drug prices, and via the increase in quantity demanded, lower drug prices result in higher expenditure. In the source country, the drug price increase following from the increase of the wholesale price results in additional expenses for consumers under both cost-sharing systems. Under coinsurance, additional expenses are relatively lower. Parallel trade results in lower health expenditure in the source country under both cost-sharing systems, as the effect from a lower quantity consumed dominates the effect of a higher drug price on expenditure. Under indemnity insurance, the relative reduction of health expenditure is higher.

The rest of the paper is organized as follows. In the next section, the two-country model with a vertical distributor relationship is presented and the case of segmented markets, when parallel trade is not allowed, and the case of integrated markets, when parallel trade is possible are analyzed. In Section 3, the effects of parallel trade with respect to price changes, changes in copayments, and public health expenditure are studied. Section 4 concludes.

2 The Model

Following Maskus & Chen (2002), (2005), consider a (domestic) manufacturer M selling a brand-name drug b in two countries, in its home country D and a foreign country S. In country D, the manufacturer sells directly to the consumers; in country S, it sells through an independent intermediary I. The manufacturer follows a two-part pricing strategy, it charges the intermediary a wholesale price w and a fixed fee ϕ.

In a regime of international exhaustion of intellectual property rights, due to lack of complete vertical control, the intermediary may engage in parallel trade and resell the drug (hereafter noted as β) in the home country. That is, the foreign country is the source country of the parallel import and the home country is the destination country. Therefore, the home country will be denoted as country D and the foreign country as country S.

While consumers in S buy the drug from the intermediary, consumers in D have the choice between the locally sourced version b when purchasing from the manufacturer and the parallel import β when buying from the intermediary. Consumers associate a lower quality with the parallel import, which is captured by a discount factor τ in consumer valuation. The perception of parallel imports as qualitatively inferior results from differences in appearance and packaging (Maskus, 2001). In addition, following Schmalensee (1982), uncertainty regarding product characteristics can be translated into quality differentials. If consumers are not sure whether the parallel import is identical with the locally sourced version of the drug, their willingness to pay for the parallel import will be lower and the intermediary must offer a price reduction in order to convince consumers to try and learn about the parallel import. Moreover, there is evidence that the price of a drug may serve as a quality indicator (Waber et al., 2008). Accordingly, due to a lower price, the parallel import may be 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 $[0, 1]$. Thus, the total mass of consumers is given by 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

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

where $\tau \in (0, 1)$ reflects the perceived quality difference between both versions b and β of the drug and $c_{i,j}$ is the patient copayment for drug i in country j ($j = D, S$). For $\tau = 1$, consumers associate no value at all with the parallel import, for $\tau = 0$, both products are homogenous and are thus considered perfect substitutes.

A consumer with a positive net utility of drug consumption will choose the most preferred drug version by trading off perceived drug quality against drug copayment. The higher the gross valuation of drug treatment θ, the more the consumer is willing to pay in order to purchase the (high-quality) locally sourced drug. The consumer heterogeneity with respect to valuation θ can be interpreted as differences in willingness to pay for a locally sourced version, differences in risk aversion regarding the trial of substitutes or differences in the severity of the condition or differences in prescription practices (see e.g. Brekke, Holmas & Straume, 2010).

If parallel trade is not allowed (regime of national exhaustion of intellectual property rights), only the locally sourced version is available in country D. The marginal consumer who is indifferent between buying the locally sourced version directly from the manufacturer (b) or not purchasing at all (0), has a gross valuation $\theta_D^{b,0}$, given by

$$\theta_D^{b,0} - c_{b,D} = 0 \;\Leftrightarrow\; \theta_D^{b,0} = c_{b,D}. \tag{2}$$

Hence, in country D, if the parallel import is not available, demand for b is given by

$$q_{b,D} = 1 - c_{b,D}. \tag{3}$$

If parallel trade is legal (international exhaustion of intellectual property rights), consumers in country D have the choice between the locally sourced version (b) (directly) from the manufacturer or the parallel import (β) from the intermediary. The marginal consumer who is indifferent between buying the locally sourced version b and the parallel import β has a gross valuation $\theta_D^{b,\beta}$, given by

$$\theta_D^{b,\beta} - c_{b,D} = \theta_D^{b,\beta}(1-\tau) - c_{\beta,D} \;\Leftrightarrow\; \theta_D^{b,\beta} = \frac{c_{b,D} - c_{\beta,D}}{\tau}, \tag{4}$$

while a consumer who is indifferent between buying the parallel import (β) and not buying at all (0) has a gross valuation $\theta_D^{\beta,0}$, given by

$$\theta_D^{\beta,0}(1-\tau) - c_{\beta,D} = 0 \;\Leftrightarrow\; \theta_D^{\beta,0} = \frac{c_{\beta,D}}{(1-\tau)}. \tag{5}$$

Consequently, in country D, if the parallel import is available, demand for the authorized product b and for the parallel import β is given by

$$q^*_{b,D} = 1 - \frac{c_{b,D} - c_{\beta,D}}{\tau} \text{ and } q^*_{\beta,D} = \frac{c_{b,D} - c_{\beta,D}}{\tau} - \frac{c_{\beta,D}}{(1-\tau)}. \tag{6}$$

An asterisk is used to denote variables associated with parallel trade.

In country S, the brand-name drug is only sold by the intermediary. A consumer who is indifferent between buying the drug and not buying has a gross valuation $\theta_S^{b,0}$, given by

$$\theta_S^{b,0} - c_{b,S} = 0 \iff \theta_S^{b,0} = c_{b,S}. \tag{7}$$

Accordingly, in country S demand for the authorized product b is given by

$$q^*_{b,S} = 1 - c_{b,S}. \tag{8}$$

Production technologies exhibit constant marginal costs, which are normalized to zero for simplicity. It is assumed that parallel trade is costless.

The structure of the model can be summarized by the following two-stage game: In the first stage, the manufacturer specifies a wholesale price w and fixed fee ϕ. In the second and final stage, the intermediary and manufacturer set prices.

Coinsurance In the case of coinsurance, health insurance reimburses a fraction of the drug price, the remaining fraction γ is paid by the patient. Thus, the effective price of the drug to the patient amounts to the proportion γ of the market price set by the manufacturer or intermediary (Zweifel et al., 2009). Consequently, copayments are given as

$$c_{i,D} = \gamma_D p_{i,D} \text{ and } c_{i,S} = \gamma_S p_{i,S}. \tag{9}$$

If parallel trade is not allowed, the location of the consumer indifferent between the locally sourced version of the drug and not purchasing is given by

$$\theta_D^{b,0}(\gamma) = \gamma_D p_{b,D}. \tag{10}$$

If parallel trade is legal, the location of the consumer indifferent between the locally sourced version of the drug and the parallel import is given by

$$\theta_D^{b,\beta}(\gamma) = \frac{\gamma_D \left(p_{b,D}^* - p_{\beta,D}^*\right)}{\tau}. \tag{11}$$

That is, for the choice between the two versions of the drug, the patient trades off the fraction γ_D of the price difference $p_{b,D}^* - p_{\beta,D}^*$ against then perceived quality difference τ.

In country S, the location of the consumer indifferent between the locally sourced version of the drug and not purchasing is given by

$$\theta_S^{b,0}(\gamma) = \gamma_S p_{b,S}, \text{ resp. } \theta_S^{b,0}(\gamma) = \gamma_S p_{b,S}^*. \tag{12}$$

Indemnity Insurance Indemnity insurance describes a form of lump-sum payment in the event of drug purchase. Reimbursement is not tied to the effectively accrued cost of the drug (Zweifel et al., 2009). Patients are reimbursed a fixed amount δ, independent of their choice of drug. Accordingly, copayments are given as

$$c_{i,D}(\delta) = p_{i,D} - \delta_D \text{ and } c_{i,S}(\delta) = p_{i,S} - \delta_S. \tag{13}$$

If parallel trade is not allowed (regime of national exhaustion of intellectual property rights), the location of the consumer indifferent between the locally sourced version of the drug and not purchasing is given by

$$\theta_D^{b,0}(\delta) = p_{b,D} - \delta_D. \tag{14}$$

If parallel trade is legal (international exhaustion of intellectual property rights), the location of the consumer indifferent between the locally sourced version of the drug and the parallel import is given by

$$\theta_D^{b,\beta}(\delta) = \frac{p_{b,D}^* - p_{\beta,D}^*}{\tau}, \tag{15}$$

that is, for the choice between the two versions of the drug, consumers take the full price difference $p_{b,D}^* - p_{\beta,D}^*$ into account.

In country S, the location of the consumer indifferent between the locally sourced version of the drug and not purchasing is given by

$$\theta_S^{b,0}(\delta) = p_{b,S} - \delta_S, \text{ resp. } \theta_S^{b,0}(\delta) = p_{b,S}^* - \delta_S. \tag{16}$$

Compared to the original demand curve with no reimbursement by the health insurance, coinsurance rotate the demand curve, while indemnity insurance shifts the demand curve. Figure 1 illustrates this. The bold line is the original demand curve $p = 1 - q$, the thin dashed line is the demand curve with a coinsurance rate of $\gamma = 0.5$ and the solid line is the demand curve with a reimbursement amount $\delta = 0.5$. Point A denotes the point with identical out-of-pocket expenditure for a price of $p = 1$.

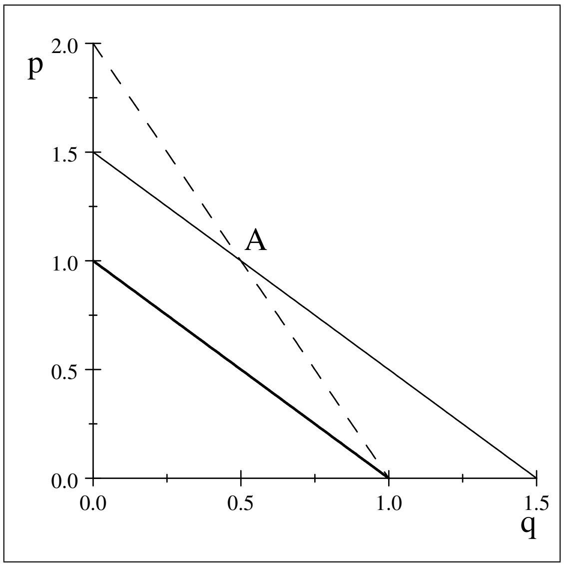

Figure 1: Coinsurance rates vs. indemnity insurance

2.1 No Parallel Trade

First consider the case of no parallel trade, when parallel trade is not allowed and markets are segmented. Both pricing decisions by the manufacturer – the drug price in country D and the wholesale price w, which determines the drug price in country S – are independent.

The manufacturers profit is given as

$$\pi_M = \underbrace{p_{b,D}\left(1 - c_{b,D}\right)}_{\pi_{b,D}} + \underbrace{w\left(1 - c_{b,S}\right)}_{\pi_{w_b}} + \phi, \tag{17}$$

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

The wholesaler's total profit is given as

$$\pi_I = \underbrace{\left(p_{b,S} - w\right)\left(1 - c_{b,S}\right)}_{\pi_{b,S}} - \phi, \tag{18}$$

where $\pi_{b,S}$ denotes the profit from sales in country S.

In market D, the manufacturer M maximizes (17) with respect to $p_{b,D}$. The first order condition to this problem is

$$\underbrace{\left(1 - c_{b,D}\right)}_{I} + \underbrace{p_{b,D}\left(-\frac{\partial c_{b,D}}{\partial p_{b,D}}\right)}_{II} = 0, \tag{19}$$

yielding the monopoly drug price $p_{b,D}\left(c_{b,D}\right)$.

In market S, the intermediary I maximizes (18) with respect to $p_{b,S.}$ The first order condition to this problem is

$$\left(1 - c_{b,S}\right) + \left(p_{b,S} - w\right)\left(-\frac{\partial c_{b,S}}{\partial p_{b,S}}\right) = 0, \tag{20}$$

resulting in the monopoly drug price $p_{b,S}\left(c_{b,S}\right)$. The first order condition shows that $p_{b,S}$ increases in the wholesale price w.

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

$$\phi = \pi_{b,S} = \left(p_{b,S} - w\right)\left(1 - c_{b,S}\right) \tag{21}$$

in order to extract the intermediary's profit. In the absence of parallel trade and for segmented markets, the manufacturer's optimal strategy is to set the wholesale price equal to the marginal cost of production, i.e. $w = 0$[9]. This pricing decision avoids the double marginalization problem and results in the same drug price and sales volume as if the manufacturer sold directly to the consumers.

[9] Substituting (21) and equilibrium prices into (17) and maximizing with respect to w results in $w = 0$.

Drug prices in both countries are given as:

D↓, S⟶	Coinsurance	Indemnity insurance
Coinsurance	$p_{b,D}(\gamma) = \frac{1}{2\gamma_D}$, $p_{b,S}(\gamma) = \frac{1}{2\gamma_S}$	$p_{b,D}(\gamma) = \frac{1}{2\gamma_D}$, $p_{b,S}(\delta) = \frac{1+\delta_S}{2}$
Indemnity insurance	$p_{b,D}(\delta) = \frac{1+\delta_D}{2}$, $p_{b,S}(\gamma) = \frac{1}{2\gamma_S}$	$p_{b,D}(\delta) = \frac{1+\delta_D}{2}$, $p_{b,S}(\delta) = \frac{1+\delta_S}{2}$.

(22)

Note that drug prices only depend on the cost-sharing system in the respective country.

Under coinsurance, drug prices decrease in coinsurance rates. Effective prices for consumers ($\gamma_D p_{b,D}(\gamma) = \gamma_S p_{b,S}(\gamma) = \frac{1}{2}$) are equivalent to prices without insurance coverage ($p_{b,D} = p_{b,S} = \frac{1}{2}$). That is, the effect from reimbursement by health insurance is completely appropriated by the manufacturer. Price differences result from differences in health care systems (= coinsurance rates) only. Quantities are independent of coinsurance rates, as the effect from reimbursement completely accrues to the manufacturer.

Under indemnity insurance, drug prices increase in the reimbursement amount. Effective prices ($p_{b,D}(\delta) - \delta_D = \frac{1-\delta_D}{2}$ and $p_{b,S}(\delta) - \delta_S = \frac{1-\delta_S}{2}$) are lower than prices without insurance ($p_{b,D} = p_{b,S} = \frac{1}{2}$). The effect from reimbursement benefits both the manufacturer (higher market prices than without insurance) and patients (lower effective prices than without insurance). Price differences occur, when reimbursement differs across countries. Quantities increase in the reimbursement amount, as effective prices decrease in the reimbursement amount and more consumers buy. Differences in quantities sold in country D and S stem from differences in health care system (reimbursement amounts).

2.2 Parallel Trade

If parallel trade is allowed, the manufacturer's pricing decisions – the drug price in country D and the wholesale price charged the intermediary – are no longer independent. A low wholesale price induces parallel imports sold by the intermediary in country D (the wholesale price constitutes the lower price bound for the intermediary). Increasing the wholesale price in response creates and aggravates a double marginalization problem in country S. Consequently, if parallel trade is allowed, the choice of the wholesale price reflects the trade-off between an aggravated double marginalization problem in country S and intensified competition from parallel trade in country D.

The manufacturer's profit is given as

$$\pi_M^* = \underbrace{p_{b,D}^* \left(1 - \frac{c_{b,D}^* - c_{\beta,D}^*}{\tau}\right)}_{\pi_b^*} + \underbrace{w^* \left(1 - c_{b,S}^*\right)}_{\pi_{w_b}^*} + \underbrace{w^* \left(\frac{c_{b,D}^* - c_{\beta,D}^*}{\tau} - \frac{c_{\beta,D}^*}{(1-\tau)}\right)}_{\pi_{w_\beta}^*} + \phi^*, \tag{23}$$

where π_b^* denotes the profit from direct sale in D, $\pi_{w_b}^*$ the wholesale profit from the intermediary's sales in market S, $\pi_{w_\beta}^*$ the wholesale profit from the intermediary's sales as parallel imports in market D, and ϕ^* the fixed fee. An asterisk is used to denote variables associated with parallel trade.

The manufacturer's profit differs from the profit under no parallel trade in three respects: First, it faces competition by the intermediary in market D. Second, for a given wholesale price, the fixed fee extracted from the intermediary is higher, as it now also contains the intermediary's profit from parallel importing. Third, the intermediary's sales as reimports result in additional wholesale profit for the manufacturer.

The intermediary's profit is given as

$$\pi_I^* = \underbrace{\left(p_{b,S}^* - w^*\right)\left(1 - c_{b,S}^*\right)}_{\pi_{b,S}^*} + \underbrace{\left(p_{\beta,D}^* - w^*\right)\left(\frac{c_{b,D}^* - c_{\beta,D}^*}{\tau} - \frac{c_{\beta,D}^*}{(1-\tau)}\right)}_{\pi_{\beta,D}^*} - \phi^*, \tag{24}$$

where $\pi_{b,S}^*$ denotes the profit from sales in S and $\pi_{\beta,D}^*$ the profit from sales as parallel imports in market D.

In country D, the manufacturer M maximizes (23) with respect to $p_{b,D}^*$. The first order condition of this problem is

$$\underbrace{\left(1 - \frac{c_{b,D}^* - c_{\beta,D}^*}{\tau}\right)}_{I} + \underbrace{p_{b,D}^*\left(-\frac{\partial c_{b,D}^*}{\partial p_{b,D}^*}\frac{1}{\tau}\right)}_{II} + \underbrace{w^*\left(\frac{\partial c_{b,D}^*}{\partial p_{b,D}^*}\frac{1}{\tau}\right)}_{III} = 0, \tag{25}$$

which yields the best response function $p_{b,D}^*\left(c_{b,D}^*, w, p_{\beta,D}^*\right)$. Compared to the first order condition for segmented markets, part I and consequently $p_{b,D}^*$ are higher (lower) under parallel trade, if $c_{b,D}^* < \frac{c_{\beta,D}^*}{(1-\tau)}$ ($c_{b,D}^* > \frac{c_{\beta,D}^*}{(1-\tau)}$). For coinsurance, $c_{b,D}^* < \frac{c_{\beta,D}^*}{(1-\tau)}$ if $p_{b,D}^* < \frac{p_{\beta,D}^*}{(1-\tau)}$, that is, if the parallel import is priced higher than the locally sourced version times the quality discount. For indemnity insurance, $c_{b,D}^* < \frac{c_{\beta,D}^*}{(1-\tau)}$ if $p_{b,D}^* < \frac{p_{\beta,D}^* - \delta_D \tau}{(1-\tau)}$. Part II of the first order condition differs by the factor $\frac{1}{\tau}$ from the first order condition without parallel trade. For $0 < \tau < 1$, part II and consequently $p_{b,D}^*$ are lower under parallel trade. Part III illustrates the indirect effect of competition from parallel trade: A larger volume of parallel imports results in a higher wholesale profit. A higher wholesale price results in a higher price for the locally sourced version, as it leads to less competition from parallel trade.

The intermediary maximizes (24) with respect to $p_{\beta,D}^*$, which yields the first order condition

$$\left(\frac{c_{b,D}^* - c_{\beta,D}^*}{\tau} - \frac{c_{\beta,D}^*}{(1-\tau)}\right) + \left(p_{\beta,D}^* - w^*\right)\left(-\frac{\partial c_{\beta,D}^*}{\partial p_{\beta,D}^*}\frac{1}{\tau} - \frac{\partial c_{\beta,D}^*}{\partial p_{\beta,D}^*}\frac{1}{1-\tau}\right) = 0 \tag{26}$$

and the best response function $p_{\beta,D}^*\left(c_{\beta,D}^*, w, p_{b,D}^*\right)$. Solving for equilibrium prices results in

$p^*_{b,D}\left(c^*_{b,D}, w\right)$ and $p^*_{\beta,D}\left(c^*_{\beta,D}, w\right)$.

In country S, the intermediary maximizes (24) with respect to $p^*_{b,S}$. The first order condition to this maximization problem is

$$\left(1 - c^*_{b,S}\right) + \left(p^*_{b,S} - w^*\right)\left(-\frac{\partial c^*_{b,S}}{\partial p^*_{b,S}}\right) = 0, \tag{27}$$

resulting in the price $p^*_{b,S}\left(c^*_{b,S}, w\right)$. The first order condition is identical to the first order condition, if parallel trade is not allowed. Note that as $p^*_{b,S}$ increases in the wholesale price w^*, $p^*_{b,S}$ will be higher under parallel trade, if $w^* > 0$.

With

$$\phi^* = \pi^*_{b,S} + \pi^*_{\beta,D} \tag{28}$$

$$= \underbrace{\left(p^*_{b,S} - w^*\right)\left(1 - c^*_{b,S}\right)}_{\pi^*_{b,S}} + \underbrace{\left(p^*_{\beta,D} - w^*\right)\left(\frac{c^*_{b,D} - c^*_{\beta,D}}{\tau} - \frac{c^*_{\beta,D}}{(1-\tau)}\right)}_{\pi^*_{\beta,D}} \tag{29}$$

the manufacturer extracts the intermediary's total profit. Substituting (28) and equilibrium prices into (23) and maximizing with respect to w^* gives the wholesale price $w^*\left(c^*_{i,j}\right)$.

For segmented markets, the manufacturer's optimal strategy to avoid the double marginalization problem resulting from vertical separation in imperfectly competitive markets is to set the wholesale price equal to marginal cost, i.e. $w = 0$. However, if parallel trade is allowed and results in market integration, a low wholesale price induces more parallel trade. Consequently, the manufacturer will set a higher wholesale price to limit competition from parallel trade in country D. The optimal wholesale price w reflects the trade-off between an aggravated double marginalization problem in country S and intensified competition in country D. Note that as markets are integrated by parallel trade and the wholesale price incorporates the effects in both the destionation country D and the source country S, the wholesale price depends on cost-sharing systems in both countries. Similarly, prices and quantities also depend on cost-sharing systems in both countries. To account for the interdependence of pricing decisions under parallel trade, variables such as prices, quantities, will be characterized contingent on cost-sharing systems in both countries. The cost-sharing system's parameters in parentheses denote the cost-sharing in country D and S, resp., e.g. $p^*_{b,S}(\gamma, \delta)$ denotes the drug price in the source country, if country D applies coinsurance and country S indemnity insurance. The specification of drug prices and quantities for the different combinations of cost-sharing systems in the destination and source country can be found in Appendix B.

3 The Effect of Parallel Trade on Health Care Systems

If parallel trade is allowed, the manufacturer raises the wholesale price to limit competition from parallel trade. This creates a double marginalization effect with a higher drug price and a lower quantity in the source country S. As the manufacturer cannot block parallel trade entirely, parallel trade generates a competition effect with lower drug prices and a higher quantity consumed in the destination country D.

The direct link between these price changes (resulting from parallel trade) in both countries and the consequences for public health care systems is the cost-sharing system: It drives the changes in copayments for consumers and public health expenditure funded by health insurance.

The copayment mechanism determines, whether and to what extent consumers in the destination country benefit from price decreases through savings and whether and to what extent consumers in the source country are exposed to price increases by higher copayments. In addition, the reimbursement mechanism determines also the consequences of parallel trade for public health expenditure. Ex ante, price and quantity changes generated by parallel trade have an ambiguous impact on public health expenditure: In the destination country, lower prices may contribute to lower health expenditure, but a higher quantity consumed may work towards higher spending. In the source country, a higher price may have an expenditure-increasing effect, but a lower quantity consumed may reduce health expenditure.

3.1 Changes in Copayments and Public Health Expenditure in the Destination Country

This (sub)section investigates the consequences of parallel trade for public health care systems in the destination country. Proposition 1 summarizes the effects of parallel trade on consumer copayments and public health expenditure in the destination country D.

Proposition 1 *In the destination country D, lower drug prices under parallel trade decrease copayments under both cost-sharing systems. Suppose that drug prices under segmented markets are identical under coinsurance and indemnity insurance. Then savings for consumers are higher under indemnity insurance, independent of the cost-sharing system in the source country S. Parallel trade generates savings for health insurance only under coinsurance, under indemnity insurance, health expenditure is higher than under segmented markets.*

Proof. See Appendix C.1. ■

Under both cost-sharing systems, copayments strictly increase in drug prices. Consequently, under both coinsurance and indemnity insurance, price decreases translate to lower copayments:

$$\begin{aligned}\Delta c_{b,D}(\gamma,.) &= c^*_{b,D}(\gamma) - c_{b,D}(\gamma) = \gamma_D\left(p^*_{b,D}(\gamma,.) - p_{b,D}(\gamma)\right) < 0,\\ \Delta c_{b,D}(\delta,.) &= c^*_{b,D}(\delta) - c_{b,D}(\delta) = p^*_{b,D}(\delta,.) - p_{b,D}(\delta) < 0. \qquad (30)\end{aligned}$$

since $p^*_{b,D}(\gamma,.) < p_{b,D}(\gamma)$ and $p^*_{b,D}(\delta,.) < p_{b,D}(\delta)$, resp. This is, consumers benefit from parallel trade independent of the cost-sharing system.

Which cost-sharing system creates higher savings, is determined by two factors: First, there is a direct impact of the cost-sharing system for a given wholesale price: Under indemnity insurance, reimbursement is price-independent and consumers benefit from the full price decrease. Under coinsurance, only fraction γ_D of the price decrease is passed on to consumers. Second, the wholesale price drives the intensity of competition, as it is the lower bound for the price of the parallel import and thus limits the intermediary undercutting the manufacturer's price.

These two factors are interdependent, as the wholesale price also depends on the degree of competition in the destination country. This is, the first factor would result in a higher wholesale price under indemnity insurance c.p. At the same time, the increase of the wholesale price is limited by the double marginalization effect in the source country. The (relative) magnitude of this effect also depends on the cost-sharing system. Under indemnity insurance, the double marginalization effect is higher c.p.: Consumers bear the full price increase under indemnity insurance and the higher price elasticity turns a given price increase into a higher reduction of quantity.

Accordingly, for a comparison of copayment changes under coinsurance and indemnity insurance, cost-sharing systems in both countries are important: In the destination country, the total effect of the cost-sharing system and the effect of the cost-sharing system itself on the wholesale price is important. In the source country, the cost-sharing system determines by how much the manufacturer can increase the wholesale price in response to the competition effect in the destination country.

Comparing relative copayments under coinsurance and indemnity insurance[10], I assume identical drug prices for both cost-sharing systems under segmented markets. Taking into account that reimbursement may not exceed the drug price and consumers co-pay a positive amount, identical drug prices under coinsurance and indemnity insurance imply high coinsurance rates of $\gamma_D > 0.6$, see Appendix C.1 for details. Identical drug prices as standard of comparison imply that the reimbursement amount under indemnity insurance can be written in terms of the coinsurance rate as follows:

$$p_{b,D}(\gamma) = \frac{1}{2\gamma_D} = \frac{1+\delta_D}{2} = p_{b,D}(\delta) \Longleftrightarrow \delta_D = \frac{1}{\gamma_D} - 1. \tag{31}$$

Note that identical drug prices under both cost-sharing instruments does not imply identical copayments under coinsurance and indemnity insurance due to the different insurance effects. Suppose, $\gamma_D = 0.75$. For $\delta_D = \frac{1}{3}$ drug prices are identical under both coinsurance and indemnity insurance ($p_{b,D}(\gamma) = \frac{2}{3} = p_{b,D}(\delta)$). Then, under coinsurance, consumers pay $c_{b,D}(\gamma) = \frac{1}{2}$ [11] and

[10] Note that absolute copayments are higher under coinsurance for both the locally sourced version and the parallel import, independent of the cost-sharing system in the source country, see Appendix E.

[11] Note that the copayment under coinsurance is independent of the coinsurance rate, as the insurance effect is absorbed by the manufacturer completely.

under indemnity insurance $c_{b,D}(\delta) = \frac{1}{3}$. Assuming identical copayments for both cost-sharing systems under segmented markets would involve no reimbursement under indemnity insurance due to the insurance absorbing effect of coinsurance under segmented markets. See Appendix D for a detailed explanation of this limitation associated with identical copayments under both cost-sharing systems as a basis of comparison. Also, assuming identical quantities for both cost-sharing systems under segmented markets is subject to the same limitation.

The change in copayments is lower under indemnity insurance than under coinsurance independent of the cost-sharing system in the source country:

$$\frac{c^*_{b,D}(\gamma,\gamma)}{c_{b,D}(\gamma)} > \frac{c^*_{b,D}(\delta,\gamma)}{c_{b,D}(\delta)}\,|_{\delta_D=\frac{1}{\gamma_D}-1},\ \frac{c^*_{b,D}(\gamma,\delta)}{c_{b,D}(\gamma)} > \frac{c^*_{b,D}(\delta,\delta)}{c_{b,D}(\delta)}\,|_{\delta_D=\frac{1}{\gamma_D}-1}\,. \tag{32}$$

As a lower ratio of relative copayments corresponds to a higher reduction of copayments, this is equivalent to copayments being reduced to a larger extent under indemnity insurance. No matter whether coinsurance or indemnity insurance is applied in the source country, the wholesale price is higher under indemnity insurance ($w^*(\delta,\gamma) > w^*(\gamma,\gamma)$, $w^*(\delta,\delta) > w^*(\gamma,\delta)$ resp.). This is, the higher intensity of competition under indemnity insurance induces the manufacturer to raise the wholesale price more under indemnity insurance as compared to coinsurance. At that the cost-sharing system in the source country restricts the increase of the wholesale price with respect to the double marginalization effect, but does not inhibit the higher increase of the wholesale price under indemnity insurance. In total, the impact of the full price difference accrueing to consumers exceeds the effect of the higher wholesale price and consumer copayments are reduced more under indemnity insurance.

The competition effect generated by parallel trade has an ambiguous impact on total expenditure. Lower prices decrease expenditure, higher quantities increase expenditure. Whether parallel trade results in reductions of public health expenditure, i.e. the part of total expenditure which is reimbursed by health insurance, depends on the cost-sharing system. Only if reimbursement is linked to drug prices, lower prices under parallel trade benefit health insurance.

Under coinsurance, the change in public health expenditure associated parallel trade is given as:

$$\begin{aligned} & \Delta E_D(\gamma) = E^*_D(\gamma) - E_D(\gamma) \\ = \quad & (1-\gamma_D)\left(p^*_{b,D}(\gamma,.)\,q^*_{b,D}(\gamma,.) + p^*_{\beta,D}(\gamma,.)\,q^*_{\beta,D}(\gamma,.) - p_{b,D}(\gamma)\,q_{b,D}(\gamma)\right), \end{aligned} \tag{33}$$

of which the second, parenthesized part denotes the change in total expenditure. This can be decomposed into the expenditure-decreasing effect of lower drug prices and the expenditure-increasing effect of a higher quantity being reimbursed:

$$\begin{aligned}&\left(p_{b,D}^{*}(\gamma,.)\,q_{b,D}^{*}(\gamma,.)+p_{\beta,D}^{*}(\gamma,.)\,q_{\beta,D}^{*}(\gamma,.)-p_{b,D}(\gamma)\,q_{b,D}(\gamma)\right)\\ =\;&\underbrace{-\left(p_{b,D}(\gamma)-p_{b,D}^{*}(\gamma,.)\right)q_{b,D}}_{I}+\underbrace{p_{b,D}^{*}(\gamma,.)\left(q_{b,D}^{*}(\gamma,.)-q_{b,D}(\gamma)\right)}_{II}+\underbrace{p_{\beta,D}^{*}(\gamma,.)\,q_{\beta,D}^{*}(\gamma,.)}_{III}\end{aligned} \quad (34)$$

The negative part I of the decomposition exhibits the expenditure-decreasing effect from a lower price, while ignoring changes in quantity. The monopoly quantity $q_{b,D}$ sold and reimbursed under segmented markets is reimbursed based on a lower price, when parallel trade is possible. The positive parts II and III of the decomposition indicate the expenditure-increasing effect of a higher quantity being sold and hence reimbursed under parallel trade. Due to lower prices, more is sold of the locally sourced version (part II) and in addition, also the parallel import (part III) is sold and reimbursed.

The effect of lower prices dominates the effect of a higher quantity and independent of the cost-sharing system in the source country S, parallel trade results in lower public health expenditure under coinsurance:

$$\frac{E_D^*(\gamma,\gamma)}{E_D(\gamma)}<1,\ \frac{E_D^*(\gamma,\delta)}{E_D(\gamma)}<1. \quad (35)$$

Under indemnity insurance, reimbursement is independent of the drug price and the decrease of drug prices under from parallel trade has no expenditure-decreasing effect. The higher quantity sold results in an increase of public health expenditure associated with parallel trade:

$$\Delta E_D(\delta)=E_D^*(\delta,.)-E_D(\delta)=\delta_D\left(q_{b,D}^*(\delta,.)+q_{\beta,D}^*(\delta,.)-q_{b,D}(\delta)\right)>0, \quad (36)$$

since $q_{b,D}^*(\delta,.)+q_{\beta,D}^*(\delta,.)>q_{b,D}(\delta)$. As reimbursement is not linked to drug prices, health insurance do not benefit from lower prices under parallel trade.

3.2 Changes in Copayments and Public Health Expenditure in the Source Country

Comparing the consequences of parallel trade for consumer copayments and public health expenditure in the source country yields the following proposition:

Proposition 2 *In the source country S, a higher price under parallel trade increases copayments under both cost-sharing systems. Suppose that drug prices under segmented markets are identical under coinsurance and indemnity insurance. Then additional expenses for consumers are lower under coinsurance, independent of the cost-sharing system in the destination country D. Savings for health insurance from parallel trade are higher under indemnity insurance, regardless of the cost-sharing system in the destination country.*

Proof. See Appendix C.2. ■

Under both coinsurance and indemnity insurance, copayments strictly increase in drug prices and consequently, price increases give rise to higher copayments:

$$\begin{aligned} \Delta c_{b,S}(\gamma,.) &= c^*_{b,S}(\gamma) - c_{b,S}(\gamma) = \gamma_S \left(p^*_{b,S}(\gamma,.) - p_{b,S}(\gamma)\right) > 0, \\ \Delta c_{b,S}(\delta,.) &= c^*_{b,S}(\delta) - c_{b,S}(\delta) = p^*_{b,S}(\delta,.) - p_{b,S}(\delta) > 0. \end{aligned} \tag{37}$$

since $p^*_{b,S}(\gamma,.) > p_{b,S}(\gamma)$ and $p^*_{b,S}(\delta,.) > p_{b,S}(\delta)$, resp. Thus, consumers lose from parallel trade independent of the cost-sharing system.

Under which cost-sharing system the additional expense is higher, is determined by two factors, similar to the link between competition effect and consumer savings in the destination country: First, the direct impact of the cost-sharing system for a given drug price now works in the opposite direction as compared to impact on savings in the destination country: Under indemnity insurance, consumers have to bear the full price increase. Under coinsurance, only the fraction γ_S of the price increase is incurred by consumers, the remaining is is borne by health insurance. Second, price changes resulting from the increase of the wholesale price contribute to changes in copayments. Here, the higher reduction in quantity due to the higher price elasticity under indemnity insurance tends to bring about a lower increase of the wholesale price.

As the change in the wholesale price is determined by both the competition effect and the double marginalization effect, thus by cost-sharing systems in both countries, relative copayment changes are compared for a given cost-sharing system in the other country.

Again, I assume identical drug prices for both cost-sharing systems under segmented markets. This implies the following relationship between the coinsurance rate and the reimbursement amount under indemnity insurance:

$$p_{b,S}(\gamma) = \frac{1}{2\gamma_S} = \frac{1+\delta_S}{2} = p_{b,S}(\delta) \Longleftrightarrow \delta_S = \frac{1}{\gamma_S} - 1 \Longleftrightarrow \gamma_S = \frac{1}{\delta_S + 1}. \tag{38}$$

Note that, similar to assuming identical drug prices in the destination country D implying high coinsurance rates, this standard of comparison for the source country requires rather high coinsurance rates due to the positive copayment condition under indemnity insurance, see Appendix C for details.

The change in relative copayments[12], is lower under coinsurance than under indemnity insurance independent of the cost-sharing system in the destination country:

$$\frac{c^*_{b,S}(\gamma,\gamma)}{c_{b,S}(\gamma)} < \frac{c^*_{b,S}(\gamma,\delta)}{c_{b,S}(\delta)} |_{\delta_S = \frac{1}{\gamma_S} - 1}, \quad \frac{c^*_{b,S}(\delta,\gamma)}{c_{b,S}(\gamma)} < \frac{c^*_{b,S}(\delta,\delta)}{c_{b,S}(\delta)} |_{\delta_S = \frac{1}{\gamma_S} - 1}. \tag{39}$$

As a higher ratio of relative copayments implies higher price increases, this corresponds to copayments being increased less under coinsurance. Although the wholesale price is higher under coinsurance regardless of the cost-sharing system in the destination country ($w^*(\gamma,\gamma) > w^*(\gamma,\delta)$,

[12] Note that absolute copayments are higher under coinsurance independent of the cost-sharing system in the destination country, see Appendix E.

$w^*(\delta,\gamma) > w^*(\delta,\delta)$), the direct effect of the cost-sharing system of consumers being insulated from part of the price increases dominates and copayments are less increased.

The double marginalization effect induced by parallel trade has an ambiguous impact on total expenditure and public health expenditure. The higher drug price tends to increase expenditure, the lower quantity contributes to a reduction of quantity.

Under coinsurance, the change in public health expenditure associated parallel trade is given as:

$$\Delta E_S(\gamma) = E_S^*(.,\gamma) - E_S(\gamma) = (1-\gamma_S)\left(p_{b,S}^*(.,\gamma)\, q_{b,S}^*(.,\gamma) - p_{b,S}(\gamma)\, q_{b,S}(\gamma)\right),$$

of which the second, parenthesized part denotes the change in total expenditure. This can be decomposed into the expenditure-increasing effect of a higher drug price and the expenditure-decreasing effect from a lower quantity:

$$\begin{aligned} & \left(p_{b,S}^*(.,\gamma)\, q_{b,S}^*(.,\gamma) - p_{b,S}(\gamma)\, q_{b,S}(\gamma)\right) \\ = \; & \underbrace{\left(p_{b,S}^*(.,\gamma) - p_{b,S}(\gamma)\right) q_{b,S}(\gamma)}_{I} - \underbrace{p_{b,S}^*\left(q_{b,S}(\gamma) - q_{b,S}^*(.,\gamma)\right)}_{II}. \end{aligned} \tag{40}$$

The positive part I of the decomposition exhibits the expenditure-increasing effect of a higher drug price being the basis for reimbursement under parallel trade, while neglecting changes in quantity. The negative part II reflects the reduction of expenditure due to the lower quantity sold and reimbursed under parallel trade.

The effect of a lower quantity exceeds the effect of a higher drug and independent of the cost-sharing system in the destination country D, parallel trade results in lower public health expenditure under coinsurance:

$$\frac{E_S^*(\gamma,\gamma)}{E_S(\gamma)} < 1, \frac{E_S^*(\delta,\gamma)}{E_S(\gamma)} < 1. \tag{41}$$

Under indemnity insurance, the change in public health expenditure associated parallel trade is given as:

$$\Delta E_S(\delta) = E_S^*(.,\delta) - E_S(\delta) = \delta_S\left(q_{b,S}^* - q_{b,S}\right) < 0,$$

since $q_{b,S}^* < q_{b,S}$. Since reimbursement is not linked to drug prices, the drug price increase does not give rise to an expenditure-increasing effect. Instead, the decrease in quantity unambiguously decreases public health expenditure.

Comparing relative expenditure reductions under coinsurance and indemnity insurance for identical drug prices for both cost-sharing systems under segmented markets, public health expenditure is more reduced under indemnity insurance, independent of the cost-sharing system in the destination country:

$$\frac{E_S^*(\gamma,\gamma)}{E_S(\gamma)} - \frac{E_S^*(\gamma,\delta)}{E_S(\delta)}\,|_{\delta_S=\frac{1}{\gamma_S}-1} > 0, \; \frac{E_S^*(\delta,\gamma)}{E_S(\gamma)} - \frac{E_S^*(\delta,\delta)}{E_S(\delta)}\,|_{\gamma_S=\frac{1}{\delta_S+1}} > 0 \tag{42}$$

Under indemnity insurance, the drug-price increase under parallel trade has no expenditure-increasing effect, as reimbursement is independent of the drug price. Accordingly, expenditure is decreased more, if reimbursement is price-independent.

3.3 Total Changes

So far I considered changes for consumers and health insurance separately, with the implicit assumption that compensation between consumers and health insurance in form of transfers is not possible. This subsection drops this assumption and considers total changes in expenditure, both private expenditure (sum of all copayments) and public expenditure (reimbursed part).

For the comparison, I assume identical drug prices for both cost-sharing systems under segmented markets. The complexity of the expressions allows only for numerical results, see Appendix F.

In both countries, the total change in expenditure is negative, independent of the cost-sharing system. In the destination country, under coinsurance, both copayments and public health expenditure are lower under parallel trade. Under indemnity insurance, the effect of lower copayments exceeds the effect of higher public health expenditure. In the source country, the effect of lower public health expenditure exceeds the effect of higher copayments. This is, in both countries, parallel trade generates net savings under both cost-sharing systems. The level of the copayment determines, under which cost-sharing system savings are higher. In the destination country and independent of the cost-sharing system in the source country, total savings are higher under indemnity insurance for a sufficiently low copayment. For a higher copayment, total savings are higher under coinsurance. In the source country and independent of the cost-sharing system in the destination country, total savings are higher under coinsurance for a sufficiently low copayment. For a higher copayment, total savings are higher under indemnity insurance. However, compensation between consumers and health insurance in form of transfers might not be feasible, as savings are contigent on the version of the drug purchased.

4 Conclusion

In this paper, I have studied the consequences of parallel trade for health care systems. In particular, I have compared a coinsurance scheme (consumers pay a percentage of the drug price out-of-pocket) and an indemnity insurance scheme (reimbursement is independent of the drug price) with respect to changes of copayments, i.e. out-of-pocket expenditure for patients, and public health expenditure.

The model suggests a strong link between the consequences of parallel trade and cost-sharing systems. Although, under both cost-sharing schemes, parallel trade results in price decreases in the destination country and a price increase in the source country, the cost-sharing scheme determines whether savings from parallel trade accrue and for whom. The extent to which price decreases (in the destination country) and price increases (in the source country) are passed on to consumers and sickness funds and translate to copayment and health expenditure reductions or increases is based on reimbursement mechanism.

In the destination country, savings for patients from parallel trade occur under both systems, but are relatively higher under indemnity insurance. However, savings for health insurance from parallel trade occur only under coinsurance. Indemnity insurance fails to establish a link between the reimbursement and drug prices. The procompetitive effect from parallel trade does not benefit health insurances, but rather results in a growth of expenditure, as consumption increases due to lower drug prices. Consequently, maximizing savings for patients by adopting indemnity insurance occurs at expense of public health expenditure. The greater incentive for patients to buy the less expensive parallel import under indemnity insurance rather hurts health insurance than benefitting it. Applying coinsurance instead shifts savings from patients to sickness funds partially: Savings for patients are relatively lower than under indemnity insurance, but also sickness funds benefit from lower prices. This makes coinsurance a more attractive cost-sharing mechanism for health insurance; the failure to link prices to expenditure and full responsiveness to changes in quantity may constitute a reason why indemnity insurance is considered to be inappropriate as a cost-sharing instrument by regulatory bodies. Pure indemnity insurance is not observed any member state of the European Union.

In the source country, the drug price increase following from the increase of the wholesale price results in additional expenses for consumers under parallel trade, but the associated reduction in quantity consumed benefits health insurance, as it dominates the effect of higher prices on public health expenditure. Again a conflict between minimizing negative consequences from parallel trade for patients and maximizing positive consequences for health insurance emerges. Under coinsurance, additional expenses for patients are relatively lower; under indemnity insurance, the reduction of health expenditure is relatively higher. Consequently, also the distributive effects of parallel trade in the source country are determined by the cost-sharing scheme. Considering that regulatory bodies in source countries should prefer indemnity insurance to minimize public health expenditure, it remains unexplained, why indemnity insurance is not applied in the respective source countries of parallel imports.

Accordingly, if minimizing public health expenditure is the dominant health policy objective, coinsurance should be the cost-sharing instrument of choice in the destination country and indemnity insurance in the source country. If minimizing financial exposure of patients and maximizing access to pharmaceuticals is the prevailing health policy objective, indemnity insurance is the appropriate cost-sharing scheme in the destination country and coinsurance in the source country. Thus, these health policy objectives should be carefully balanced.

In the European Union, health policy, including the general organization of health care systems as well as cost-sharing systems, is in the national competence of member states. However, a harmonization of health care systems with respect to cost-sharing systems would not make sense, as this paper illustrates. Under parallel trade reimbursement systems have different effects in source and destination countries of parallel imports. Thus, a harmonization of reimbursement systems would result in welfare losses in source and/or destination countries.

Generally, this model considers stylized, i.e. simplified versions of cost-sharing systems. In the Scandinavian countries, e.g. combinations of different cost-sharing systems (deductibles and coinsurance) are applied. In addition, there is a tendency for cost-sharing systems to become more complex. For instance, coinsurance rates may depend on drug classes, exemptions may be added etc. The stylized versions of cost-sharing systems in this paper allow me to compare different systems on a basic level. A specific and precise comparison of cost-sharing systems of different member states would have to take the detailed design of cost-sharing systems into account.

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A Drug Quantities under No Parallel Trade

Equilibrium quantities are given as:

D↓, S⟶	Coinsurance	Indemnity insurance
Coinsurance	$q_{b,D}(\gamma) = \frac{1}{2}$, $q_{b,S}(\gamma) = \frac{1}{2}$	$q_{b,D}(\gamma) = \frac{1}{2}$, $q_{b,S}(\delta) = \frac{1+\delta_S}{2}$
Indemnity insurance	$q_{b,D}(\delta) = \frac{1+\delta_D}{2}$, $q_{b,S}(\gamma) = \frac{1}{2}$	$q_{b,D}(\delta) = \frac{1+\delta_D}{2}$, $q_{b,S}(\delta) = \frac{1+\delta_S}{2}$.

B Drug Prices and Quantities under Parallel Trade

The wholesale price is given as:

D↓, S⟶	Coinsurance	Indemnity insurance
Coinsurance	$w^*(\gamma,\gamma) = \frac{2(1-\tau)(9-5\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}$	$w^*(\gamma,\delta) = \frac{2(1-\tau)(9-5\tau)}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$
Indemnity insurance	$w^*(\delta,\gamma) = \frac{2(1-\tau)[(9-5\tau)+\delta_D(9-\tau)]}{4(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}$	$w^*(\delta,\delta) = \frac{2(1-\tau)[(9-5\tau)+\delta_D(9-\tau)]}{4(9-5\tau)+(1-\tau)(3+\tau)^2}$.

Drug prices in both countries are given as:

D↓, S⟶	Coinsurance
Coinsurance	$p^*_{b,D}(\gamma,\gamma) = \frac{2\gamma_D(9-5\tau)+2\tau\gamma_S(3+\tau)(1-\tau)}{\gamma_D[4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2]}$, $p^*_{\beta,D}(\gamma,\gamma) = \frac{(1-\tau)[2\gamma_D(9-5\tau)+\tau\gamma_S(3+\tau)(1-\tau)]}{\gamma_D[4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2]}$, $p^*_{b,S}(\gamma,\gamma) = \frac{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)}{2\gamma_S[4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2]}$
Indemnity insurance	$p^*_{b,D}(\delta,\gamma) = \frac{2\delta_D(9-7\tau)+2(9-5\tau)+(\delta_D+2)\tau\gamma_S(\tau+3)(1-\tau)}{4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2}$, $p^*_{\beta,D}(\delta,\gamma) = \frac{2(1-\tau)(9-5\tau)+2\delta_D\left(9-4\tau-\tau^2\right)+(2\delta_D+(1-\tau))\gamma_S\tau(\tau+3)(1-\tau)}{4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2}$,[13] $p^*_{b,S}(\delta,\gamma) = \frac{4(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)+2\gamma_S\delta_D(1-\tau)(9-\tau)}{2\gamma_S[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2]}$

D↓, S⟶	Indemnity insurance
Coinsurance	$p^*_{b,D}(\gamma,\delta) = \frac{2(\gamma_D(9-5\tau)+\tau(1-\tau)(\tau+3))}{\gamma_D[4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2]}$, $p^*_{\beta,D}(\gamma,\delta) = \frac{(1-\tau)(2\gamma_D(9-5\tau)+\tau(1-\tau)(\tau+3))}{\gamma_D[4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2]}$, $p^*_{b,S}(\gamma,\delta) = \frac{(1-\tau)\left(27-4\tau+\tau^2\right)+\delta_S(1-\tau)(\tau+3)^2+(1+\delta_S)4\gamma_D(9-5\tau)}{2[4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2]}$[14]
Indemnity insurance	$p^*_{b,D}(\delta,\delta) = \frac{2\left(9-2\tau-2\tau^2-\tau^3\right)+\delta_D\left(18-11\tau-2\tau^2-\tau^3\right)}{4(9-5\tau)+(1-\tau)(3+\tau)^2}$, $p^*_{\beta,D}(\delta,\delta) = \frac{(1-\tau)\left(18-7\tau-2\tau^2-\tau^3\right)+2\delta_D\left(9-\tau-3\tau^2-\tau^3\right)}{4(9-5\tau)+(1-\tau)(3+\tau)^2}$,[15] $p^*_{b,S}(\delta,\delta) = \frac{\left(63-51\tau+5\tau^2-\tau^3\right)+2\delta_D(1-\tau)(9-\tau)+\delta_S[4(9-5\tau)+(1-\tau)(\tau+3)^2]}{2[4(9-5\tau)+(1-\tau)(\tau+3)^2]}$[16].

Equilibrium quantities are given as:

H, F	Coinsurance
Coinsurance	$q^*_{b,D}(\gamma,\gamma) = \frac{2[\gamma_D(9-5\tau)+\gamma_S(3+\tau)(1-\tau)]}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}$, $q^*_{\beta,D}(\gamma,\gamma) = \frac{\gamma_S(3+\tau)(1-\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}$, $q^*_{b,S}(\gamma,\gamma) = \frac{4\gamma_D(9-5\tau)-\gamma_S(1-\tau)\left(9-16\tau-\tau^2\right)}{2[4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2]}$
Indemnity insurance	$q^*_{b,D}(\delta,\gamma) = \frac{2(9-5\tau)+2\delta_D(3-\tau)+\gamma_S(\tau+3)(1-\tau)(\delta_D+2)}{4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2}$, $q^*_{\beta,D}(\delta,\gamma) = \frac{4\delta_D(3-\tau)+(2\delta_D+(1-\tau))\gamma_S(\tau+3)(1-\tau)}{(1-\tau)[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2]}$, $q^*_{b,S}(\delta,\gamma) = \frac{4(9-5\tau)-\gamma_S(1-\tau)\left(9-16\tau-\tau^2\right)-2\gamma_S\delta_D(\tau-1)(\tau-9)}{2[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2]}$

D↓, S⟶	Indemnity insurance
Coinsurance	$q^*_{b,D}(\gamma,\delta) = \frac{2(\gamma_D(9-5\tau)+(\tau+3)(1-\tau))}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$, $q^*_{\beta,D}(\gamma,\delta) = \frac{(\tau+3)(1-\tau)}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$, $q^*_{b,S}(\gamma,\delta) = \frac{\delta_S(1-\tau)(\tau+3)^2+(1+\delta_S)4\gamma_D(9-5\tau)-(1-\tau)\left(9-16\tau-\tau^2\right)}{2\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$
Indemnity insurance	$q^*_{b,D}(\delta,\delta) = \frac{2\left(12-7\tau-\tau^2\right)+\delta_D\left(9-4\tau-\tau^2\right)}{4(9-5\tau)+(1-\tau)(3+\tau)^2}$, $q^*_{\beta,D}(\delta,\delta) = \frac{(3+\tau)(1-\tau)^2+2\delta_D\left(9-4\tau-\tau^2\right)}{(1-\tau)[4(9-5\tau)+(1-\tau)(3+\tau)^2]}$, $q^*_{b,S}(\delta,\delta) = \frac{27+5\tau-15\tau^2-\tau^3+\delta_S[4(9-5\tau)+(1-\tau)(3+\tau)^2]-2\delta_D(1-\tau)(9-\tau)}{2[4(9-5\tau)+(1-\tau)(3+\tau)^2]}$.

C The Effect of Parallel Trade

In country D, parallel trade generates a competition effect with lower prices and a higher quantity.

Compared to segmented markets, parallel trade reduces the price of the drug sold directly by the manufacturer under both cost-sharing systems and independent of the cost-sharing system in the source country:

$$
\begin{aligned}
\frac{p^*_{b,D}(\gamma,\gamma)}{p_{b,D}(\gamma)} &= \frac{4\gamma_D(9-5\tau)+4\tau\gamma_S(1-\tau)(3+\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} < 1, \\
\frac{p^*_{b,D}(\gamma,\delta)}{p_{b,D}(\gamma)} &= \frac{(4\gamma_D(9-5\tau)+4\tau(\tau+3)(1-\tau))}{4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2} < 1, \\
\frac{p^*_{b,D}(\delta,\gamma)}{p_{b,D}(\delta)} &= \frac{4\delta_D(9-7\tau)+4(9-5\tau)+2(\delta_D+2)\tau\gamma_S(\tau+3)(1-\tau)}{4\delta_D(9-5\tau)+4(9-5\tau)+(\delta_D+1)\gamma_S(1-\tau)(\tau+3)^2} < 1, \\
\frac{p^*_{b,D}(\delta,\delta)}{p_{b,D}(\delta)} &= \frac{4\left(9-2\tau-2\tau^2-\tau^3\right)+2\delta_D\left(18-11\tau-2\tau^2-\tau^3\right)}{(1+\delta_D)[4(9-5\tau)+(1-\tau)(3+\tau)^2]} < 1.
\end{aligned}
$$

Under both coinsurance and indemnity insurance, the price of the parallel import is lower than the price of the locally sourced version:

$$\begin{aligned}
\frac{p^*_{\beta,D}(\gamma,\gamma)}{p^*_{b,D}(\gamma,\gamma)} &= (1-\tau)\frac{2\gamma_D(9-5\tau)+\tau\gamma_S(3+\tau)(1-\tau)}{2\gamma_D(9-5\tau)+2\tau\gamma_S(3+\tau)(1-\tau)} < 1,\\
\frac{p^*_{\beta,D}(\gamma,\delta)}{p^*_{b,D}(\gamma,\delta)} &= (1-\tau)\frac{(2\gamma_D(9-5\tau)+\tau(1-\tau)(\tau+3))}{(2\gamma_D(9-5\tau)+2\tau(1-\tau)(\tau+3))} < 1,\\
\frac{p^*_{\beta,D}(\delta,\gamma)}{p^*_{b,D}(\delta,\gamma)} &= \frac{2(1-\tau)(9-5\tau)+2\delta_D\left(9-4\tau-\tau^2\right)+(2\delta_D+(1-\tau))\gamma_S\tau(\tau+3)(1-\tau)}{2(9-5\tau)+2\delta_D(9-7\tau)+(\delta_D+2)\gamma_S\tau(\tau+3)(1-\tau)} < 1,\\
\frac{p^*_{\beta,D}(\delta,\delta)}{p^*_{b,D}(\delta,\delta)} &= \frac{(1-\tau)\left(18-7\tau-2\tau^2-\tau^3\right)+\delta_D\left(18-2\tau-6\tau^2-2\tau^3\right)}{(18-4\tau-4\tau^2-2\tau^3)+\delta_D(18-11\tau-2\tau^2-\tau^3)} < 1.
\end{aligned}$$

Under coinsurance, the quantity of the locally sourced version is higher under parallel trade:

$$\begin{aligned}
\frac{q^*_{b,D}(\gamma,\gamma)}{q_{b,D}(\gamma)} &= \frac{4\gamma_D(9-5\tau)+4\gamma_S(1-\tau)(3+\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} > 1,\\
\frac{q^*_{b,D}(\gamma,\delta)}{q_{b,D}(\gamma)} &= \frac{4\gamma_D(9-5\tau)+4(1-\tau)(\tau+3)}{4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2} > 1,
\end{aligned}$$

Under indemnity insurance, the quantity of the locally sourced version is higher under parallel trade, if the reimbursement amount is low:

$$\begin{aligned}
\frac{q^*_{b,D}(\delta,\gamma)}{q_{b,D}(\delta)} &= \frac{4(9-5\tau)+4\delta_D(3-\tau)+2\gamma_S(\tau+3)(1-\tau)(\delta_D+2)}{4(9-5\tau)+4\delta_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2(\delta_D+1)} > 1,\\
\text{if } \delta_D &< \frac{\gamma_S(\tau+3)(1-\tau)^2}{8(3-2\tau)+\gamma_S(\tau+3)(1-\tau)(\tau+1)},\\
\frac{q^*_{b,D}(\delta,\delta)}{q_{b,D}(\delta)} &= \frac{4\left(12-7\tau-\tau^2\right)+2\delta_D\left(9-4\tau-\tau^2\right)}{(1+\delta_D)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]} > 1,\\
\text{if } \delta_D &< \frac{(3+\tau)(1-\tau)^2}{(27-15\tau-3\tau^2-\tau^3)}.
\end{aligned}$$

However, the total quantity sold in country D, i.e. locally sourced version plus parallel import, is (always) higher than the sales volume under no parallel trade:

$$\begin{aligned}
\frac{q^*_{b,D}(\delta,\gamma)+q^*_{\beta,D}(\delta,\gamma)}{q_{b,D}(\delta)} &= \frac{4(1-\tau)(9-5\tau)+4\delta_D(3-\tau)^2+2\gamma_S(\tau+3)(1-\tau)(3(1-\tau)+\delta_D(3-\tau))}{4(1-\tau)(9-5\tau)+4\delta_D(1-\tau)(9-5\tau)+\gamma_S(\tau+3)^2(1-\tau)^2(\delta_D+1)} > 1,\\
\frac{q^*_{b,D}(\delta,\delta)+q^*_{\beta,D}(\delta,\delta)}{q_{b,D}(\delta)} &= \frac{2(1-\tau)\left(27-16\tau-3\tau^2\right)+2\delta_D(3-\tau)\left(9-4\tau-\tau^2\right)}{(1+\delta_D)(1-\tau)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]} > 1.
\end{aligned}$$

In country S, the introduction of parallel trade induces an increase of the wholesale price w. This translates to an increase of the drug price (double marginalization effect) under both cost-sharing systems:

$$\frac{p^*_{b,S}(\gamma,\gamma)}{p_{b,S}(\gamma)} = \frac{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} > 1,$$

$$\frac{p^*_{b,S}(\delta,\gamma)}{p_{b,S}(\gamma)} = \frac{4(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)+2\gamma_S\delta_D(1-\tau)(9-\tau)}{4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2} > 1,$$

$$\frac{p^*_{b,S}(\gamma,\delta)}{p_{b,S}(\delta)} = \frac{(1-\tau)\left(27-4\tau+\tau^2\right)+\delta_S(1-\tau)(\tau+3)^2+(1+\delta_S)4\gamma_D(9-5\tau)}{(1-\tau)(\tau+3)^2+\delta_S(1-\tau)(\tau+3)^2+(1+\delta_S)4\gamma_D(9-5\tau)} > 1,$$

$$\frac{p^*_{b,S}(\delta,\delta)}{p_{b,S}(\delta)} = \frac{\left(63-51\tau+5\tau^2-\tau^3\right)+\delta_S\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)+2\delta_D(1-\tau)(9-\tau)}{\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)+\delta_S\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)} > 1$$

Due to a higher price, parallel trade reduces the quantity sold:

$$\frac{q^*_{b,S}(\gamma,\gamma)}{q_{b,S}(\gamma)} = \frac{4\gamma_D(9-5\tau)-\gamma_S(1-\tau)\left(9-16\tau-\tau^2\right)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} < 1,$$

$$\frac{q^*_{b,S}(\delta,\gamma)}{q_{b,S}(\gamma)} = \frac{4(9-5\tau)-\gamma_S(1-\tau)\left(9-16\tau-\tau^2\right)-2\gamma_S\delta_D(1-\tau)(9-\tau)}{4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2} < 1,$$

$$\frac{q^*_{b,S}(\gamma,\delta)}{q_{b,S}(\delta)} = \frac{\delta_S(1-\tau)(\tau+3)^2+(1+\delta_S)4\gamma_D(9-5\tau)-(1-\tau)\left(9-16\tau-\tau^2\right)}{\delta_S(1-\tau)(\tau+3)^2+4\gamma_D(\delta_S+1)(9-5\tau)+(1-\tau)(\tau+3)^2} < 1,$$

$$\frac{q^*_{b,S}(\delta,\delta)}{q_{b,S}(\delta)} = \frac{(1+\delta_S)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]-2(1-\tau)(9-5\tau)-2\delta_D(1-\tau)(9-\tau)}{(1+\delta_S)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]} < 1.$$

C.1 Changes in Copayments and Public Health Expenditure in the Destination Country

Given that coinsurance is applied in the source country S, the relative copayment change in the destination country D under coinsurance is given as:

$$\frac{c^*_{b,D}(\gamma,\gamma)}{c_{b,D}(\gamma)} = \frac{4\gamma_D(9-5\tau)+4\tau\gamma_S(\tau+3)(1-\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2},$$

which is equivalent to the price change under coinsurance, since $\frac{c^*_{b,D}(\gamma,\gamma)}{c_{b,D}(\gamma,\gamma)} = \frac{\gamma_D p^*_{b,D}(\gamma,\gamma)}{\gamma_D p_{b,D}(\gamma,\gamma)}$. The relative copayment change in the destination country D under indemnity insurance is given as:

$$\frac{c^*_{b,D}(\delta,\gamma)}{c_{b,D}(\delta)} = \frac{2\left(2(9-5\tau)-6\delta_D(3-\tau)+2\tau\gamma_S(\tau+3)(1-\tau)-3\gamma_S\delta_D(\tau+3)(1-\tau)\right)}{(1-\delta_D)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)},$$

which does not coincide with the price change, since $\frac{c^*_{b,D}(\delta,\gamma)}{c_{b,D}(\delta,\gamma)} = \frac{p^*_{b,D}(\delta,\gamma)-\delta_D}{p_{b,D}(\delta,\gamma)-\delta_D}$. The difference between relative copayment changes then is given as:

$$\begin{aligned}
&\frac{c^*_{b,D}(\gamma,\gamma)}{c_{b,D}(\gamma)} - \frac{c^*_{b,D}(\delta,\gamma)}{c_{b,D}(\delta)} \\
= \quad & \frac{32\tau\gamma_D\delta_D(9-5\tau)+4\gamma_S\delta_D(1-\tau)(\tau+3)\left(\gamma_D(3-\tau)(9-5\tau)+\left(27-36\tau+17\tau^2\right)\right)}{(1-\delta_D)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)} \\
&+\frac{2\gamma_S^2\delta_D(3-2\tau)(\tau-1)^2(\tau+3)^3-12\gamma_S(\tau+3)(9-5\tau)(\tau-1)^2(1-\gamma_D)}{(1-\delta_D)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)}.
\end{aligned}$$

Identical drug prices as standard of comparison imply that the reimbursement amount under indemnity insurance can be written in terms of the coinsurance as follows:

$$p_{b,D}(\gamma) = \frac{1}{2\gamma_D} = \frac{1+\delta_D}{2} = p_{b,D}(\delta) \Longleftrightarrow \delta_D = \frac{1}{\gamma_D} - 1.$$

Identical drug prices under segmented markets as standard of comparison imply coinsurance rates of $\gamma_D > 0.5$ or $\gamma_D > 0.6$, depending on the cost-sharing system in the source country. Identical drug prices without parallel trade implies that the reimbursement amount under indemnity insurance can be written in terms of the coinsurance rate as follows: $p_{b,D}(\gamma) = \frac{1}{2\gamma_D} = \frac{1+\delta_D}{2} = p_{b,D}(\delta) \Longleftrightarrow \delta_D = \frac{1}{\gamma_D} - 1$. Taking into account that consumers are required to co-pay a positive amount, the reimbursement amount δ_D is restricted to $\delta_D < \widetilde{\delta_D}$, with $\widetilde{\delta_D}(\delta,\gamma) = \frac{2(1-\tau)(9-5\tau)+\tau\gamma_S(\tau+3)(1-\tau)^2}{2(3-\tau)^2+\gamma_S(1-\tau)(\tau+3)(3-\tau)}$ and $\widetilde{\delta_D}(\delta,\delta) = \frac{(1-\tau)\left(18-7\tau-2\tau^2-\tau^3\right)}{(27-21\tau+\tau^2+\tau^3)}$. In combination with $\delta_D = \frac{1}{\gamma_D} - 1$, this implies $\gamma_D > \frac{(3-\tau)(2(3-\tau)+\gamma_S(1-\tau)(\tau+3))}{4(9-10\tau+3\tau^2)+\gamma_S(1-\tau)(\tau+3)(3-\tau^2)}$ (a) for γ in S, $\gamma_D > \frac{(3-\tau)\left(9-4\tau-\tau^2\right)}{45-46\tau+6\tau^2+2\tau^3+\tau^4}$(b) for δ in S, with (a) $\in$ (0.5, 1), (b) $\in$ (0.6, 1). Also, for $\gamma_D < \gamma_S$ (parallel trade from the low price to high price-country, (a) implies $\gamma_S > \frac{\sqrt{-2538\tau+1591\tau^2-476\tau^3+159\tau^4-58\tau^5+9\tau^6+1377}-27+31\tau-13\tau^2+\tau^3}{2(1-\tau)(\tau+3)(3-\tau^2)}$, which is only satisfied for high γ_S.

The difference between relative copayment changes is positive[17]:

$$\frac{c^*_{b,D}(\gamma,\gamma)}{c_{b,D}(\gamma)} - \frac{c^*_{b,D}(\delta,\gamma)}{c_{b,D}(\delta)} |_{\delta_D=\frac{1}{\gamma_D}-1}$$

$$= -\frac{2(1-\gamma_D)\left(\gamma_S(\tau+3)(1-\tau)\left(2\left(27-36\tau+17\tau^2\right)+\gamma_S(\tau-1)(2\tau-3)(\tau+3)^2\right)\right)}{(1-2\gamma_D)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)}$$
$$-\frac{2(1-\gamma_D)(4\tau\gamma_D(9-5\tau)(4+\gamma_S(1-\tau)(\tau+3)))}{(1-2\gamma_D)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)}.$$

The wholesale price is higher under indemnity insurance:

$$w^*(\delta,\gamma) = \frac{2(1-\tau)[(9-5\tau)+\delta_D(9-\tau)]}{4(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} > \frac{2(1-\tau)(9-5\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} = w^*(\gamma,\gamma).$$

Given that indemnity insurance is applied in the source country S, the relative copayment change in the destination country D under coinsurance is given as:

$$\frac{c^*_{b,D}(\gamma,\delta)}{c_{b,D}(\gamma)} = \frac{4(\gamma_D(9-5\tau)+\tau(\tau+3)(1-\tau))}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)},$$

the relative copayment change under indemnity insurance is given as:

$$\frac{c^*_{b,D}(\delta,\delta)}{c_{b,D}(\delta)} = \frac{2\left(2\left(9-2\tau-2\tau^2-\tau^3\right)-3\delta_D\left(9-4\tau-\tau^2\right)\right)}{(1-\delta_D)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}.$$

The difference between relative copayment changes then is given as

$$\frac{c^*_{b,D}(\gamma,\delta)}{c_{b,D}(\gamma)} - \frac{c^*_{b,D}(\delta,\delta)}{c_{b,D}(\delta)}$$

$$= \frac{-12(\tau+3)(9-5\tau)(\tau-1)^2(1-\gamma_D)+4\gamma_D\delta_D(9-5\tau)\left(9-\tau-\tau^2+\tau^3\right)}{(1-\delta_D)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$$
$$+\frac{2\delta_D(1-\tau)(\tau+3)\left(81-99\tau+25\tau^2+7\tau^3+2\tau^4\right)}{(1-\delta_D)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}.$$

[17] Under lower coinsurance rates, the difference between relative copayment changes would be negative, suggesting that copayments change to a greater extent under coinsurance rates. This is due to to lower coinsurance rates implying high reimbursement amounts, which correspond to negative copayments, i.e. subsidies. Lower drug prices under parallel trade then result in an increase of the subsidy and a ratio of copayments $\frac{c^*_{b,H}(\delta,)}{c_{b,H}(\delta)}$ larger than 1, misleading into interpreting this as an increase of copayments under parallel trade and a negative difference between relative copayment changes as a higher reduction of copayments under coinsurance rates.

For identical prices, it is positive:

$$
\begin{aligned}
&\frac{c_{b,D}^{*}(\gamma,\delta)}{c_{b,D}(\gamma)}-\frac{c_{b,D}^{*}(\delta,\delta)}{c_{b,D}(\delta)}\,|_{\delta_D=\frac{1}{\gamma_D}-1}\\
= \quad &-2\frac{(1-\gamma_D)\left((1-\tau)(\tau+3)\left(81-99\tau+25\tau^2+7\tau^3+2\tau^4\right)+4\tau\gamma_D(9-5\tau)\left(7-2\tau-\tau^2\right)\right)}{(1-2\gamma_D)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}>0.
\end{aligned}
$$

The wholesale price is higher under indemnity insurance:

$$
w^{*}(\delta,\gamma)=\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]}{4(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}>\frac{2(1-\tau)(9-5\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2}=w^{*}(\gamma,\gamma).
$$

The relative change in public health expenditure under coinsurance is given as:

$$
\frac{E_D^{*}(\gamma,.)}{E_D(\gamma)}=\frac{(1-\gamma_D)\left(p_{b,D}^{*}(\gamma,.)\,q_{b,D}^{*}(\gamma,.)+p_{\beta,D}^{*}(\gamma,.)\,q_{\beta,D}^{*}(\gamma,.)\right)}{(1-\gamma_D)\,p_{b,D}(\gamma)\,q_{b,D}(\gamma)}.
$$

Given that coinsurance is applied in the source country S, the relative change in public health expenditure is

$$
\frac{E_D^{*}(\gamma,\gamma)}{E_D(\gamma)}=\frac{\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2-\gamma_S^2(9-5\tau)(\tau+3)^2(1-\tau)^3}{\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2}<1,
$$

given that indemnity insurance is applied in the source country S, the relative change in public health expenditure is

$$
\frac{E_D^{*}(\gamma,\delta)}{E_D(\gamma)}=\frac{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)^2-(9-5\tau)(\tau+3)^2(1-\tau)^3}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)^2}<1.
$$

C.2 Changes in Copayments and Public Health Expenditure in the Source Country

Under coinsurance, the change in copayments in the destination country S is given as:

$$
\begin{aligned}
\Delta c_{b,S}(\gamma,.) &= c_{b,S}^{*}(\gamma)-c_{b,S}(\gamma)\\
&= \gamma_S\left(p_{b,S}^{*}(\gamma,.)-p_{b,S}(\gamma)\right)>0,
\end{aligned}
$$

since $p^*_{b,S}(\gamma,.) > p_{b,S}(\gamma)$. Under indemnity insurance, the change in copayments in S is given as

$$\begin{aligned}\Delta c_{b,S}(\delta,.) &= c^*_{b,S}(\delta) - c_{b,S}(\delta)\\ &= p^*_{b,S}(\delta,.) - p_{b,S}(\delta) > 0,\end{aligned}$$

since $p^*_{b,S}(\delta,.) > p_{b,S}(\delta)$.

Given that coinsurance is applied in the destination country D, the relative copayment change in the source country S under coinsurance is given as:

$$\frac{c^*_{b,S}(\gamma,\gamma)}{c_{b,S}(\gamma)} = \frac{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)}{\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)}$$

and under indemnity insurance as:

$$\frac{c^*_{b,S}(\gamma,\delta)}{c_{b,S}(\delta)} = \frac{(1-\tau)\left(27-4\tau+\tau^2\right)+4\gamma_D(9-5\tau)(1-\delta_S)-\delta_S(1-\tau)(\tau+3)^2}{(1-\delta_S)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)},$$

with the difference between relative copayment changes then amounting to:

$$\begin{aligned}&\frac{c^*_{b,S}(\gamma,\gamma)}{c_{b,S}(\gamma)} - \frac{c^*_{b,S}(\gamma,\delta)}{c_{b,S}(\delta)}\\ =\ &\frac{2(9-5\tau)(1-\tau)\left(-4\gamma_D(9-5\tau)(1-\gamma_S(1-\delta_S))-\gamma_S\delta_S(1-\tau)(\tau+3)^2\right)}{(1-\delta_S)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}.\end{aligned}$$

Assuming identical drug prices allows to express the reimbursement amount under indemnity insurance in terms of the coinsurance in the following way:

$$p_{b,S}(\gamma) = \frac{1}{2\gamma_S} = \frac{1+\delta_S}{2} = p_{b,S}(\delta) \Longleftrightarrow \delta_S = \frac{1}{\gamma_S} - 1.$$

Similar to assuming identical drug prices in the destination country D implying high coinsurance rates, this standard of comparison for the source country requires rather high coinsurance rates due to the positive copayment condition under indemnity insurance. Taking into account that consumers are required to co-pay a positive amount, the reimbursement amount is δ_S restricted to $\delta_S < \widetilde{\delta_S}$, with $\widetilde{\delta_S}(\gamma,\delta) = \frac{4\gamma_D(9-5\tau)+(1-\tau)\left(27-4\tau+\tau^2\right)}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$ and $\widetilde{\delta_S}(\delta,\delta) = \frac{45-55\tau+19\tau^2-\tau^3}{27-21\tau+\tau^2+\tau^3}$. In combination with $\delta_S = \frac{1}{\gamma_S} - 1$, this implies $\gamma_S > \frac{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}{8\gamma_D(9-5\tau)+(1-\tau)(2\tau^2+2\tau+36)}$ (a) for γ in D, $\gamma_S > \frac{27-21\tau+\tau^2+\tau^3}{72-76\tau+20\tau^2}$(b) for δ in D, with (a) $\in$ (0.25, 0.5), (b) $\in$ (0.375, 0.5). Admittedly, this also allows for rather moderate coinsurance rates, but this would correspond to restrictions on the degree of vertical product differentation τ or the coinsurance rate in the destination country. The general case, without further restrictions, however, assumes high coinsurance rates.

The difference between relative copayment changes is negative:

$$\frac{c^*_{b,S}(\gamma,\gamma)}{c_{b,S}(\gamma)} - \frac{c^*_{b,S}(\gamma,\delta)}{c_{b,S}(\delta)}\,|_{\delta_S=\frac{1}{\gamma_S}-1}$$
$$= \frac{2\gamma_S(1-\tau)(1-\gamma_S)(9-5\tau)\left(8\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}{(1-2\gamma_S)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)} < 0$$

As a higher ratio of relative copayments implies higher price increases, this corresponds to copayments being increased less under coinsurance.

The wholesale price is higher under coinsurance:

$$w^*(\gamma,\gamma) = \frac{2(1-\tau)(9-5\tau)}{4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} > \frac{2(1-\tau)(9-5\tau)}{\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)} = w^*(\gamma,\delta)\,.$$

Given that indemnity insurance is applied in the destination country D, the relative copayment change in the source country S under coinsurance is given as:

$$\frac{c^*_{b,S}(\delta,\gamma)}{c_{b,S}(\gamma)} = \frac{4(9-5\tau)+\gamma_S(1-\tau)\left(27-4\tau+\tau^2\right)+2\gamma_S\delta_D(1-\tau)(9-\tau)}{\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)},$$

and under indemnity insurance as:

$$\frac{c^*_{b,S}(\delta,\delta)}{c_{b,S}(\delta)} = \frac{(1-\tau)\left(27-4\tau+\tau^2\right)+4(9-5\tau)(1-\delta_S)-\delta_S(1-\tau)(\tau+3)^2+2\delta_D(1-\tau)(9-\tau)}{(1-\delta_S)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}.$$

The difference between relative copayment changes then amounts to:

$$\frac{c^*_{b,S}(\delta,\gamma)}{c_{b,S}(\gamma)} - \frac{c^*_{b,S}(\delta,\delta)}{c_{b,S}(\delta)}$$
$$= \frac{2(1-\tau)((9-5\tau)+\delta_D(9-\tau))\left(-4(9-5\tau)(1-\gamma_S(1-\delta_S))-\gamma_S\delta_S\left((1-\tau)(\tau+3)^2\right)\right)}{(1-\delta_S)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}.$$

Assuming identical drug prices under segmented markets, the difference between relative copayment changes is negative:

$$\frac{c^*_{b,S}(\delta,\gamma)}{c_{b,S}(\gamma)} - \frac{c^*_{b,S}(\delta,\delta)}{c_{b,S}(\delta)}\,|_{\delta_S=\frac{1}{\gamma_S}-1}$$
$$= \frac{2\gamma_S(1-\tau)(1-\gamma_S)((9-5\tau)+\delta_D(9-\tau))\left(81-\tau^3-5\tau^2-43\tau\right)}{(1-2\gamma_S)\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)} < 0.$$

This is, copayments increase less under coinsurance.

The wholesale price is higher under coinsurance:

$$w^*(\delta,\gamma) = \frac{2(1-\tau)[(9-5\tau)+\delta_D(9-\tau)]}{4(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2} > \frac{2(1-\tau)[(9-5\tau)+\delta_D(9-\tau)]}{4(9-5\tau)+(1-\tau)(3+\tau)^2} = w^*(\delta,\delta).$$

In the source country, the relative change in public health expenditure under coinsurance is given as:

$$\frac{E_S^*(.,\gamma)}{E_S(\gamma)} = \frac{(1-\gamma_S)\,p_{b,S}^*(.,\gamma)\,q_{b,S}^*(.,\gamma)}{(1-\gamma_S)\,p_{b,S}(\gamma)\,q_{b,S}(\gamma)}.$$

Given that coinsurance is applied in the destination country D, the relative change in public health expenditure is:

$$\frac{E_S^*(\gamma,\gamma)}{E_S(\gamma)} = \frac{\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2 - 4\gamma_S^2(\tau-1)^2(5\tau-9)^2}{\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2} < 1,$$

given that indemnity insurance is applied in country D, the relative change in public health expenditure is:

$$\begin{aligned}\frac{E_S^*(\delta,\gamma)}{E_S(\gamma)} &= \frac{\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)^2 - 4\gamma_S^2(1-\tau)^2(9-5\tau)^2}{\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)^2} \\ &\quad - \frac{4\gamma_S^2\delta_D(9-\tau)(\tau-1)^2(2(9-5\tau)+\delta_D(9-\tau))}{\left(4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right)^2} < 1.\end{aligned}$$

For coinsurance in country D, the difference between relative health expenditure changes under coinsurance and indemnity insurance is given as:

$$\begin{aligned}&\frac{E_S^*(\gamma,\gamma)}{E_S(\gamma)} - \frac{E_S^*(\gamma,\delta)}{E_S(\delta)} \\ &= \frac{2\left(5\tau^2-14\tau+9\right)\left(16\gamma_D^2(5\tau-9)^2 - \gamma_S^2(\tau+3)^2(\tau-1)^2\left(2\delta_S(9-5\tau)+\left(9-16\tau-\tau^2\right)\right)\right)}{(\delta_S+1)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau)+(1-\tau)(3+\tau)^2\right)} \\ &\quad + \frac{2\left(5\tau^2-14\tau+9\right)\left(8\gamma_S\gamma_D(1-\tau)(9-5\tau)\left((\tau+3)^2-\gamma_S(9-5\tau)(\delta_S+1)\right)\right)}{(\delta_S+1)\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau)+(1-\tau)(3+\tau)^2\right)}\end{aligned}$$

Assuming identical drug prices as a standard of comparison, the difference between relative health expenditure changes is positive:

$$
\begin{aligned}
&\frac{E_S^*(\gamma,\gamma)}{E_D(\gamma)} - \frac{E_S^*(\gamma,\delta)}{E_D(\delta)} |_{\delta_S = \frac{1}{\gamma_S}-1} \\
= \quad &\frac{2\gamma_S\left(5\tau^2 - 14\tau + 9\right)\left(16\gamma_D^2(5\tau-9)^2 + 8\tau\gamma_S\gamma_D(1-\tau)(\tau+11)(9-5\tau)\right)}{\left(4\gamma_D(9-5\tau) + \gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau) + (1-\tau)(3+\tau)^2\right)} \\
&+ \frac{2\gamma_S\left(5\tau^2 - 14\tau + 9\right)\left(\gamma_S^2(\tau-1)^2(\tau+3)^4 - 2\gamma_S(9-5\tau)(\tau+3)^2(\tau-1)^2\right)}{\left(4\gamma_D(9-5\tau) + \gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau) + (1-\tau)(3+\tau)^2\right)} > 0.
\end{aligned}
$$

$$
\begin{aligned}
&\frac{E_S^*(\gamma,\gamma)}{E_D(\gamma)} - \frac{E_S^*(\gamma,\delta)}{E_D(\delta)} |_{\delta_S = \frac{1}{\gamma_S}-1} \\
= \quad &\frac{2\gamma_S\left(5\tau^2 - 14\tau + 9\right)\left(16\gamma_D^2(5\tau-9)^2 + 8\tau\gamma_S\gamma_D(1-\tau)(\tau+11)(9-5\tau)\right)}{\left(4\gamma_D(9-5\tau) + \gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau) + (1-\tau)(3+\tau)^2\right)} \\
&+ \frac{2\gamma_S\left(5\tau^2 - 14\tau + 9\right)\left(\gamma_S^2(\tau-1)^2(\tau+3)^4 - 2\gamma_S(9-5\tau)(\tau+3)^2(\tau-1)^2\right)}{\left(4\gamma_D(9-5\tau) + \gamma_S(1-\tau)(3+\tau)^2\right)^2\left(4\gamma_D(9-5\tau) + (1-\tau)(3+\tau)^2\right)},
\end{aligned}
$$

$$
\begin{aligned}
&16\gamma_D^2(5\tau-9)^2 - 2\gamma_S(9-5\tau)(\tau+3)^2(\tau-1)^2 + 8\tau\gamma_S\gamma_D(1-\tau)(\tau+11)(9-5\tau) \\
&\qquad + \gamma_S^2(\tau-1)^2(\tau+3)^4 > 0 \\
&\text{if } \gamma_D > \frac{1}{4}(1-\tau)\frac{\sqrt{\gamma_S(9-5\tau)^3\left(2(\tau+3)^2 - \gamma_S(17\tau+2\tau^2+9)\right)} - \tau\gamma_S(\tau+11)(9-5\tau)}{(5\tau-9)^2}.
\end{aligned}
$$

$$
\begin{aligned}
&16\gamma_D^2(5\tau-9)^2 - 2\gamma_S(9-5\tau)(\tau+3)^2(\tau-1)^2 + 8\tau\gamma_S\gamma_D(1-\tau)(\tau+11)(9-5\tau) \\
&\qquad + \gamma_S^2(\tau-1)^2(\tau+3)^4 < 0 \\
&\text{if } \gamma_D < \frac{1}{4}(1-\tau)\frac{\sqrt{\gamma_S(9-5\tau)^3\left(2(\tau+3)^2 - \gamma_S(17\tau+2\tau^2+9)\right)} - \tau\gamma_S(\tau+11)(9-5\tau)}{(5\tau-9)^2}.
\end{aligned}
$$

The positive copayment condition requires $\gamma_D > 0.5$. Combination with the condition above results in

$$\frac{1}{4}(1-\tau)\,\frac{\sqrt{\gamma_S(9-5\tau)^3\left(2(\tau+3)^2-\gamma_S\left(17\tau+2\tau^2+9\right)\right)}-\tau\gamma_S(\tau+11)(9-5\tau)}{(5\tau-9)^2}<0.5$$

$$\rightarrow\quad \gamma_D<\frac{1}{4}(1-\tau)\,\frac{\sqrt{\gamma_S(9-5\tau)^3\left(2(\tau+3)^2-\gamma_S\left(17\tau+2\tau^2+9\right)\right)}-\tau\gamma_S(\tau+11)(9-5\tau)}{(5\tau-9)^2},$$

which is not possible.

For indemnity insurance in country D, the difference between relative health expenditure changes under coinsurance and indemnity insurance amounts to:

$$\frac{E_S^*(\delta,\gamma)}{E_S(\gamma)}-\frac{E_S^*(\delta,\delta)}{E_S(\delta)}$$

$$=\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[16(9-5\tau)^2+8\gamma_S(1-\tau)(9-5\tau)(\tau+3)^2\right]}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right]^2}$$

$$-\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[2\gamma_S^2(1-\tau)\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)\left(\delta_S(9-5\tau)+\delta_D(\delta_S+1)(9-\tau\right.\right.}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right]^2}$$

$$-\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[\gamma_S^2(1-\tau)\left(729-891\tau+194\tau^2+74\tau^3+21\tau^4+\tau^5\right)\right]}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)+\gamma_S(1-\tau)(\tau+3)^2\right]^2}.$$

Under identical drug prices as standard of comparison, this is positive:

$$\frac{E_S^*(\delta,\gamma)}{E_S(\gamma)}-\frac{E_S^*(\delta,\delta)}{E_S(\delta)}\,\Big|_{\gamma_S=\frac{1}{\delta_S+1}}$$

$$=\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left(27+5\tau-15\tau^2-\tau^3\right)+16\delta_S^2(5\tau-9)^2\right]}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)(\delta_S+1)+(1-\tau)(3+\tau)^2\right]^2}$$

$$+\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[2\delta_S(\tau+3)(9-5\tau)\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)\right]}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)(\delta_S+1)+(1-\tau)(3+\tau)^2\right]^2}$$

$$-\frac{2(1-\tau)\left[(9-5\tau)+\delta_D(9-\tau)\right]\left[2\delta_D(1-\tau)(9-\tau)\left(4(9-5\tau)+(1-\tau)(3+\tau)^2\right)(\delta_S+1)\right]}{(\delta_S+1)\left[4(9-5\tau)+(1-\tau)(3+\tau)^2\right]\left[4(9-5\tau)(\delta_S+1)+(1-\tau)(3+\tau)^2\right]^2}>0$$

$$
\begin{aligned}
&\Big[\Big[4(9-5\tau)+(1-\tau)(3+\tau)^2\Big]\left(27+5\tau-15\tau^2-\tau^3\right)+16\delta_S^2(5\tau-9)^2\Big] \\
&+\Big[2\delta_S(\tau+3)(9-5\tau)\Big(4(9-5\tau)+(1-\tau)(3+\tau)^2\Big)\Big] \\
&-\Big[2\delta_D(1-\tau)(9-\tau)\Big(4(9-5\tau)+(1-\tau)(3+\tau)^2\Big)(\delta_S+1)\Big]<0, \\
\text{if } \delta_D \quad > \quad & \frac{1}{2}\frac{\Big[4(9-5\tau)+(1-\tau)(3+\tau)^2\Big]\left(27+5\tau-15\tau^2-\tau^3\right)+16\delta_S^2(5\tau-9)^2}{(1-\tau)(9-\tau)(\delta_S+1)\Big[4(9-5\tau)+(1-\tau)(3+\tau)^2\Big]} \\
&+\frac{1}{2}\frac{2\delta_S(\tau+3)(9-5\tau)\Big[4(9-5\tau)+(1-\tau)(3+\tau)^2\Big]}{(1-\tau)(9-\tau)(\delta_S+1)\Big[4(9-5\tau)+(1-\tau)(3+\tau)^2\Big]},
\end{aligned}
$$

violated is by positive copayment-condition even for $\delta_S = 0$.

D Identical Copayments as standard of comparison

To make coinsurance and indemnity insurance comparable, the main body of the paper assumes identical drug prices under segmented markets as standard of comparison. This implies a certain threshold of coinsurance rates.

Identical copayments under segmented markets may provide another standard of comparison, which does not assume a certain level of coinsurance rates, but is subject to another, probably more severe limitation.

Identical copayments under segmented markets correspond to identical quantities consumed. Assuming identical copayments is intended to give a notion of financial exposure of patients and access to pharmaceuticals. It includes the different insurance effect of both cost-sharing systems. This is illustrated by the comparison between insurance and no insurance under segmented markets, under coinsurance, the insurance effect entirely absorbed by manufacturer, under indemnity insurance, the insurance effect benefits both manufacturer and consumers. Identical copayments entail the reimbursement amount under indemnity insurance being zero:

$$
\gamma_D p_{b,D}(\gamma) = \gamma_D \frac{1}{2\gamma_D} = \frac{1+\delta_D}{2} - \delta_D = p_{b,D}(\delta) - \delta_D \Longleftrightarrow \delta_D = 0.
$$

Under coinsurance, the insurance effect is entirely absorbed by the manufacturer and for consumers, coinsurance has the same effect as no reimbursement (effective prices under coinsurance correspond to effective prices under no insurance). Assuming identical copayments then transfers this effect to indemnity insurance as well. But for coinsurance, the manufacturer is only able to absorb the insurance effect entirely under segmented markets. Under parallel trade, competition prevents it from doing so. Assuming identical copayments under segmented markets not only transfers this insurance-absorbance-effect to the indemnity insurance scheme under segmented markets, but also to the indemnity insurance scheme under parallel trade, corresponding to assuming no reimbursement under indemnity insurance for both cases and thus comparing coinsurance with no insurance. This results in copayments decreasing always more under coinsurance, as coinsurance provides reimbursement, whereas indemnity insurance under this standard of comparison does not.

E Absolute Copayments

Comparing relative copayments under coinsurance and indemnity insurance, I assume identical drug prices for both cost-sharing systems under segmented markets.

In the destination country, absolute copayments for the locally sourced version and the parallel import are higher under coinsurance, independent of the cost-sharing system in the source country:

$$\begin{aligned} & c_{b,D}^{*}\left(\gamma,\gamma\right)-c_{b,D}^{*}\left(\delta,\gamma\right)|_{\delta_D=\frac{1}{\gamma_D}-1} \\ = \;& 3\left(1-\gamma_D\right)\frac{8\gamma_D\left(9-5\tau\right)\left(3-\tau\right)+2\gamma_S\gamma_D\left(1-\tau\right)\left(9-5\tau\right)\left(\tau+3\right)\left(\tau+1\right)}{\gamma_D\left(4\gamma_D\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\right)} \\ & +3\left(1-\gamma_D\right)\frac{\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\left(2\left(3-\tau\right)+\gamma_S\left(\tau+3\right)\left(1-\tau\right)\right)}{\gamma_D\left(4\gamma_D\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\right)} \end{aligned}$$

$$\begin{aligned} & c_{b,D}^{*}\left(\gamma,\delta\right)-c_{b,D}^{*}\left(\delta,\delta\right)|_{\delta_D=\frac{1}{\gamma_D}-1} \\ = \;& 3\left(1-\gamma_D\right)\frac{\left(1-\tau\right)\left(9-4\tau-\tau^2\right)\left(\tau+3\right)^2+2\gamma_D\left(9-5\tau\right)\left(-\tau^3-3\tau^2-3\tau+15\right)}{\gamma_D\left(4\left(9-5\tau\right)+\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\gamma_D\left(9-5\tau\right)+\left(1-\tau\right)\left(\tau+3\right)^2\right)} \end{aligned}$$

$$\begin{aligned} & c_{\beta,D}^{*}\left(\gamma,\gamma\right)-c_{\beta,D}^{*}\left(\delta,\gamma\right)|_{\delta_D=\frac{1}{\gamma_D}-1} \\ = \;& \left(3-\tau\right)\left(1-\gamma_D\right)\frac{8\gamma_D\left(9-5\tau\right)\left(3-\tau\right)+2\gamma_S\gamma_D\left(1-\tau\right)\left(9-5\tau\right)\left(\tau+3\right)\left(\tau+1\right)}{\gamma_D\left(4\gamma_D\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\right)} \\ & +\left(3-\tau\right)\left(1-\gamma_D\right)\frac{\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\left(2\left(3-\tau\right)+\gamma_S\left(\tau+3\right)\left(1-\tau\right)\right)}{\gamma_D\left(4\gamma_D\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\left(9-5\tau\right)+\gamma_S\left(1-\tau\right)\left(\tau+3\right)^2\right)} \end{aligned}$$

$$c_{\beta,D}^{*}\left(\gamma,\delta\right)-c_{\beta,D}^{*}\left(\delta,\delta\right)=\left(3-\tau\right)\left(1-\gamma_D\right)\frac{\left(1-\tau\right)\left(9-4\tau-\tau^2\right)\left(\tau+3\right)^2+2\gamma_D\left(9-5\tau\right)\left(-\tau^3-3\tau^2-3\tau+15\right)}{\gamma_D\left(4\left(9-5\tau\right)+\left(1-\tau\right)\left(3+\tau\right)^2\right)\left(4\gamma_D\left(9-5\tau\right)+\left(1-\tau\right)\left(\tau+3\right)^2\right)}$$

In the source country, absolute copayments are higher under coinsurance, independent of the cost-sharing system in the destination country:

$$c^*_{b,S}(\gamma,\gamma) - c^*_{b,S}(\gamma,\delta)\,|_{\delta_S=\frac{1}{\gamma_S}-1}$$

$$= (1-\gamma_S)\frac{4\gamma_D(9-5\tau)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)-4\gamma_S\gamma_D(1-\tau)(9-5\tau)\left(9-16\tau-\tau^2\right)}{2\gamma_S\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$$

$$+(1-\gamma_S)\frac{\gamma_S(1-\tau)^2(\tau+3)^4}{2\gamma_S\left(4\gamma_D(9-5\tau)+\gamma_S(1-\tau)(3+\tau)^2\right)\left(4\gamma_D(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$$

$$c^*_{b,S}(\delta,\gamma) - c^*_{b,S}(\delta,\delta)\,|_{\gamma_S=\frac{1}{\delta_S+1}}$$

$$= \delta_S\frac{1377-702\tau-841\tau^2+340\tau^3+71\tau^4+10\tau^5+\tau^6+4\delta_S(9-5\tau)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}{2\left(4(9-5\tau)(1+\delta_S)+(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$$

$$-\delta_S\frac{8\delta_D(1-\tau)(9-\tau)(9-5\tau)}{2\left(4(9-5\tau)(1+\delta_S)+(1-\tau)(\tau+3)^2\right)\left(4(9-5\tau)+(1-\tau)(\tau+3)^2\right)}$$

F Total Changes

Comparing total changes in expenditure – both private expenditure (sum of all copayments) and public expenditure (reimbursed part) – under coinsurance and indemnity insurance, I assume identical drug prices for both cost-sharing systems under segmented markets.

F.1 Destination country

Given that coinsurance is applied in the source country, the total change in expenditure under coinsurance are given as:

$$\frac{c^*_{b,D}(\gamma,\gamma)\,q^*_{b,D}(\gamma,\gamma)+c^*_{\beta,D}(\gamma,\gamma)\,q^*_{\beta,D}(\gamma,\gamma)}{c_{b,D}(\gamma)\,q_{b,D}(\gamma)}+\frac{E_D(\gamma,\gamma)}{E_D(\gamma)}<1.$$

The total change in expenditure under indemnity insurance are given as:

$$\frac{c^*_{b,S}(\delta,\gamma)\,q^*_{b,D}(\delta,\gamma)+c^*_{\beta,D}(\delta,\gamma)\,q^*_{\beta,D}(\delta,\gamma)}{c_{b,D}(\delta)\,q_{b,D}(\delta,)}+\frac{E_D(\delta,\gamma)}{E_D(\delta)}<1.$$

Under both cost-sharing system, the change in expenditure in negative, i.e. savings are generated.

Figure 2 illustrates the comparison of total changes in expenditure under coinsurance and indemnity for $\tau = 0.5$. The abscissa shows the value for γ_D, the ordinate the value for γ_S. In the white area, the change in total expenditure is higher under coinsurance, in the (darker) gray area it is higher under indemnity insurance. In the light gray area total changes are very similar under coinsurance and indemnity insurance. Identical drug prices under segmented markets as standard of comparison imply coinsurance rates of $\gamma_D > 0.5$, see Appendix C.1. For $0.5 < \gamma_D \lesssim 0.6$, the total change in expenditure is higher under indemnity insurance, for $\gamma_D \gtrsim 0.75$ the total change in expenditure is higher under coinsurance.

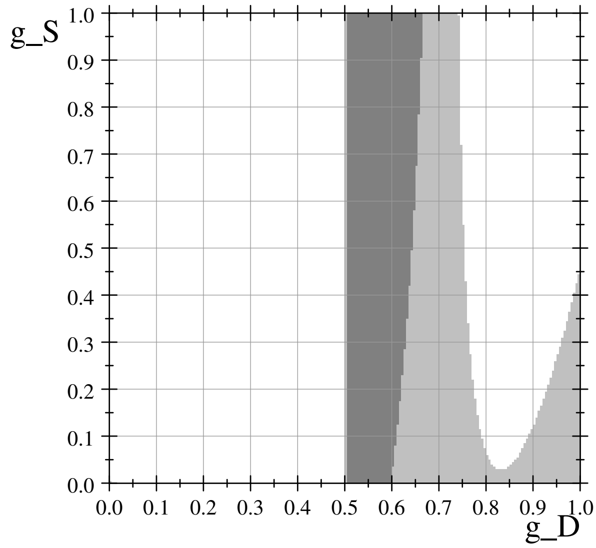

Figure 2: Coinsurance vs. indemnity in D, coinsurance in S, $\tau = 0.5$

The comparison of total changes in expenditure under coinsurance and indemnity for other degrees of τ is similar.

Given that indemnity insurance is applied in the source country, the total change in expenditure under coinsurance are given as:

$$\frac{c^*_{b,D}(\gamma,\delta)\, q^*_{b,D}(\gamma,\delta) + c^*_{\beta,D}(\gamma,\delta)\, q^*_{\beta,D}(\gamma,\delta)}{c_{b,D}(\gamma)\, q_{b,D}(\gamma)} + \frac{E_D(\gamma,\delta)}{E_D(\gamma)}.$$

The total change in expenditure under indemnity insurance are given as:

$$\frac{c^*_{b,S}(\delta,\delta)\, q^*_{b,D}(\delta,\delta) + c^*_{\beta,D}(\delta,\delta)\, q^*_{\beta,D}(\delta,\delta)}{c_{b,D}(\delta)\, q_{b,D}(\delta)} + \frac{E_D(\delta,\delta)}{E_D(\delta)}.$$

Under both cost-sharing system, the change in expenditure in negative, i.e. savings are generated.

Figure 3 illustrates the comparison of total changes in expenditure under coinsurance and indemnity for $\tau = 0.5$. The abscissa shows the value for γ_D, the ordinate the value for γ_S. In the white area, the change in total expenditure is higher under coinsurance, in the (darker) gray area it is higher under indemnity insurance. In the light gray area total changes are very similar under coinsurance and indemnity insurance. Identical drug prices under segmented markets as standard of comparison imply coinsurance rates of $\gamma_D > 0.6$, see Appendix C.1. For $0.6 < \gamma_D \lesssim 0.65$, the total change in expenditure is higher under indemnity insurance, for $\gamma_D \gtrsim 0.7$ the total change in expenditure is higher under coinsurance.

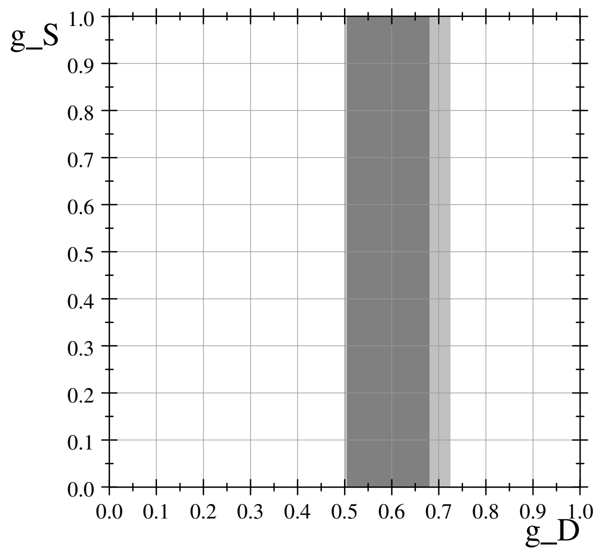

Figure 3: Coinsurance vs. indemnity insurance in D, indemnity insurance in S, $\tau = 0.5$

The comparison of total changes in expenditure under coinsurance and indemnity for other degrees of τ is similar.

F. 2 Source Country

Given that coinsurance is applied in the destination country, the total change in expenditure under coinsurance are given as:

$$\frac{c^*_{b,S}(\gamma,\gamma)\, q^*_{b,S}(\gamma,\gamma)}{c_{b,S}(\gamma)\, q_{b,S}(\gamma)} + \frac{E_S(\gamma,\gamma)}{E_S(\gamma)}.$$

The total change in expenditure under indemnity insurance are given as:

$$\frac{c^*_{b,S}(\gamma,\delta)\, q^*_{b,S}(\gamma,\delta)}{c_{b,S}(\gamma)\, q_{b,S}(\gamma)} + \frac{E_S(\gamma,\delta)}{E_S(\gamma)}.$$

Under both cost-sharing system, the change in expenditure in negative, i.e. savings are generated.

Figure 4 illustrates the comparison of total changes in expenditure under coinsurance and indemnity for $\tau = 0.5$. The abscissa shows the value for γ_D, the ordinate the value for γ_S. In the white area, the change in total expenditure is higher under coinsurance, in the (darker) gray area it is higher under indemnity insurance. In the light gray area total changes are very similar under coinsurance and indemnity insurance. Identical drug prices under segmented markets as standard of comparison imply coinsurance rates of $\gamma_S > 0.5$, see Appendix C.2. For $0.5 < \gamma_S \lesssim 0.75$ and

$\gamma_D > 0.5$, the total change in expenditure is higher under coinsurance, for $\gamma_S \gtrsim 0.75$ and $\gamma_D > 0.5$, the total change in expenditure is higher under indemnity insurance.

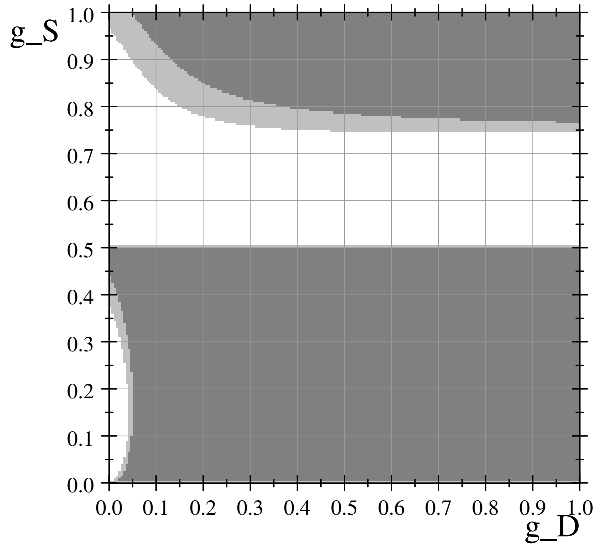

Figure 4: Coinsurance vs. indemnity in S, coinsurance in D, $\tau = 0.5$

The comparison of total changes in expenditure under coinsurance and indemnity for other degrees of τ is similar.

Given that indemnity insurance is applied in the destination country, the total change in expenditure under coinsurance are given as:

$$\frac{c^*_{b,S}(\delta,\gamma)\, q^*_{b,S}(\delta,\gamma)}{c_{b,S}(\gamma)\, q_{b,S}(\gamma)} + \frac{E_S(\delta,\gamma)}{E_S(\gamma)}.$$

The total change in expenditure under indemnity insurance are given as:

$$\frac{c^*_{b,S}(\delta,\delta)\, q^*_{b,S}(\delta,\delta)}{c_{b,S}(\gamma)\, q_{b,S}(\gamma)} + \frac{E_S(\delta,\delta)}{E_S(\gamma)}.$$

Under both cost-sharing system, the change in expenditure in negative, i.e. savings are generated.

Figure 5 illustrates the comparison of total changes in expenditure under coinsurance and indemnity for $\tau = 0.5$. The abscissa shows the value for δ_D, the ordinate the value for δ_S. In the white area, the change in total expenditure is higher under coinsurance, in the (darker) gray area it is higher under indemnity insurance. In the light gray area total changes are very similar under coinsurance and indemnity insurance. Due to the positive copayment condition under indemnity insurance the reimbursement amounted is restricted to $\delta_D < 0.65$ and $\delta_S < 1.6$,, see Appendix C.2. For $1.6 > \delta_S \gtrsim 1$ and $\delta_S \lesssim 1$, the total change in expenditure is higher under coinsurance, for $\gamma_S \gtrsim 0.75$ and $\gamma_D > 0.5$, the total change in expenditure is higher under indemnity insurance.

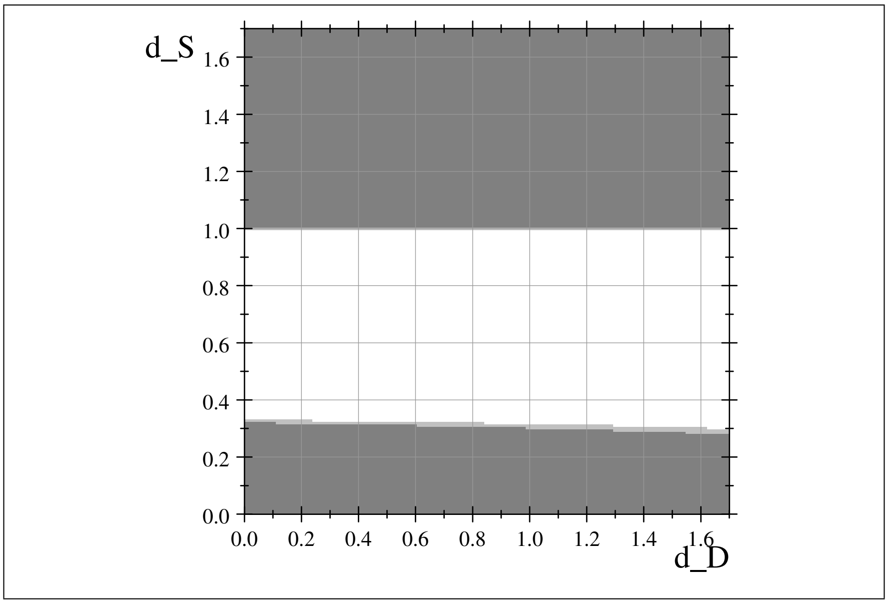

Figure 5: Coinsurance vs. indemnity in S, indemnity insurance in D, $\tau = 0.5$

The comparison of total changes in expenditure under coinsurance and indemnity for other degrees of τ is similar.