Equilibrium parallel import policies and international market structure[*]

Santanu Roy[†]
Southern Methodist University, Dallas, TX.

Kamal Saggi[‡]
Vanderbilt University, Nashville, TN.

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Abstract

This paper derives equilibrium government policies towards parallel imports in a North-South model where the Northern firm produces high quality and the Southern firm produces low quality. Given policies, each firm decides whether or not to serve the other country's market. If Northern consumers have sufficiently higher preference for high quality, the Northern government forbids parallel imports and international price discrimination obtains: when the threat of *indirect competition* from arbitrage-induced parallel imports is absent, firms choose to *directly compete* in both markets. If demand structures are relatively similar across countries, the North permits parallel imports and uniform pricing obtains.

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[†]Corresponding Author. Address: Department of Economics, Southern Methodist University, 3300 Dyer Street, Dallas, TX 75275-0496, USA. E-mail: sroy@smu.edu; Tel: (+1) 214 768 2714.

[‡]Address: Department of Economics, Vanderbilt University, Box 1819-Station B, Nashville, TN 37235-1819, USA. E-mail: k.saggi@Vanderbilt.Edu; phone: (+1) 615-322-3237.

1 Introduction

Parallel trade is said to occur when a product protected by some form of intellectual property rights (IPRs) offered for sale by the rights holder in one country is re-sold in another country without the right holder's consent. As is clear, the incentive to engage in such trade naturally arises in the presence of significant international price differences, which in turn often reflect the underlying market power of sellers (Scherer and Watal, 2002). It is noteworthy that current multilateral rules of the World Trade Organization (WTO) are essentially silent on the issue of parallel trade, leaving member countries free to determine the legality of such trade in their respective markets. Indeed, the lack of multilateral consensus on the desirability of parallel trade is reflected in the diversity of parallel trade policies pursued by WTO member countries. While national laws pertaining to parallel trade are complex and multi-faceted, the following characterization broadly captures the global policy spectrum for the case of pharmaceuticals: while the two largest markets in the world – i.e. United States and the European Union (EU) – forbid parallel imports from most other countries, developing countries tend to vary widely in their restraints on such imports (Maskus, 2000).[1]

Such international variation in parallel import policies raises several interesting questions. What role does heterogeneity in demand structure across countries play in determining equilibrium parallel import policies? How does a country's preferred policy depend upon that of its trading partners? What policies do governments implement when firms respond to their policies by choosing whether or not to offer their products for sale in foreign markets? What kind of international externalities, if any, are created by the implementation of parallel import policies based purely on national interest? We address these questions in a North-South model in which countries differ with respect to their domestic demand structure as well as the quality of goods produced by their respective firms. In particular, the Northern firm's product is of high quality and the Southern firm's product is of low quality. Further, market size as well as the relative preference for high quality over low quality (the quality premium consumers are willing to pay) is higher in the North than in the South. We believe that these asymmetries

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[1]Maskus (2000) describes the policy variation among developing countries as follows: "...some nations disallow PI because their patent laws provide a strict right of importation to authorized licensees; these laws are common in countries with British or French colonial legacies. Moreover, several developing nations have laws permitting only one national distributor for products imported under trademark, effectively banning parallel imports... India follows a regime of international exhaustion in trademarked and patented goods. A number of developing countries including Argentina, Thailand, and South Africa, recently have enacted laws permitting parallel imports of pharmaceutical products."

capture some of the stylized facts about differences between Northern and Southern markets. Furthermore, we argue that without properly accounting for such asymmetries, it is difficult to explain the observed variation in parallel import policies across countries.

The timing of decisions in our model is as follows. First, welfare-maximizing governments simultaneously decide whether or not to permit parallel imports. Next, each firm chooses whether or not to offer its product for sale in the foreign market. Finally, given policies and market structure, firms compete in prices and international trade and consumption occur.

By incorporating strategic interaction at the policy-setting stage as well as in the product market, the model sheds new light on the interdependence of national parallel import policies and on the nature of international spillovers generated by them. Indeed, our analysis contributes to, and to some extent unifies, two strands of the literature on parallel imports: one that studies interaction between firms taking government policies as given and another that analyzes the impact of alternative government policies but abstracts from strategic interaction between firms. In the latter tradition, the seminal paper is by Malueg and Schwartz (1994) who show that the possibility of parallel imports can induce a monopolist to not serve markets with higher elasticities of demand and thereby lower world welfare.[2] The central question addressed by Malueg and Schwartz is a normative one: should firms be allowed to establish exclusive sales territories internationally? Our analysis asks related questions that, in some senses, complement the normative inquiry of Malueg and Schwartz (1994). In our view, it is important to also identify the incentives that individual governments have to allow or restrict parallel imports strictly from a national welfare perspective.

One of the few papers that analyzes the choice of parallel import policies in a multi-country setting is Richardson (2002). However, our analysis differs from his along several important dimensions. First, in our model each firm decides whether or not to sell its product in the foreign market, while Richardson (2002) considers a scenario where all countries import a common good from a foreign monopolist who necessarily sells in all markets. Second, by incorporating oligopolistic competition, our model captures strategic considerations absent from his analysis. Third, because each country is an importer as well as an exporter in our model, government policies must consider both consumer and producer interests, as opposed to only consumer interests. Indeed, firm profitability turns out to be an important determinant

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[2]Valletti and Szymanski (2006) build on Malueg and Schwartz (1994) by endogenising product quality and show that a policy regime of international exhaustion (under which parallel trade is permitted) yields lower welfare relative to national exhaustion (under which it is prohibited).

of parallel import policies in our model.

A commonly advanced argument against parallel trade is that it reduces innovation incentives by undermining the ability of IPR holders to profit from their investments in research and development (R&D) - see, for instance, Li and Maskus (2006).[3] In a North-South model of endogenous innovation, Grossman and Lai (2008) analyze strategic policy choice when the South determines its *price control policy* in response to the parallel import policy of the North and show that the incentives for product innovation in the North (as well as its aggregate welfare) can be higher when the North permits parallel imports relative to when it does not. In this paper, we focus on the use of parallel import policy to strategically influence the rents and consumer welfare outcomes resulting from oligopolistic competition between domestic and foreign firms (and the decisions of firms on whether or not to access foreign markets). Therefore, we abstract from issues related to innovation and R&D. Further, price controls are not applicable to a variety of consumer goods – such as books, software, and video games – for which the issue of parallel imports is relevant; therefore, our paper focuses squarely on the interaction between parallel imports policies of the two regions. Nonetheless, some of the international policy externalities identified in Grossman and Lai (2008) also appear in our analysis; in particular, Northern openness to parallel import may induce the Northern firm to eschew the Southern market in order to avoid indirect competition, and this, in turn, can hurt the South.

The existing literature on parallel imports has explored the some of the implications of policies that induce uniform pricing and international price discrimination.[4] In addition to these pricing outcomes, asymmetric market structures of the type where one of the firms refrains from selling in the foreign market play a crucial role in our analysis. To develop some intuition about such market structures, suppose the North permits parallel imports while the South does not. Under such a policy configuration, if the relative preference for high quality in the North is not too high compared to that in the South, the low quality (Southern) firm charges its optimal monopoly price locally while both firms charge their optimal discriminatory

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[3]However, Valletti (2006) shows that parallel trade can actually encourage cost reducing R&D when differential pricing is cost based.

[4]The literature on economic integration contains analysis of outcomes of international oligopoly with integrated and segmented markets where integration or segmentation is exogenous, and integration eliminates price differences across countries. See, among others, Smith and Venables (1988) and Venables (1990). Markusen and Venables (1988) examine optimal trade and industrial policy in this context. Note that in our paper, national policies *endogenously* determine the extent and manner in which markets are segmented or integrated.

prices in the larger Northern market. Such a market structure can be sustained because firms have asymmetric incentives: the lure of the Northern market is stronger than that of the smaller Southern market. Furthermore, we show that such an asymmetric market structure can arise not only when only one country permits parallel imports but also when *both* countries permit them.

However, if the relative preference for high quality in the North is sufficiently higher than in the South, the low quality firm's optimal monopoly price in the South is lower than its optimal discriminatory price for the Northern market. Under such a scenario, the North's openness to parallel imports induces the low quality firm to set a common international price that actually *exceeds* its optimal monopoly price for the Southern market: i.e. it tolerates a sub-optimally high price in the Southern market to charge a more attractive price in the Northern market. The resulting softening of price competition in the Northern market, in turn, makes forsaking the Southern market even more attractive for the Northern firm, especially considering the fact that the local demand for its high quality product is relatively large.

Discussions regarding parallel import policies have been especially charged in the context of pharmaceuticals and perhaps for good reason. In this regard, it is worth noting that Goldberg (2009) has argued that the practice of "global reference pricing" on the part of some rich countries and the possibility of parallel imports can induce pharmaceutical multinationals to not serve low income countries and/or raise their prices (even above their optimal monopoly prices) in such markets – outcomes that emerge quite sharply in our model.[5]

Our policy analysis yields several novel insights. Perhaps most interestingly, we find that when the relative preference for high quality in the North is sufficiently higher than that in the South, the Northern government chooses to forbid parallel imports. This result accords quite well with the type of parallel import policies we observe in the world: recall that the two largest markets in the world – the EU and the USA – prohibit parallel imports from most of the rest of the world. The intuition for this result is as follows. If markets are sufficiently asymmetric in demand for high quality and the North forbids parallel imports, the two national markets become perfectly segmented and firms are free to price discriminate internationally. Thus, by inducing international market segmentation and shielding firms from the *indirect* competition of arbitrage-induced parallel imports, the Northern prohibition on parallel imports ensures

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[5] For empirical evidence on how pricing regulations affect the extent and the timing of drug launches in world markets by pharmaceutical multinationals, see Danzon and Epstein (2008), Danzon et. al. (2005), and Lanjouw (2005).

that firms opt for *direct* competition with each other in both markets.

This policy result is noteworthy for several reasons. First, it is surprising since North's welfare under uniform pricing is strictly higher than that under price discrimination. So why doesn't the North simply permit parallel imports? As was noted earlier, if the North permits parallel imports and markets are sufficiently different in preference for high quality, uniform pricing does not emerge as an equilibrium market structure. Rather, under such circumstances the high quality firm abstains from serving the less lucrative Southern market in order to charge a higher price in the Northern market, an outcome that is detrimental for Northern consumers and overall Northern welfare. To avoid such an outcome, the North is better off prohibiting parallel imports – in other words, while international price discrimination is not as desirable to the North as uniform pricing, it is preferable to asymmetric market structures under which it's firm abstains from selling in the South. The second noteworthy aspect of this result is that by yielding international price discrimination, a unilateral prohibition on parallel imports by the North generates a substantial *positive spillover* for the South: not only do Southern consumers enjoy low prices under discrimination, the low quality firm also benefits from being able to charge a higher price in the Northern market. Third, the result contrasts sharply with what would be obtained in a monopoly model of third degree price discrimination; in such a model, with sufficient demand asymmetry, the North (where the discriminatory price is higher) would like to allow parallel import (to secure uniform pricing), while the South would be better off if parallel trade is prevented. Our analysis indicates that allowing for competition may reverse the incentives; the North may want to allow parallel imports to induce tougher competition in its own market and, at the same time, induce its domestic firm to seek foreign rent.

Finally, we show that when markets are relatively similar in size and preference for high quality, the North permits parallel imports and uniform pricing obtains. Thus, only when firms are reluctant to opt out of the Southern market can the North implement a policy that yields its most preferred market outcome. Furthermore, when demand does not differ across countries, national parallel import policies have no discernible effect on firm behavior under all policy combinations: both products are sold internationally at prices that are independent of the underlying global policy regime. This result demonstrates the importance of demand heterogeneity across countries in understanding equilibrium government policies toward parallel imports. It also suggests that similarity of taste for quality can help explain why the US

allows parallel import of pharmaceuticals from Canada[6], or why countries in the EU allow parallel trade among member countries.

2   Model

We consider a vertically differentiated industry in a world comprised of two countries: North (N) and South (S). The industry produces good x that comes in two quality levels where s_h denotes the high quality and s_l the low quality ($s_h > s_l = 1$). Assume that the Northern firm produces the high quality and the Southern firm the low quality and that the cost of production for both qualities equals zero. Each consumer buys at most one unit of good x. If a consumer in country i buys quality j at price p_{ji}, its utility is given by

$$U_i = \theta s_j - p_{ji} \text{ where } j = h, l \tag{1}$$

Utility under no purchase is normalized to zero and $\theta \geq 0$ is a taste parameter that captures the willingness to pay for higher quality. All consumers prefer high quality for a given price but those with a higher θ are willing to pay more for both qualities and, in addition, value high quality relatively more.

The high quality product produced by the Northern firm as well as the low quality product produced by the Southern firm are both protected by some form of intellectual property rights such as patents or trade-marks. In particular, it is perfectly legal for the Southern firm to sell its low quality product in both countries; the low quality product is not *per se* a counterfeit or illegal version of the high quality product. One can think of the two products as belonging to different generations - an existing drug and a more effective drug that is recently introduced after new scientific advances (with non-overlapping patent protection between the products); alternatively, one can think of the quality difference as reflecting country bias or perceived differences in regulatory conditions (such as monitoring of product safety), technology and input quality between the North and the South. The role of parallel import policy of each country is to determine whether or not the property right enjoyed by a firm over its product is exhausted after it is sold abroad which, in turn, determines whether or not the firm can legally prevent parallel import of units (of its own product) that it sells abroad. Note that in our framework, if parallel imports are permitted, consumers do not differentiate between units

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[6]See, for instance, Pecorino (2002).

of the product sold directly by the manufacturing firm and those sold by an importer.[7]

To capture demand asymmetry between the North and the South, we will assume that market size is larger in the North than in the South; in particular, we set the total mass of consumers in the South equal to 1 and let $\mu \geq 1$ denote the total mass of consumers in the North. Further, we assume that the preference parameter θ is uniformly distributed over the interval $[0, \mu_i]$ in country $i = N, S$ where

$$\mu_N = \mu \geq \mu_S = 1.$$

Thus, not only is the market demand for both qualities higher in the North, but in fact Northern consumers exhibit higher *relative* preference for high quality over low quality in the sense that the distribution of θ, the marginal willingness to pay for better quality, in the population of consumers in the North dominates that in the South (in a first order stochastic sense). In other words, the proportion and the number of consumers willing to pay any given level of quality premium in the North is higher than in the South. The Northern market is more lucrative than the South for both products and relatively more so for the high quality product. Furthermore, when both products are offered for sale, demand for high quality is less price elastic in the Northern market than in the South i.e., price competition is softer. Observe that this formulation allows us to capture asymmetry in size as well as the distribution of preferences by a single parameter μ. In what follows, we refer to μ as the extent of demand asymmetry between the two markets.[8]

Under autarky (i.e. the complete absence of international trade), the local firm in country i acts as a monopolist. In the North, consumers in the range $[\theta_h, \mu]$ buy the (local) high quality good where $\theta_h = \frac{p_h}{s_h}$ and the demand curve facing the high quality firm is given by $x_j(p_j) = \mu - \frac{p_h}{s_h}$. The Northern firm chooses p_h to maximize its profit:

$$\max_{p_h} p_h x_h(p_h) = p_h(\mu - \frac{p_h}{s_h})$$

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[7]This kind of differentiation may be important when the product comes with warranties and other services that are only provided by the manufacturer or it's authorized dealers. See, for instance, Ahmadi and Yang (2000).

[8]It should be mentioned here that the assumption that the support of θ in each market has zero as lower bound ensures that if both firms set prices without bothering about the effect of their pricing on their profit in other markets, then both sell in equilibrium. In other words, if firms choose not to serve a market in our model it is not because of the "natural monopoly" effect that can arise in models of price competition in vertically differentiated duopoly (see, Shaked and Sutton, 1983).

which gives the autarkic equilibrium price in the North as

$$p_h^M = \frac{\mu s_h}{2} \tag{2}$$

Similarly, in the South, we have $p_l^M = \frac{1}{2}$.

Under autarky, consumer surplus in the North equals

$$cs_i = \int_{\theta_h}^{\mu} (s_h \theta - p_h^M) d\theta = \left[s_h \frac{\theta^2}{2} - p_h^M \theta \right]_{\theta_h}^{\mu} = (\mu - \theta_h) \left[\frac{s_h(\mu + \theta_h)}{2} - p_h^M \right]$$

Replacing s_h by s_l and setting $\mu = 1$ in the above formula gives the consumer surplus in the South. Country i's autarkic welfare is defined as the sum of consumer surplus and the local firm's profit. In the autarkic equilibrium, we have $\theta_h|_{p_h=p_h^M} = \frac{\mu s_h}{2 s_h} = \frac{\mu}{2}$ so that only half the market is covered in each country. Denote the autarkic market structure by $\{N(h^M), S(l^M)\}$ or simply $\{A\}$.

When trade is possible, the interaction between firms and governments occurs as follows. In the first stage, governments simultaneously choose their parallel import policies. Since each country may either permit parallel imports (P) or not (N), there exist four possible global policy regimes: (P,P), (P,N), (N,P), and (N,N), where the policy choice of the North is listed first. Given national parallel import policies, each firm decides whether or not to offer its product for sale in the foreign market. Our implicit assumption is that each firm has the option of offering its product for sale abroad via a retail sector that is assumed to be perfectly competitive in each country.[9] Firms' decisions regarding the authorization of sales territories determine global market structure. In the final stage, given market structure and government policies, firms compete in prices and consumption (and trade) occur.

Before proceeding with the analysis of this model, we briefly comment on some of our modeling choices. For simplicity, like the existing literature on parallel imports, we assume that authorizing products for sale in foreign markets does not impose any additional costs on firms. An important advantage of this approach is that it allows us to highlight the interaction between parallel import policies, pricing behavior, and the strategic incentives firms have for selling or not selling in each other's markets even when such sales do not involve additional

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[9]Thus, firms do not have to share rents with retailers and the vertical pricing issues that are central to the analysis of Maskus and Chen (2002) and Maskus and Chen (2004) do not arise in our model. In a related context, Raff and Schmitt (2007) have shown that when competitive retailers order inventories before observing market demand, a manufacturer can actually benefit from parallel trade.

costs relative to domestic sales. In any case, as we note later, the qualitative nature of our results continues to hold even when firms face additional costs for accessing foreign markets so long as these costs are small relative to product market profits.

In our model, each firm decides whether or not to allow the sale of its product in the foreign market *prior* to setting prices. An important implication of this formulation is that if firm i decides not to serve the market in country $j \neq i$, then in the next stage, firm i's pricing strategy in no way affects the demand for firm j's product in country j and there is no price competition between firms in country j. An alternative specification would be one where both products are always offered for sale in both markets and each firm simply chooses a pair of prices – one for each market. Under such a formulation, firm i can effectively eliminate sales in country j by charging a price that is sufficiently higher than the price charged by firm j. While equilibrium policy outcomes under this alternative approach are likely to be similar to ours, the price competition stage is more tractable under our formulation. The two approaches differ at the price competition stage because in the alternative specification an outcome where firm i finds it profitable to abandon the market in country j – for instance, when parallel import policies prevent price discrimination and the market in country j is too small or the degree of market competition is too severe or both – could be consistent with a continuum of pricing equilibria where firm i's foreign price (at which it sells zero in country j) still affects the demand for firm j's product and places a ceiling on the market power of firm j. Furthermore, these equilibria will differ with respect to the price at which consumers buy in country j and therefore in terms of the welfare that they generate. By allowing firms to abandon foreign markets prior to price competition, our approach simplifies the price competition stage and avoids this kind of indeterminacy.

Under trade, if both qualities are available for purchase at prices p_{hi} and p_{li}, country i's consumers can be partitioned into three groups on the basis of two threshold parameters θ_{li} and θ_{hi}: those in the range $[0, \theta_{li})$ buy neither high nor low quality; those in $[\theta_{li}, \theta_{hi})$ buy low quality; and those in $[\theta_{hi}, \mu_i]$ buy high quality where

$$\theta_{li} = \frac{p_{li}}{s_l} \text{ and } \theta_{hi} = \frac{p_{hi} - p_{li}}{\Delta s} \tag{3}$$

where $\Delta s \equiv s_h - s_l > 0$. Using these threshold parameters, demand functions in country i for

the two qualities are as follows:

$$x_{ji}(p_{li}, p_{hi}) = \begin{cases} \theta_{hi} - \theta_{li} = \dfrac{p_{hi} - p_{li}}{\Delta s} - \dfrac{p_{li}}{s_l} & \text{if } j = l \\ \mu_i - \theta_{hi} = \mu_i - \dfrac{p_{hi} - p_{li}}{\Delta s} & \text{if } j = h \end{cases} \tag{4}$$

The demand functions in (4) can be used to calculate consumer surplus in country i over the two qualities:

$$cs_i(p_{li}, p_{hi}) = \sum_j cs_{ji}(p_{li}, p_{hi}) = \int_{\theta_{li}}^{\theta_{hi}} (s_l \theta - p_{li}) d\theta + \int_{\theta_{hi}}^{\mu_i} (s_h \theta - p_{hi}) d\theta \tag{5}$$

which simplifies to

$$cs_{li}(p_{li}, p_{hi}) = (\theta_{hi} - \theta_{li}) \left[\frac{s_l(\theta_{hi} + \theta_{li})}{2} - p_{li} \right] \text{ and } cs_{hi} = (\mu_i - \theta_{hi}) \left[\frac{s_h(\mu_i + \theta_{hi})}{2} - p_{hi} \right] \tag{6}$$

In what follows, let

$$r \equiv \frac{s_h}{s_l} \geq 1$$

denote the quality gap between goods and normalize $s_l = 1$.

3 Two polar market structures

An important point to note is that even when both firms serve both markets, their pricing behavior depends upon the parallel import policies adopted by governments. In this regard, it is useful to distinguish between two market structures that have been frequently analyzed in the international trade literature: (a) *Price discrimination (or segmented markets)* $\{N(h,l), S(h,l)\}^D$ or simply $\{D\}$: each firm serves both markets at discriminatory prices and (b) *uniform pricing (or integrated markets)* $\{N(h,l), S(h,l)\}$ or simply $\{U\}$ under which each firm serves both markets at a uniform price.

Under international price discrimination $\{D\}$, in country i the low quality firm chooses p_{li} to solve

$$\underset{p_{li}}{Max}\ \pi_{li}(p_{li}, p_{hi}) = p_{li} x_{li}(p_{li}, p_{hi}) = p_{li} \left(\frac{p_{hi} - p_{li}}{\Delta s} - \frac{p_{li}}{s_l} \right) \tag{7}$$

whereas the high quality firm choose p_{hi} to solve

$$\underset{p_{hi}}{Max}\ \pi_{hi}(p_{li}, p_{hi}) = p_{hi} x_{hi}(p_{li}, p_{hi}) = p_{hi} \left(\mu_i - \frac{p_{hi} - p_{li}}{\Delta s} \right) \tag{8}$$

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The reaction functions in market i under price discrimination are given by

$$p_{li} = \frac{p_{hi}}{2r} \text{ and } p_{hi} = \frac{\mu_i(r-1)}{2} + \frac{p_{li}}{2}$$

Under uniform pricing $\{U\}$, the low quality firm chooses p_l to solve

$$\underset{p_l}{Max} \sum_i \pi_{li}(p_l, p_h) = 2p_l x_l(p_l, p_h) = 2p_l \left(\frac{p_h - p_l}{\Delta s} - \frac{p_l}{s_l} \right) \tag{9}$$

whereas the high quality firm chooses p_h to solve:

$$\underset{p_h}{Max} \sum_i \pi_{hi}(p_l, p_h) = \sum_i p_h x_{hi}(p_l, p_h) = \sum_i p_h \left(\mu_i - \frac{p_h - p_l}{\Delta s} \right) \tag{10}$$

The reaction functions under uniform pricing are as follows

$$p_l = \frac{p_h}{2r} \text{ and } p_h = \frac{(\mu+1)(r-1)}{4} + \frac{p_l}{2}$$

The reaction functions for the low quality firm are the same under discrimination and uniform pricing (i.e. $R_l(D)$ is the same as $R_l(U)$) because the demand asymmetry parameter μ directly affects demand for only the high quality good and it does not appear in the low quality firm's first order condition for profit maximization. In other words, an increase in μ leads to an increase the low quality firm's price only because the high quality firm finds it optimal to raise its price due to an expansion in the set of Northern consumers that value quality relatively more. A comparison of the solutions to the pricing problems under the two market structures yields:

Lemma 1: *Under price discrimination, each firm charges a higher price in the North: $p_{jN}(D) > p_{jS}(D)$. Furthermore, each firm's price under uniform pricing is the average of its optimal discriminatory prices in the two markets: $p_j(U) = \sum_i p_{ji}(D)/2$.*

Lemma 1 highlights an important aspect of price discrimination and uniform pricing from the viewpoint of consumer welfare. While prices are strictly lower in the North under uniform pricing relative to price discrimination, the opposite is true in the South. As we will show later, this clash between consumer welfare in the two countries over these market structures plays an important role in determining the welfare implications of different policy regimes.

Figure 1a below illustrates price competition under uniform pricing and discrimination in the South. While the reaction function for the low quality firm is the same under both scenarios

$(R_l(D) = R_l(U))$, the reaction function for the high quality firm under uniform pricing $R_h(U)$ lies strictly above its reaction function under discrimination $R_h(D)$. As a result, the uniform pricing equilibrium (point U in figure 1 a) in the South yields strictly higher prices than that under price discrimination (point D in figure 1a). Of course, in the North, exactly the opposite situation applies.

– Figure 1a here –

In our model, when both products are offered for sale in markets and firms are constrained to charge uniform prices, if the relative preference for high quality is extremely high in the North i.e., there is too much of asymmetry in demand for high quality between the markets, then the equilibrium outcome could be one where the high quality price is too high for the good to be sold in the South. To ensure that positive quantities are sold in both markets under uniform pricing, the following parameter restriction is assumed to hold through-out the paper:

Assumption 1: $\mu < \overline{\mu} \equiv \frac{6r-1}{2r-1}$.

Having discussed prices and firm profits under these familiar market structures, we next consider how parallel import policies of individual countries influence equilibrium market structure and outcome. Since parallel imports are induced by the possibility of arbitrage between national markets, it is useful to begin with the case where parallel imports are permitted by the North but not by the South.

4   If only the North permits parallel imports

To derive equilibrium market structures under the mixed policy regime (P,N), first suppose that the high quality firm chooses to not serve the Southern market while the low quality firm serves both markets. Under such a scenario, the low quality firm's pricing behavior depends upon the extent of disparity in demand for high quality between the two countries. While the North's openness toward parallel imports undoes any attempt on its part to charge a lower price in the South, it is free to charge a *higher* price there since parallel imports are forbidden by it. Furthermore, such pricing can indeed arise when the low quality firm enjoys monopoly status in the South. To see this, suppose that the low quality firm charges its optimal

monopoly price $p_l^M = 1/2$ in the South and the two firms charge their optimal discriminatory prices $p_{lN}(D)$ and $p_{hN}(D)$ in the North. Given that only the North permits parallel imports, such a configuration of prices can be sustained iff

$$p_{lS}^M \geq p_{lN}(D) \Leftrightarrow \frac{1}{2} \geq \frac{\mu(r-1)}{4r-1} \Leftrightarrow \mu \leq \mu_l^M \equiv \frac{4r-1}{2(r-1)} \tag{11}$$

In other words, if $\mu \leq \mu_l^M$ the two markets in effect become perfectly segmented and despite the North's openness to parallel imports, the low quality firm is free to act as an *unconstrained monopolist* in the South.[10] Note also that, under such a scenario, the market equilibrium in the North *coincides* with international price discrimination. We refer to this asymmetric market structure by $\{N(h, l)^D, S(l^M)\}$ or simply $\{\Lambda^M\}$, where the superscript M indicates monopoly pricing by the low quality firm in the South and the superscript D indicates optimal discriminatory pricing by both firms in the North.

As is clear from the preceding discussion, when $\mu > \mu_l^M$ the low quality firm must charge a common international price if it chooses to sell in both markets under (P,N). Denote this common price by p_l^Λ and the associated market structure by $\{N(h, l), S(l)\}$ or simply $\{\Lambda\}$. We next derive prices under this market structure.

Under the asymmetric market structure $\{\Lambda\}$, the low quality firm chooses its common international price to solve

$$\underset{p_l}{Max} \; p_l \left(\frac{p_h - p_l}{\Delta s} - \frac{p_l}{s_l} \right) + p_l \left(1 - \frac{p_l}{s_l} \right) \tag{13}$$

where the first term denotes its profits in the North and the second in the South, where it is the sole seller.

The high quality firm serves only the North and solves

$$\underset{p_h}{Max} \; p_h \left(\mu - \frac{p_h - p_l}{\Delta s} \right) \tag{14}$$

The first order conditions for these problems yield the following reaction functions under $\{\Lambda\}$:

$$p_l = \frac{r-1}{2(2r-1)} + \frac{p_h}{2(2r-1)} \; \text{and} \; p_h = \frac{\mu(r-1) + p_l}{2}$$

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[10] Note that

$$\frac{d\mu_l^m}{dr} = -\frac{3}{2(r-1)^2} < 0 \tag{12}$$

i.e. as product becomes more differentiated in quality, the critical value of μ required for the low quality firm to be able to charge its unconstrained monopoly price in the Southern market declines.

Solving these reaction functions for equilibrium prices $p_j(\Lambda)$ under $\{\Lambda\}$ allows us to state:

Lemma 2: *Suppose the North permits parallel imports while the South does not and the high quality firm chooses to not serve the Southern market. Then, the following hold:*

(a) If $\mu \leq \mu_l^M$, the asymmetric market structure $\{\Lambda^M\}$ obtains under which firm j charges its optimal discriminatory price $p_{jN}(D)$ in the North whereas in the South the low quality firm charges its optimal monopoly price $p_l^M = 1/2$ where $p_l(U) < p_{lN}(D) < p_l^M$.

(b) If $\mu > \mu_l^M$, the asymmetric market structure $\{\Lambda\}$ obtains under which firm j's price $p_j(\Lambda)$ lies in between its prices under $\{U\}$ and $\{D\}$: $p_j^U(U) < p_j(\Lambda) < p_{jN}(D)$. Furthermore, the low quality firm's common international price $p_l(\Lambda)$ exceeds its optimal monopoly price: $p_l^M < p_l(\Lambda)$.

The fact that prices are higher under the asymmetric market structure $\{\Lambda\}$ relative to uniform pricing is rather intuitive. Under uniform pricing, both firms directly compete for the entire world market whereas under $\{\Lambda\}$, the high quality firm abstains from serving the South and the reduction in competition in the South increases prices in *both* markets relative to $\{U\}$. However, it is quite noteworthy that when $\mu > \mu_l^M$ we have $p_l^M < p_l(\Lambda) < p_{jN}(D)$ – i.e. the common price charged by the low quality firm under $\{\Lambda\}$ actually *exceeds* its optimal monopoly price for the South while it falls short of its optimal discriminatory price for the North. The inequality $p_l^M < p_l(\Lambda)$ obtains because the North's openness to parallel imports induces the low quality firm to raise its price above its optimal monopoly price in the South in order to sustain a more attractive price in the North. In other words, the low quality firm tolerates a reduction in profits in the South in order to get closer to its preferred Northern price $p_{jN}(D)$.[11]

As Figure 1b drawn in the (p_l, p_h) space illustrates, whenever the optimal monopoly price in the South $p_l^M = 1/2$ cannot be sustained by the low quality firm (which happens when $\mu > \mu_l^M$) its reaction function $R_l(\Lambda)$ under $\{\Lambda\}$ lies strictly above its reaction function $R_l(D)$ under $\{D\}$ – i.e. when $\mu > \mu_l^M$, relative to price discrimination, the low quality is relatively *more* aggressive in price competition. This is because $p_l(\Lambda) > p_l^M$ and the low quality firm is quite eager to reduce its price in response to a price cut by its rival. As a result, the equilibrium pair of prices under $\{\Lambda\}$ are lower relative to $\{D\}$ whereas they are higher relative to $\{U\}$.

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[11]It is worth noting here that under $\{\Lambda^M\}$ the low quality firm can be better off charging the common price $p_l(\Lambda)$ even when it can sustain its optimal monopoly price p_l^M in the South. However, since it cannot commit to charging a common price in both markets, if it is free to price discriminate internationally, as it is under the policy regime (P,N) when $\mu \leq \mu_l^M$, it will always do so in equilibrium.

– Figure 1b here –

Having described pricing behavior under the three market structures that are candidates for equilibria under (P,N) – i.e. $\{U\}$, $\{\Lambda\}$, and $\{\Lambda^M\}$ – we are now in a position to consider firm incentives that determine equilibrium outcomes under (P,N). As we shall see below, both types of heterogeneity captured by the model – the degree of product differentiation (r) and the relative heterogeneity of demand across countries (μ) – play a crucial role in determining market equilibria.

Let $\pi_i(M)$ denote firm i's equilibrium profit under the market structure M and define

$$\Delta\pi_l(\Lambda) \equiv \left\{ \begin{array}{l} \pi_l(\Lambda^M) - \pi_l(A) \text{ for } \mu \leq \mu_l^M \\ \pi_l(\Lambda) - \pi_l(A) \text{ for } \mu > \mu_l^M \end{array} \right\}$$

as the *low quality firm's unilateral incentive* to serve the North – i.e. $\Delta\pi_l(\Lambda)$ is the incremental profit earned by the low quality firm from serving the North given that the high quality firm does not serve the Southern market.

Our first result is as follows:

Proposition 1: *If the North permits parallel imports whereas the South does not, the autarkic market structure cannot arise in equilibrium since the low quality firm's unilateral incentive to serve the Northern market is strictly positive: i.e. $\Delta\pi_l(\Lambda) > 0$ for all feasible μ and r.*

To see why this is true, suppose the policy regime is (P,N) and $\mu \leq \mu_l^M$. From Lemma 2, it follows that when $\mu \leq \mu_l^M$ the low quality firm necessarily serves the North: $\Delta\pi_l(\Lambda) = \pi_{lN}(D) > 0$. To see why, simply note that serving the North confers an incremental profit of $\pi_{lN}(D)$ on the low quality firm while protecting its monopoly profit in the South – even though $p_l^M \geq p_{lS}(D)$, parallel imports cannot flow to the South due to its policy stance. When the Northern demand is only moderately higher than its own market – i.e. $\mu \leq \mu_l^M$ – the low quality firm is able to sustain its optimal monopoly price in the South when local policy prevents parallel imports from flowing in.

Now suppose $\mu > \mu_l^M$. Under this scenario, the pricing behavior described in part (b) of Lemma 2 applies and the low quality firm's unilateral incentive is given by $\Delta\pi_l(\Lambda)$ and we argue in the appendix that

$$\Delta\pi_l(\Lambda) > 0 \text{ for all } \mu > \mu_l^M$$

The above inequality is quite intuitive: when Northern demand is relatively large ($\mu > \mu_l^M$), preserving its monopoly status in the South is not particularly attractive to the low quality firm. Indeed, as noted earlier, for $\mu > \mu_l^M$ the low quality firm is willing to charge a price above its optimal monopoly price in the South so as to serve the North at a more desirable price. Therefore, the autarkic market structure fails to be an equilibrium when the North permits parallel imports.

Consider next the high quality firm's unilateral incentive to serve the South under (P,N). Given that the low quality firm does not serve the North and the North permits parallel imports, the high quality firm can charge its optimal monopoly price in the North while competing with the low quality firm in the South iff

$$p_h^M \leq p_{hS}(D) \Leftrightarrow \frac{\mu r}{2} \leq \frac{2r(r-1)}{4r-1} \Leftrightarrow \mu \leq \mu_h^M \equiv \frac{4(r-1)}{4r-1}$$

i.e. μ_h^M is the critical threshold below which the high quality firm's optimal monopoly price in the North lies below its optimal discriminatory price in the smaller one. *Observe, however, that $\mu_h^M < 1$ for all $r > 1$* and since $\mu \geq 1$, it follows that it is impossible for the high quality to sustain its optimal monopoly price in the North when its government permits parallel imports and firms compete only in the South. Thus, under (P,N), the high quality firm necessarily charges a common international price under the asymmetric market structure $\{N(h), S(h,l)\}$ or simply $\{H\}$. Next, we derive the equilibrium prices under this market structure.

Under the asymmetric market structure $\{H\}$, the high quality firm chooses its common international price to solve

$$\underset{p_h}{Max} \; p_h \left(1 - \frac{p_h - p_l}{\Delta s}\right) + p_h \left(\mu - \frac{p_h}{s_h}\right)$$

whereas the low quality firm solves the same problem (in the South) as it does under international price discrimination:

$$\underset{p_l}{Max} \; p_l \left(\frac{p_h - p_l}{\Delta s} - \frac{p_l}{s_l}\right)$$

Firm reaction functions under $\{H\}$ are given by

$$p_l = \frac{p_h}{2r} \text{ and } p_h = \frac{r}{2r-1}\left[\frac{(\mu+1)(r-1)}{2} + \frac{p_l}{2}\right]$$

These reaction functions can be solved for equilibrium prices $p_j(H)$ and it is easy to show that these prices prices exceed those under uniform pricing: the high quality firm's desire to

stay close to its optimal monopoly price in the North makes it less willing to lower its price in the South where it competes with the low quality firm. Since the low quality firm's reaction function is the same under $\{H\}$ and $\{U\}$, less aggressive price competition on the part of the high quality firm in the South also implies a higher price for the low quality under $\{H\}$ relative to under $\{U\}$.

Let the *high quality firm's unilateral incentive* to serve the South be defined by

$$\Delta \pi_h(H) \equiv \pi_h(H) - \pi_h(A)$$

The following result is intuitive:

Lemma 3: *When the North permits parallel imports and the South does not, the high quality firm's unilateral incentive for serving the South $\Delta \pi_h(H)$ decreases in μ. Furthermore, $\Delta \pi_h(H) \geq 0$ iff $\mu \leq \mu_h^H(r)$ where $\frac{d\mu_h^H(r)}{dr} > 0$.*

To derive equilibrium market structures, we next consider each firm's best response when the rival firm chooses to serve both markets. Suppose that the high quality firm chooses to serve the South. If the low quality firm opts to serve the North in response, uniform pricing obtains due to the North's openness to parallel imports. If it does not, the market structure $\{H\}$ obtains under which the high quality is sold in both markets at the common international price $p_h(H)$. Given this, the *low quality firm's reciprocal incentive* for serving the North when it must charge a common price in both markets (due to the North's openness to parallel imports) is defined by

$$\Delta \pi_l(U) \equiv \pi_l(U) - \pi_l(H)$$

It is straightforward to show that $\Delta \pi_l(U) \geq 0$ iff $r \geq r^* = 1 + \frac{3\sqrt{2}}{8}$.[12]

In what follows, we assume that the degree of product differentiation is not so low that the low quality firm has no reciprocal incentive to serve the Northern market when it permits parallel imports. In other words, we assume the following:

Assumption 2: Let $r \geq r^* \iff \Delta \pi_l(U) \geq 0$.

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[12] Note that the demand disparity between countries does not determine whether or not the low quality firm has a reciprocal incentive to serve the North. Intuitively, when the high quality firm serves both markets under (P,N), prices in each market depend upon μ even if the low quality firm does not serve the North. As a result, μ does not determine whether or not $\Delta \pi_l(U) > 0$ even though $\Delta \pi_l(U)$ is strictly increasing in μ over the range over which it is positive.

This assumption has two important implications. First, it ensures that there exists a unique equilibrium market structure for all feasible parameter values and policy combinations. Second, it implies that the market structure $\{H\}$ cannot be an equilibrium.

Consider now the high quality firm's best response to the low quality firm serving the Northern market. Given that the low quality is sold in both markets, if the high quality firm chooses to serve both markets then uniform pricing obtains under (P,N). On the other hand, if the high quality firm decides to not serve the Southern market the resulting market structure depends upon the degree of North-South size asymmetry: when $\mu \leq \mu_l^M$ we obtain $\{\Lambda^M\}$ whereas for $\mu > \mu_l^M$, we get $\{\Lambda\}$. Given this, the *high quality firm's reciprocal incentive* is defined as follows:

$$\Delta\pi_h(U) \equiv \begin{cases} \pi_h(U) - \pi_{hN}(D) \text{ for } \mu \leq \mu_l^M \\ \pi_h(U) - \pi_h(\Lambda) \text{ for } \mu > \mu_l^M \end{cases}$$

It is straightforward to show that for $\mu \leq \mu_l^M$

$$\Delta\pi_h(U) \geq 0 \Leftrightarrow \mu \leq \mu^* \equiv 1 + \sqrt{2}$$

whereas for $\mu > \mu_l^M$ we have

$$\Delta\pi_h(U) \geq 0 \Leftrightarrow \mu \leq \mu_h^U(r)$$

where $\mu_h^U(r) \leq \mu^*$ iff $\mu \leq \mu_l^M$; $\lim_{r\to\infty} \mu_h^U(r) = \mu^*$; and $\mu_h^H(r) < \mu_h^U(r)$. The fact that the high quality firm's reciprocal incentive is positive only when the Northern demand for high quality is not too large relative to the South is quite intuitive: when the North permits parallel imports, the larger the Northern demand for high quality relative to the South, the more constrained is the high quality firm's pricing behavior in the North.

Using the two types of incentive functions (unilateral and reciprocal), we can derive the following result:

Proposition 2: *If the North permits parallel imports and the South does not, the equilibrium market structure is as follows:*

(i) uniform pricing obtains over the range $\mu \leq \max\{\mu_h^U(r), \mu^*\}$;

(ii) the asymmetric market structure $\{\Lambda^M\}$ obtains over $\max\{\mu_h^U(r), \mu^*\} < \mu \leq \mu_l^M(r)$; while

(iii) the asymmetric market structure $\{\Lambda\}$ obtains when $\mu > \max\{\mu_l^M(r), \mu_h^U(r)\}$.

Figure 2 illustrates Proposition 2 in the (r, μ) space.

The downward sloping curve μ_l^M defines the boundary below which the low quality firm is able to charge its optimal monopoly price p_l^M in the South so that the market structure $\{\Lambda^M\}$ is relevant whereas above μ_l^M, the low quality firm charges the price $p_l(\Lambda)$ in both markets and the asymmetric market structure $\{\Lambda\}$ is relevant.

The horizontal line plots $\mu = \mu^*$: below this curve the high quality firm has a reciprocal incentive to serve the South when the low quality firm is able to sustain its optimal monopoly price (i.e. it plots $\Delta\pi_h(U) \geq 0$ for $\mu \leq \mu_l^M$). Above μ^*, the high quality firm lacks such an incentive and prefers the asymmetric market structure $\{\Lambda^M\}$ to uniform pricing $\{U\}$. The outer upward sloping curve μ_h^U in Figure 2 plots the locust of $\Delta\pi_h(U) = 0$ below which the high quality firm has a reciprocal incentive to serve the South when the low quality firm charges the common international price $p_l(\Lambda)$ under $\{\Lambda\}$ (i.e. for $\mu > \mu_l^M$). Below the lower upward sloping curve μ_h^H, the high quality firm has a unilateral incentive to serve the South given that $\mu \leq \mu_l^M$.

In Figure 2, when the demand asymmetry between the two countries exceeds the outer boundary defined by $\mu_h^U(r)$ and μ^*, the high quality firm prefers to *not* serve the South given that the low quality firm serves both markets. Above this outer boundary, when $\mu > \mu_l^M$ (i.e. above the downward sloping curve in Figure 2) the equilibrium market structure is $\{\Lambda\}$ whereas below μ_l^M it is $\{\Lambda^M\}$. It is worth emphasizing that the decision to not serve the South on the part of the high quality firm reflects considerations that come into play solely due to the North's policy of permitting parallel imports since, by assumption, selling abroad imposes no additional costs on firms.[13]

On the other hand, below the outer boundary defined by $\mu_h^U(r)$ and μ^*, markets are fairly similar in demand structure and the equilibrium market structure is uniform pricing. Intuitively, when demand disparity is small, firms find it attractive to serve both markets and the Northern openness to parallel imports leads to uniform pricing.

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[13]If firms incurred a fixed cost for selling abroad, each of incentive functions plotted in Figures 2, 3, and 4 would shift so as to reduce the parameter space over which the two types of incentives are positive. For example, in Figure 2 both $\mu_h^H(r)$ and $\mu_h^U(r)$ would shift downwards. While such shifts in these curves would alter the parameter space over which each of the market structures is an equilibrium, it would not change the range of outcomes described in Figure 2 provided the costs of selling abroad are not so large so as to eliminate the incentive to do so under some (or all) of the policy regimes.

5 If both countries permit

To describe equilibrium market structures when both countries permit parallel imports, we first make a preliminary observation: under (P,P) regardless of the degree of market asymmetry, if a firm serves both markets it must do so at a common international price. More specifically, this implies that market structures $\{\Lambda^M\}$ and $\{D\}$ need not be considered as candidates for equilibria.

Next, we argue that Proposition 1 does *not* hold under (P,P): i.e., when both countries permit parallel imports, the low quality firm does *not* necessarily have a unilateral incentive to serve the North. Intuitively, when products are not highly differentiated, the decision to serve the North is not attractive to the low quality firm because price competition in the North is fierce. And since the low quality firm must charge a common price in both markets under (P,P), stringent competition in the North also undermines its profit in the Southern market.[14] Under (P,P), direct calculations show that

$$\Delta\pi_l(\Lambda) \geq 0 \Leftrightarrow \mu \geq \mu_l^\Lambda(r)$$

Uniform pricing is an equilibrium under (P,P) iff each firm has a reciprocal incentive to serve the foreign market: i.e. $\Delta\pi_j(U) \geq 0$ for $j = h, l$. Using the incentive functions $\Delta\pi_j(U)$ along with $\Delta\pi_h(H)$ and $\Delta\pi_l(\Lambda)$ allows us to fully describe equilibrium market structures under (P,P). We have:

Proposition 3: *Suppose both countries permit parallel imports. Then, uniform pricing $\{U\}$ obtains for $\mu \leq \mu_h^U$ and the asymmetric market structure $\{\Lambda\}$ otherwise.*[15]

Figure 3 illustrates equilibrium market structures under (P,P). Consider first the low quality firm's incentives. Above the downward sloping curve $\Delta\pi_l(\Lambda) = 0$ or $(\mu = \mu_l^\Lambda)$ the low quality firm has a unilateral incentive to serve the foreign market. The negative slope of the curve is intuitive: as the intensity of product market competition decreases (i.e. r increases),

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[14] By contrast, under (P,N) the low quality firm's profit in the Southern market is relatively better protected due to the Southern prohibition on parallel imports and it therefore necessarily has a unilateral incentive to serve the North. Recall that when $\mu \leq \mu_l^M$, the low quality firm actually earns monopoly profit in its market under (P,N) if the high quality firm chooses to not sell its good there.

[15] For completeness, we should note that there is a tiny area over which both autarky and uniform pricing are equilibria. This area is defined by $\mu_h^H \leq \mu \leq \mu_l^\Lambda$. In this area, each firm has a reciprocal incentive to serve the foreign market but no unilateral incentive to do so. For the remainder of the paper, we will take uniform pricing to be the equilibrium over this tiny region.

the critical level of Northern demand required to induce the low quality firm to sell in the North declines.

The high quality firm's unilateral incentive to serve the Southern market $\Delta\pi_h(H)$ as well as its reciprocal incentive $\Delta\pi_h(U)$ both decrease with μ.[16] This is because the larger the demand disparity between countries, the more important it is for the firm to charge a higher price in the North. Indeed, in so far as the unilateral incentive is concerned, the high quality firm is evaluating whether or not to preserve its optimal monopoly price in the North under autarky relative to serving both markets at $p_h(H)$ where $p_h(H) < p_h^M$.

Figure 3 illustrates Proposition 3.

– Figure 3 here –

It is useful to compare Figures 2 and 3. The first point to note is that when $\mu > \mu_l^M$, the equilibrium outcome under both (P,P) and (P,N) is $\{\Lambda\}$. When the low quality firm cannot sustain its optimal monopoly price in the South under (P,N), the North's permissive policy towards parallel imports is the main determinant of market structure: the high quality firm chooses not to serve the South in order to stay close to its preferred price for the Northern market.

Second, when $\max\{\mu_h^U, \mu^*\} < \mu \le \mu_l^M$, while $\{\Lambda\}$ obtains when both countries permit parallel imports, $\{\Lambda^M\}$ obtains when only the North does so. Recall that under $\{\Lambda^M\}$ prices in the North equal p_{jN}^D while in the South the low quality firm charges its optimal monopoly price $p_l^M = 1/2$. Under $\{\Lambda\}$, prices equal $p_j(\Lambda)$ where $p_j(\Lambda) > p_l^M$ and $p_{jN}(D) > p_j(\Lambda)$. Thus, over the range $\mu^* < \mu \le \mu_l^M$, prices are lower in the North when only it permits parallel imports whereas prices are lower in the South when both countries do so.

Third, while rough intuition suggests that uniform pricing should be more likely to obtain when both countries permit parallel imports relative to when only one of them does, a comparison of Figures 2 and 3 show that this is *not* necessarily the case. More specifically, note from these figures that when $\mu_h^U(r) < \mu \le \mu^*$, the market structure $\{\Lambda\}$ obtains when both countries permit parallel imports whereas uniform pricing obtains when only the North permits them. Over this parameter region, the high quality firm's preference between alternative markets structures is as follows: $\{\Lambda\} \succ \{U\} \succ \{\Lambda^M\}$. When the North restricts parallel imports, the

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[16]Assumption 2 guarantees that the low quality firm has a reciprocal incentive to serve the North under (P,P).

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high quality firm ends up serving both markets since it prefers uniform pricing $\{U\}$ to the market structure $\{\Lambda^M\}$. However, when both countries permit parallel imports $\{\Lambda^M\}$ is not a feasible market structure since any firm serving both markets must do so at a common price. Thus, under (P,P) the high quality firm refrains from serving the South in order to induce $\{\Lambda\}$ as the market structure as opposed to uniform pricing. It is noteworthy that it is the low quality firm's inability to price discriminate internationally under (P,P) relative to the regime (P,N) that makes the high quality firm opt for the market structure $\{\Lambda\}$ over uniform pricing.

6   If North forbids

To derive equilibrium market structures under (N,P), we first argue that the autarkic market structure cannot be an equilibrium when the North prohibits parallel imports since *the high quality firm has a unilateral incentive to serve the South.* To see why, suppose the low quality firm does not serve the North. Then, the high quality firm charges its optimal monopoly price in the North so long as the South's permissive policy towards parallel imports does not prevent it from doing so. In this regard, recall that μ_h^M is the critical threshold above which the high quality firm's optimal monopoly price in the North exceeds its optimal discriminatory price in the South and that $\mu_h^M \leq 1$ for all $r \geq 1$. But since $\mu \geq 1 \geq \mu_h^M$, it follows that the high quality can *always* sustain its optimal monopoly price in the North when the Northern government forbids parallel imports and firms compete (only) in the South. This implies that beginning at the autarkic market structure, under (N,P) the high quality firm will necessarily choose to serve the South. Doing so brings an incremental gain of $\pi_{hS}(D)$ while protecting its monopoly profit in the North: parallel imports are prohibited by the North and no parallel imports occur to the South since the price of the high quality good is lower there $(p_h^M \geq p_{hS}(D))$.

We next argue that *the low quality firm necessarily has a reciprocal incentive to serve the North when it forbids parallel imports.* To see this simply note that by deviating from $\{H\}$ to $\{D\}$ the low quality firm secures an incremental gain of $\pi_{lN}(D)$ without having any detrimental affect on its monopoly profit in the South. This implies that the market structure $\{H\}$ cannot be an equilibrium under (N,P).

Next observe that when the North forbids parallel imports, the Northern policy makes it possible for the high quality firm to price discriminate internationally. This observation rules out uniform pricing as an equilibrium market structure. Thus, there remain only three candidates for equilibrium under (N,P): $\{\Lambda\}$, $\{\Lambda^M\}$, and $\{D\}$.

As before, the choice between two of three remaining candidates for equilibrium market structures – $\{\Lambda\}$ and $\{\Lambda^M\}$ – is determined by the the degree of demand asymmetry. When the South is open to parallel imports and the North is not, the low quality firm can charge its optimal monopoly price in the South only when that price is lower than its discriminatory price in the North: i.e. $p_{lS}^M \leq p_{lN}(D) \Leftrightarrow \mu \geq \mu_l^M$. Thus, over $\mu \geq \mu_l^M$, the equilibrium market structure has to be either $\{\Lambda^M\}$ or $\{D\}$. However, $\{\Lambda^M\}$ fails to be an equilibrium because the high quality firm necessarily has a reciprocal incentive to serve the South when $\mu \geq \mu_l^M$: by serving the South it secures an incremental gain of $\pi_{hS}(D)$ in the South without lowering its profit $\pi_{hN}(D)$ in the North. Thus, we have shown that when $\mu \geq \mu_l^M$, both firms have a reciprocal incentive to serve the foreign market and international price discrimination is the equilibrium market structure.

Now consider the case $\mu < \mu_l^M$. Consider $\{\Lambda\}$ as a candidate for equilibrium over this parameter range. Starting at $\{\Lambda\}$ if the high quality firm chooses to serve the South, the market structure is altered to $\{D\}$ whereas if the low quality firm chooses to withdraw from the North we revert back to autarky $\{A\}$. This implies that $\{\Lambda\}$ is an equilibrium iff (i) $\Delta\pi_h(D) \equiv \pi_h(D) - \pi_h(\Lambda) < 0 \Leftrightarrow \mu > \mu_h^D(r)$ and (ii) $\Delta\pi_l(\Lambda) \equiv \pi_l(\Lambda) - \pi_l(A) > 0 \Leftrightarrow \mu > \mu_l^\Lambda(r)$. It is easy to show that the curve μ_h^D lies strictly to the left of r^* so that Assumption 2 rules out the parameter range $\mu_l^\Lambda \leq \mu < \mu_h^D$. In other words, since $r > r^*$ it must be that $\Delta\pi_h(D) > 0$.

Thus, we have argued that both types of incentives – unilateral as well as reciprocal – are positive for both firms under the policy pair (N,P). This necessarily implies that international price discrimination is the unique equilibrium market structure under (N,P).

Finally, it is transparent that if the policy pair is (N,N) and parallel imports cannot flow in either direction, it is a dominant strategy for each firm to serve the foreign market. Furthermore, absent the threat of parallel imports, firms will charge their optimal discriminatory prices in each market.

We have:

Proposition 4: *If the North forbids parallel imports, the Southern policy is inconsequential and international price discrimination obtains as the equilibrium outcome.*

It is worth noting that Proposition 4 does not imply that both firms are better off under international price discrimination relative to autarky. In fact, it is easy to see that both can

be worse off relative to autarky when the degree of product differentiation (r) is relatively low: under such circumstances severe price competition lowers their respective profits below autarkic levels. This is shown in figure 4 which plots the zero-profit contours for $\Delta \pi_j(D) \equiv \pi_j(D) - \pi_j(A)$. The downward sloping contour is that of the low quality firm while the upward sloping one is for the high quality firm.

– Figure 4 here –

Figure 4 can be divided into four regions. In region δ, the degree of demand asymmetry (μ) is moderate and products are highly differentiated (r is large) and both firms are better off relative to autarky: each firm gets access to another market that is comparable in demand to its local market where such access is accompanied by price competition that is relatively weak. By contrast, in region α, the severity of price competition under international price discrimination tips the balance in favor of autarky for both firms. In region β, only the high quality firm is better off under international price discrimination while in region γ only the low quality firm is better off. The intuition is as follows. In region γ, the North-South demand asymmetry is large and the low quality firm benefits substantially from being able to sell its good in the North whereas the high quality firm has to share its large domestic market with a competitor and therefore loses relative to autarky. Finally, in region β, demand asymmetry is small and product differentiation is moderately large: under such a scenario, sharing its local market in return for access to the comparably sized Southern market is not as costly for the high quality firm since its competitor is at a substantial quality disadvantage. For analogous reasons, in region β the low quality firm is better off under autarky relative to international price discrimination.

7   Equilibrium government policies

We are now ready to derive equilibrium policies. Each country's objective is to maximize its welfare. Country i's welfare under market structure $\{M\}$ is given by

$$w_i(M) = \sum_j cs_{ji}(M) + \pi_{di}(M) + \pi_{ei}(M) \tag{15}$$

where $M = A$, D, H, Λ, Λ^M or U. In the above welfare function, $\pi_{di}(M)$ denotes profit of country i's firm in its domestic market whereas $\pi_{ei}(M)$ denotes its export profit.

Our first welfare result reports a comparison of the different market structures from the viewpoint of each country:

Proposition 5: *Each country's welfare ranking of the various market structures that can arise in equilibrium is as follows:*
(i) For the North: $w_N(U) > w_N(D) > w_N(\Lambda) > w_N(\Lambda^M)$ whereas
(ii) for the South: $w_S(D) > w_S(U) > \max\{w_S(\Lambda), w_S(\Lambda^M)\}$.

Note in particular that the welfare of the North under *uniform pricing is strictly higher than that under international price discrimination whereas the welfare of the South is strictly lower.* From the South's perspective, price discrimination is preferred to uniform pricing due to two reasons. First, its firm enjoys strictly higher profits under discrimination since price competition in the North is softer relative to uniform pricing. Second, recall from Lemma 2 that relative to uniform pricing, prices are lower in the South under price discrimination. As a result, both firm profitability and consumer welfare considerations work in the same direction for the South. For the North, consumer welfare and firm profitability work against each other: while consumers are better off under uniform pricing, the high quality firm prefers discrimination. Since higher prices under discrimination transfer part of consumer surplus over to the low quality firm in terms of profits, the North's aggregate welfare is higher under uniform pricing relative to international price discrimination.

To derive equilibrium policies, suppose countries are at (N,N) – i.e. they both forbid parallel imports. Then, from Proposition 4 we know that the resulting market structure is international price discrimination. Proposition 5 implies that the North has an incentive to deviate to (P,N) if altering its policy stance results in uniform pricing. Furthermore, we know from Proposition 2 that uniform pricing indeed obtains under (P,N) when $\mu \leq \max\{\mu^*, \mu_h^U(r)\}$. Thus, over this parameter range, (N,N) *cannot* be a Nash equilibrium pair of policies. The policy pair (P,N) is an equilibrium over this parameter range, if the South has no incentive to deviate to (P,P). Such is indeed the case: if $\mu \leq \mu_h^U(r) \leq \mu^*$, this policy deviation by the South fails to have any effect on market structure (i.e. uniform pricing continues to obtain regardless of its policy) whereas if $\mu_h^U(r) \leq \mu \leq \mu^*$ the Southern deviation alters the market structure to $\{\Lambda\}$, which is strictly worse for the South than uniform pricing. This implies that when $\mu \leq \max\{\mu^*, \mu_h^U(r)\}$, the equilibrium pair of policies is given by (P,N) and the equilibrium market structure is uniform pricing.

Consider now the case where $\mu > \max\{\mu^*, \mu_h^U(r)\}$ and suppose we are at (P,N). Then, the market structure that obtains is $\{\Lambda\}$ (for $\mu > \mu_l^M$) or $\{\Lambda^M\}$ (for $\mu \leq \mu_l^M$). If the North deviates deviates to (N,N), we know from Proposition 2 that price discrimination $\{D\}$ obtains. Since $w_N(D) > w_N(\Lambda)$ and $w_N(D) > w_N(\Lambda^M)$ the North indeed benefits from this policy deviation. Next note from Propositions 4 and 5 that that the South does not have an incentive to deviate from (N,N) since international price discrimination is its most preferred market structure. In any case, as we noted above, the parallel import policy of the South is rendered inconsequential by the North's prohibition on parallel imports: even if the South were to deviate to (N,P) international price discrimination would continue to prevail. This implies that when $\mu > \max\{\mu^*, \mu_h^U(r)\}$ the Nash equilibrium pair of policies is given by (N,N) or (N,P) and the equilibrium market structure is international price discrimination.

We can now state:

Proposition 6: *Given Assumption 2, equilibrium parallel import policies are as follows:*

(i) If $\mu \leq \max\{\mu^*, \mu_h^U(r)\}$, the North permits parallel imports while the South forbids them and uniform pricing obtains.[17]

(ii) If $\mu > \max\{\mu^*, \mu_h^U(r)\}$, the North forbids parallel imports and international price discrimination obtains; given this policy of the North, the South's policy choice does not matter for the market outcome.

An especially interesting aspect of this result is that, in equilibrium, the policy implemented by the North is such that *both firms necessarily serve both markets*. When markets are not too similar in demand (i.e. $\mu > \max\{\mu^*, \mu_h^U(r)\}$), the North forbids parallel imports to rule out asymmetric market structures $\{\Lambda^M\}$ and $\{\Lambda\}$ under which its own firm chooses to *not* serve the South so as to charge a high price in the North, an outcome that is detrimental for Northern consumers and overall Northern welfare.

By prohibiting parallel imports, the North makes it possible for firms to price discriminate internationally thereby ensuring that both markets are served. Indeed, it is noteworthy in this regard that, starting from a situation where both countries permit parallel imports, *a unilateral prohibition on parallel imports by the North generates a substantial positive spillover for the South*: not only do Southern consumers enjoy low prices under discrimination, the low quality firm also benefits from being able to charge a more attractive price in the North.

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[17]Note that when $\mu \leq \mu_h^U(r) \leq \mu^*$ the South is indifferent between the two policies since its policy does not affect the market outcome whereas when $\mu_h^U(r) \leq \mu \leq \mu^*$ the South strictly prefers to forbid parallel imports.

It is easy to show that aggregate world welfare is strictly higher under uniform pricing relative to price discrimination: $w_N(U) + w_S(U) > w_N(D) > w_S(D)$. Intuitively, by yielding price differentials across countries, international price discrimination creates an inefficiency relative to uniform pricing. Proposition 6 shows that when countries are not too different in demand structure, even though each is guided purely by its own interest, equilibrium policies are efficient in that they maximize aggregate welfare.

Finally, it is worth discussing the case of symmetric markets ($\mu = 1$) briefly. When $\mu = 1$ if any country permits parallel imports, uniform pricing obtains as the equilibrium market structure. However, whether markets are integrated or segmented turns out to be immaterial since firms have no incentive to price discriminate internationally. As a result, price discrimination and uniform pricing yield the same market outcome. This in turn implies that any pair of parallel import policies constitutes a Nash equilibrium since welfare of each country is equal under all policy pairs. Thus, demand asymmetry is crucial for understanding why welfare-maximizing governments might prefer one type of parallel import policy to another.

8   Concluding remarks

A sizeable literature analyzes the pros and cons of parallel trade (see Maskus, 2000 for a comprehensive overview). However, this literature has shed only limited light on factors that determine national parallel import policies. In this paper, we endogenize parallel import policies in a North-South duopoly model where the Northern firm produces the high quality and the Southern firm the low quality. A crucial feature of the model is that, given government policies, each firm decides whether or not to offer its product for the sale in the foreign market. Incorporating this feature into the model allows us to endogenously derive asymmetric market structures of the type where both qualities are sold in the North while only the low quality is sold in the South. Not only are such market structures interesting with respect to the pricing behavior of firms, the possibility that they can arise under certain North-South policy configurations plays a crucial role in determining equilibrium policies.

Intuition suggests that the Northern policy stance ought to play a key role in determining international market structure. This intuition finds support in our model, but we show that heterogeneity in demand structure across countries can matter in rather unexpected ways. In this regard, our key result – and one that matches quite well with the observed nature of real world national parallel import policies – is that if the Northern demand and, more particu-

larly, preference for high quality is sufficiently higher than that of the South, the North forbids parallel imports and international price discrimination obtains as the equilibrium outcome. An especially noteworthy aspect of this result is that international price discrimination is the South's most preferred market structure; the North's welfare is actually higher under uniform pricing. Of course, in choosing to forbid parallel imports, the North is motivated not by altruism but rather its own interests: by preventing indirect competition from arbitrage-induced parallel imports, the Northern prohibition on parallel imports induces direct competition in both markets. Thus, a Northern ban on parallel imports prevents a scenario where its own (high quality) firm abstains from serving the Southern market in order to shore up its profit at home. Only when markets are relatively similar in demand does the North choose to permit parallel imports and obtain its most preferred market structure – i.e. uniform pricing – as an equilibrium outcome.

Our analysis of parallel import policies is novel in that it allows for oligopolistic competition in the product market. In our view, this is important in the context of parallel trade: while market power is pervasive when firms are protected by patents or other IPRs, true monopolies are rather rare. For example, even in the context of pharmaceuticals several firms often supply drugs and medicines that help alleviate similar illnesses and diseases. Secondly, in our model, government policy takes into account both consumer and firm interests. As noted above, while setting its parallel import policy, the North must account for the possibility that its own firm might forsake the Southern market in order to sustain a more attractive price in its local market. By contrast, in the existing literature, parallel import policies have been studied primarily from the viewpoint of importing countries.

While the model provides some new insights, it abstracts from several important aspects of parallel trade that deserve further research. For example, it remains to be seen what additional considerations arise under oligopoly when one explictly takes into account the role of intermediaries in parallel trade and the problems of vertical control or contracting as analyzed by Maskus and Chen (2002 and 2004). It would also be useful to study the two-way relationship between parallel trade and strategic R&D competition. We hope to address these topics in future research.

9 Appendix

Proof of Lemma 1

Under international price discrimination, equilibrium prices in country i are:

$$p_{li}(D) = \frac{\mu_i \, (r-1)}{4r-1} \text{ and } p_{hi}(D) = 2r p_{li}(D) \tag{16}$$

Equilibrium prices under uniform pricing are

$$p_l(U) = \frac{(r-1)\,(\mu+1)}{2(4r-1)} \text{ and } p_h(U) = 2r p_l(U) \tag{17}$$

Note from (16) and (17) that under uniform pricing each firm charges the average of its optimal discriminatory prices:

$$2p_j(U) = \sum_i p_{ji}(D) \tag{18}$$

Proof of Lemma 2

Using the reaction functions reported in the text, prices under uniform pricing are given by

$$p_h(U) = \frac{(\mu+1)\,(r-1)\,r}{4r-1} \text{ and } p_l(U) = \frac{p_l(U)}{2r} \tag{19}$$

Firm reaction functions under $\{\Lambda\}$ are given by

$$p_l = \frac{p_h + (r-1)}{2(2r-1)} \text{ and } p_h = \frac{\mu\,(r-1) + p_l}{2} \tag{20}$$

which yield the following equilibrium prices

$$p_l(\Lambda) = \frac{(\mu+2)\,(r-1)}{(8r-5)} \text{ and } p_h(\Lambda) = \frac{(r-1)(2\mu(2r-1)+1)}{(8r-5)} \tag{21}$$

with associated profits $\pi_j(\Lambda)$. Since $r \geq 1$ it is straightforward that the low quality firm's common price in both markets under $\{\Lambda\}$ is higher than its price under uniform pricing:

$$p_l(\Lambda) - p_l(U) = \frac{(r-1)}{2} \frac{8r + 3\mu + 1}{(4r-1)\,(8r-5)} > 0 \tag{22}$$

Proof of Lemma 3

Firm reaction functions under $\{H\}$ are given by

$$p_l = \frac{p_h}{2r} \text{ and } p_h = \frac{r}{2r-1}\left[\frac{(\mu+1)(r-1)}{2} + \frac{p_l}{2}\right] \tag{23}$$

which yield the following equilibrium prices

$$p_h(H) = \frac{2(r-1)(\mu+1)r}{(8r-5)} \text{ and } p_l(H) = \frac{p_h^H}{2r} \tag{24}$$

with associated profits $\pi_j(H)$. Directly solving $\Delta\pi_h(H) = 0$ for μ yields $\mu_h^H(r)$. While the analytical expression for $\mu_h^H(r)$ is tedious, differentiating it with respect to r yields the last statement of Lemma 4.

Proof of Proposition 1

The proof proceeds in a straightforward way. Directly calculations show that $\Delta_l(\Lambda) \equiv \pi_l(\Lambda) - \pi_l(A)$ is increasing in μ and that $\Delta_l(\Lambda) > 0$ at $\mu = \mu_l^M$. This implies that $\Delta_l(\Lambda) > 0$ for all $\mu > \mu_l^M$. As argued in the paper, when $\mu \leq \mu_l^M$, the low quality firm faces no trade-off in its local market and serving the North yields a strictly positive gain.

Other supporting calculations

Equilibrium firm profits under uniform pricing equal

$$\pi_l(U) = \frac{r(r-1)(\mu+1)^2}{2(4r-1)^2} \text{ and } \pi_h(U) = 4r\pi_l(U)$$

whereas under international price discrimination we have

$$\pi_{lS}(D) = \frac{(r-1)r}{(4r-1)^2} \text{ whereas } \pi_{lN}(D) = \frac{\mu^2(r-1)r}{(4r-1)^2} \tag{25}$$

which implies

$$\pi_l(D) \equiv \sum_i \pi_{li}(D) = \frac{(\mu^2+1)(r-1)r}{(4r-1)^2}$$

Similarly,

$$\pi_h(D) \equiv \sum_i \pi_{hi}(D) = 4r\pi_l(D)$$

References

[1] Ahmadi, R., Yang, B.R., 2000. Parallel imports: Challenges from unauthorized distribution channels. Marketing Science 19, 279-94.

[2] Danzon, P. and A. Epstein, 2008. Effects of regulation on drug launch and pricing in interdependent markets. National Bureau of Economic Research Working Paper No. 14041.

[3] Danzon, Patricia, Wang, Y. Richard and L. Wang, 2005. The impact of price regulation on the launch delay of new drugs. Journal of Health Economics 14, 269-92.

[4] Goldberg, P. K., 2009. Intellectual property rights protection in developing countries: the case of pharmaceuticals. Journal of the European Economic Association, forthcoming.

[5] Grossman, G.M., Lai, E., 2008. Parallel imports and price controls. Rand Journal of Economics 39, 378-402.

[6] Lanjouw, J. O., 2005. Patents, price controls and access to new drugs: how policy affects global market entry. National Bureau of Economic Research Working Paper No. 11321.

[7] Li, C., Maskus, K.E., 2006. The impact of parallel imports on investment in cost-reducing research and development. Journal of International Economics 68, 443-455.

[8] Malueg, D.A., Schwartz, M., 1994. Parallel imports, demand dispersion, and international price discrimination. Journal of International Economics 37, 167-195.

[9] Markusen, J.R., Venables, A.J., 1988. Trade policy with increasing returns and imperfect competition. Journal of International Economics 24, 299-316.

[10] Maskus, K.E., 2000. Parallel imports. World economy 23, 1269-1284.

[11] Maskus, K.E., Chen, Y., 2002. Parallel imports in a model of vertical distribution: theory, evidence, and policy. Pacific Economic Review 7, 319-334.

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

[13] Pecorino, P. , 2002. Should the US allow prescription drug reimports from Canada? Journal of Health Economics 21, 699-708.

[14] Raff, H., Schmitt, N., 2007. Why parallel trade may raise producers' profits. Journal of International Economics 71, 434-447.

[15] Richardson, M., 2002. An elementary proposition concerning parallel imports. Journal of International Economics 56, 233-245.

[16] Scherer, F., Watal, J., 2002. Post-TRIPS options for access to patented medicines in developing nations. Journal of International Economic Law 5, 913-939.

[17] Shaked, A., Sutton, J., 1983. Natural oligopolies. Econometrica 51, 1469-84.

[18] Smith, A., Venables, A.J., 1988. Completing the internal market in the European Community: Some industry simulations. European Economic Review 32, 1501-1525.

[19] Valleti, T.M., 2006. Differential pricing, parallel trade, and the incentive to invest. Journal of International Economics 70, 314-324.

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

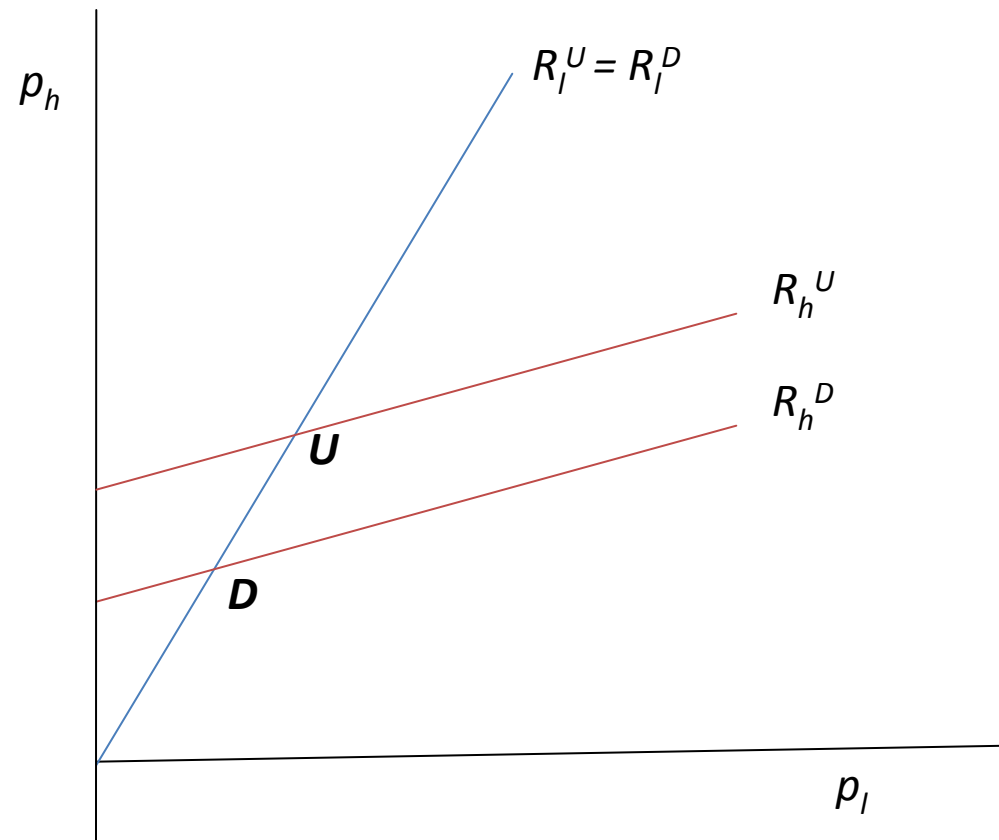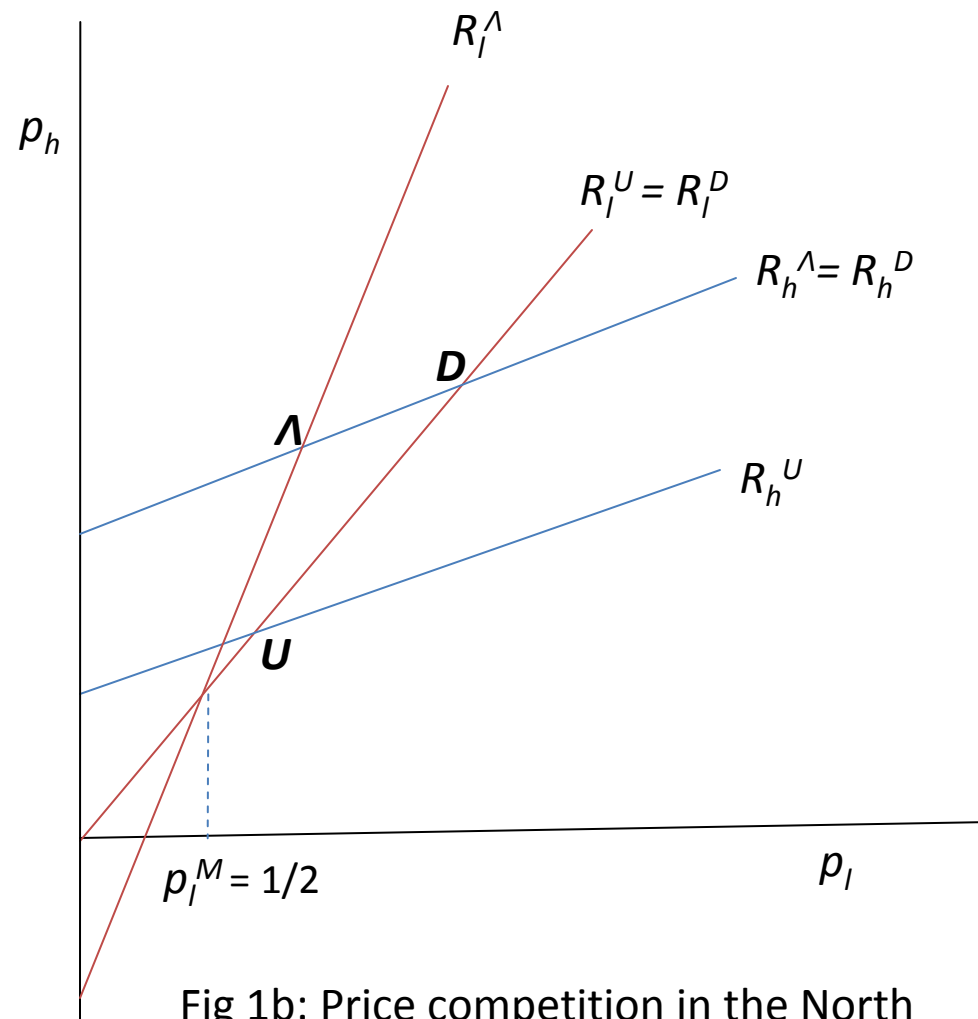[21] Venables, A.J., 1990. The economic integration of oligopolistic markets. European Economic Review 34, 753-73.
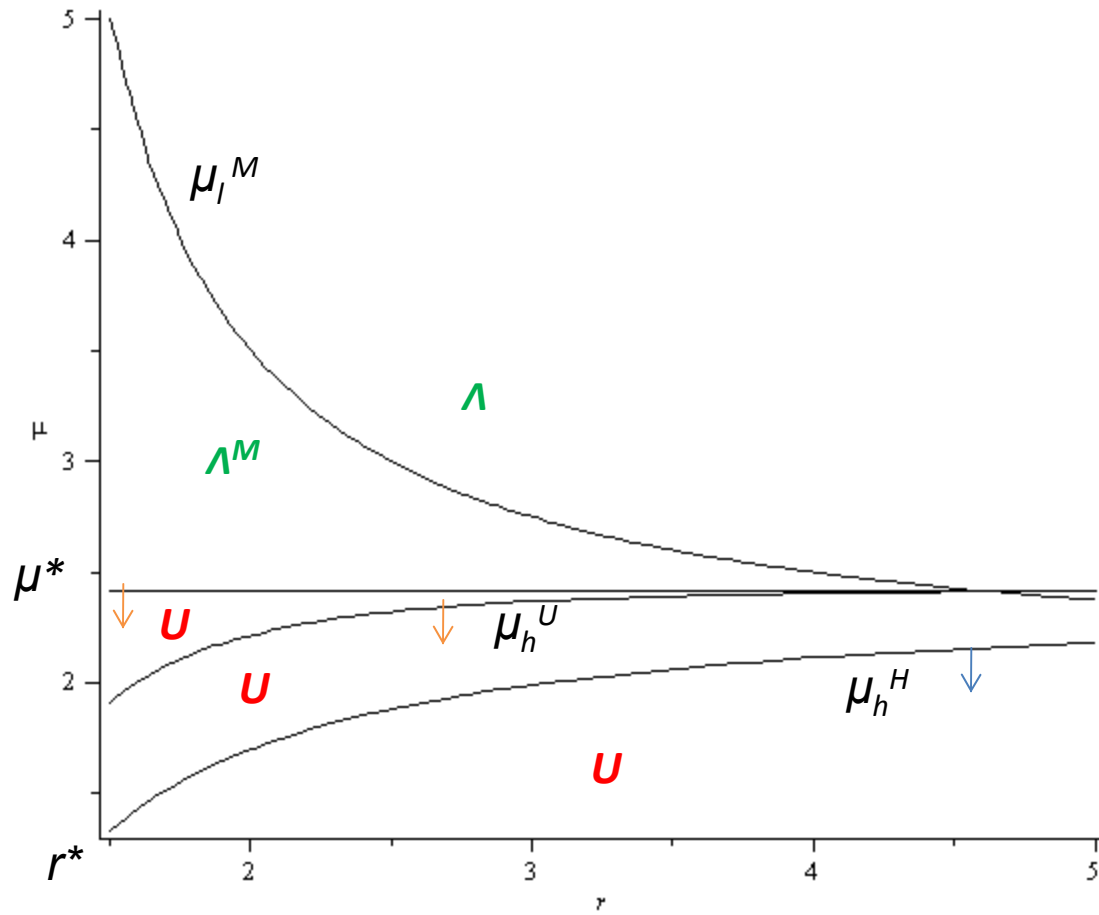
Fig 1a: Uniform Pricing versus Discrimination in the South

Fig 1b: Price competition in the North

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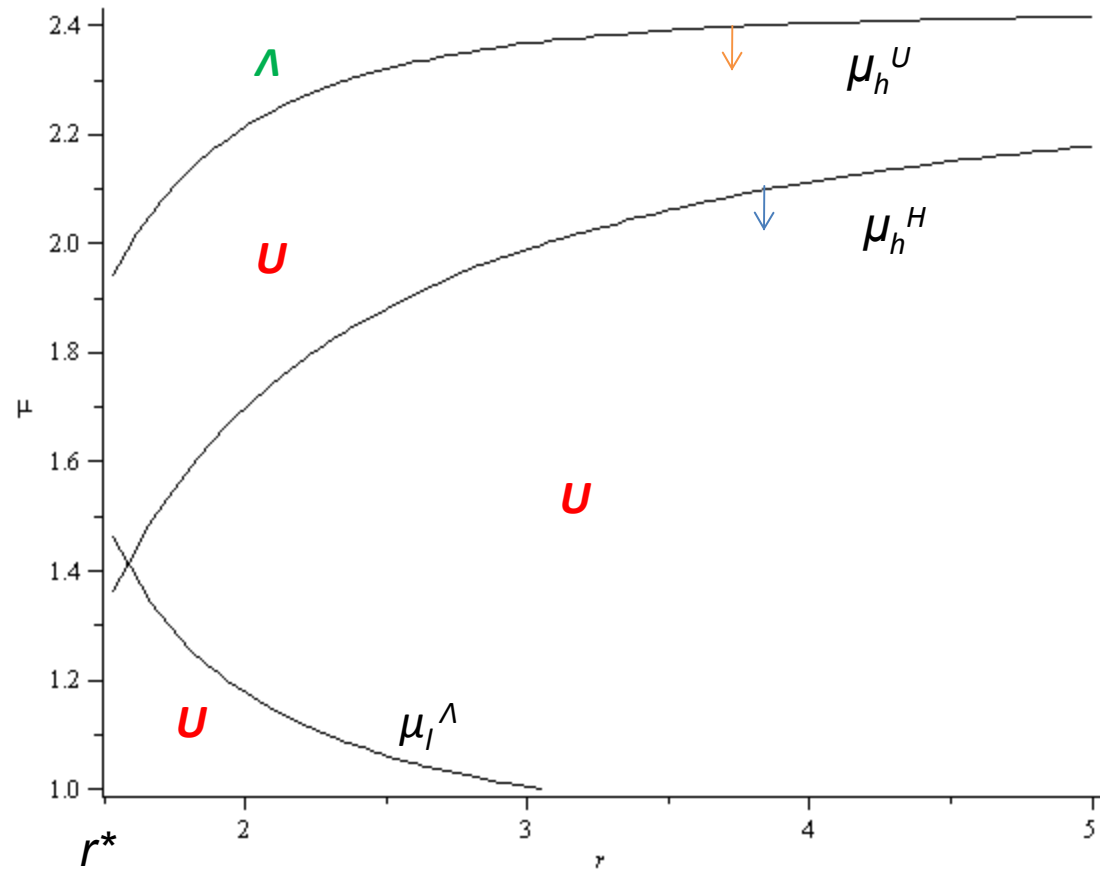
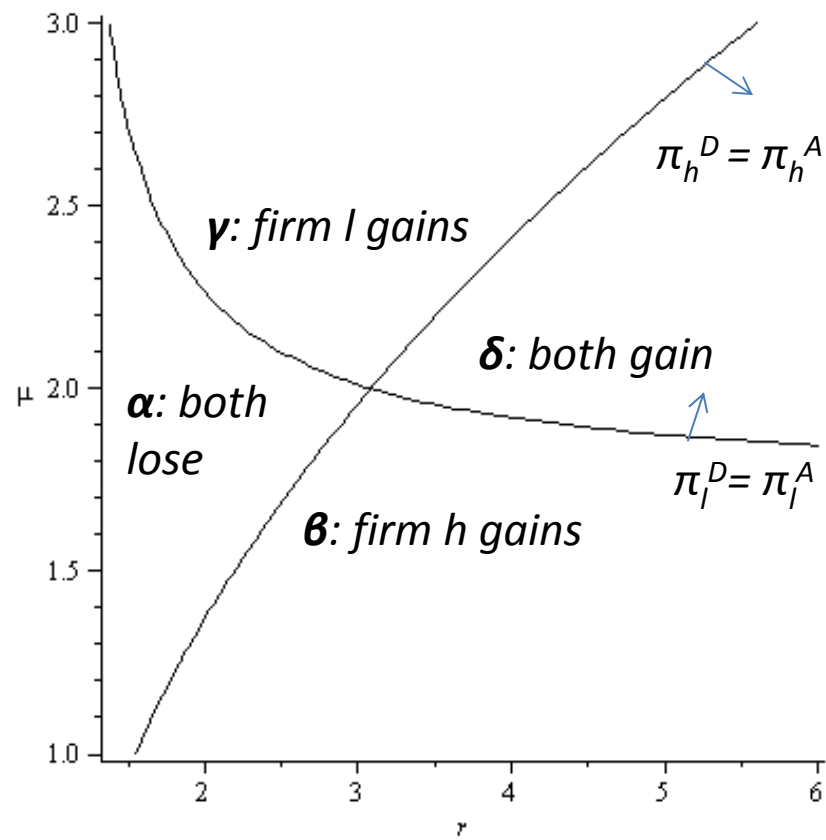Fig 2: Equilibrium market structure under (*P, N*)

Fig 3: Equilibrium market structure under (*P, P*)

Fig 4: Autarky versus price discrimination