7. Social welfare-enhancing collusion and trade

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7.1 INTRODUCTION

This chapter offers additional results and extensions derived from the model in Deltas, Salvo and Vasconcelos (2012). That paper, which at the request of an editor focused on the consumer welfare effect of collusion, developed a model of geographically separated markets in which two horizontally differentiated goods are sold by cost asymmetric suppliers. The source of the cost asymmetry is spatial, in that in a given market a 'home firm,' with production facilities located in the market, competes with a 'foreign firm' that, to bring its differentiated product to market, needs to incur an additional cost of trade from its offshore plant. Our motivation, then as well as now, is: (1) the observation that several real world cartels have adopted a 'home-market principle,' whereby cartelized firms enjoy large shares in their home markets (Motta 2004; Harrington 2006),[2] combined with (2) off-the-record speculation by executives in the Brazilian cement industry that spatial cartels, by curbing competitive cross-hauling, can raise social welfare.

In Deltas et al. (2012), we show that consumer surplus and social welfare can increase on shifting from oligopolistic competition to full collusion (monopoly). Section 7.2 of this chapter briefly lays out the basic model of that paper. We then add an analysis of first-best social outcomes (Section 7.3) to the existing derivation of equilibrium outcomes under a Nash equilibrium in prices (imperfect competition) and the joint-profit maximizing cartel (full collusion). We show that a social planner would go further than the perfect cartel in reducing the share of the foreign variety. From the social viewpoint, competition leads to excessive cross-hauling, a failure that collusion only partially addresses: trade is still too high in the collusive outcome relative to society's first-best outcome.

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It is instructive to highlight the intuition behind the welfare comparison. From a welfare point of view, prices cancel out because they are a transfer. Only market allocations matter, and what is important for these are relative prices. Since markets and all equilibria are symmetric, we can consider welfare effects in a single market. Consider first the Nash equilibrium. In this equilibrium, the foreign firm chooses a lower margin than the home firm, since being the high-cost seller it has a smaller market share and thus more aggressive pricing results in smaller revenue losses from the sales to inframarginal consumers. Therefore, the price difference between the imported and home varieties is lower than the cost difference (the trade cost). As a result, the number of consumers who purchase from the importing firm is too high relative to the social optimum. The cartel, while shifting the market allocation away from the imported variety, does not eliminate this distortion entirely because some price discrimination against each producer's home-market buyers – who in equilibrium constitute the majority of its buyers – increases the cartel's surplus. In contrast, a social planner would set the price difference between the two firms equal to the trade cost.

Section 7.4 then extends the model to a setting where consumers exhibit home bias. No longer is it the case that at equal prices the two firms would have an equal market share: we generalize the earlier set-up by specifying, for each consumer, an additional willingness to pay for the home variety relative to the imported variety. This preference for the domestic product could be due to 'patriotism,' concerns about the local economy, or simply because the homefirm has superior knowledge about local tastes and can better appeal to them. We then show that our analysis is robust to, and in fact somewhat strengthened by, the introduction of home bias. For example, home bias reduces cross-hauling, but by less under competition than it does under collusion.

Deltas et al. (2012) considered conditions under which banning trade entirely resulted in higher consumer surplus. Section 7.5 of this chapter completes this result by considering conditions under which the autarkic regime enhances social welfare – the sum of consumer surplus and producer surplus – over trade regimes. In the trade literature, Brander and Krugman (1983) show that exogenously moving from autarky (no cross-hauling) to trade competition in a homogeneous-good Cournot oligopoly, with free entry, is welfare-enhancing: '(t)he pro-competitive effect of having more firms and a larger overall market dominates the loss due to transport costs in this second best imperfectly competitive world' (p. 314). With entry barriers, however, two-way trade in the identical good when the trade cost is high enough is 'wasteful,' lowering total welfare relative to autarky. We obtain a similar result that autarky welfare-dominates trade regimes (both competitive and collusive) except when the trade cost is low.[3] Finally, Section 7.6 examines how the first-best social outcome can be implemented. We consider tax and subsidy policies, as well as price regulation.

This chapter shows that in a workhorse industrial-organization model with only standard ingredients, spatial cartels can enhance social welfare by restricting costly trade and yet still trade more than the social optimum.[4] It, therefore, complements the consumer-surplus results in Deltas et al. (2012).

7.2 THE BASIC MODEL (DELTAS, SALVO, AND VASCONCELOS, 2012)

In this section, we briefly repeat for convenience the model set-up in Deltas et al. (2012), before we proceed to the derivation of novel results in subsequent sections. We consider a geographically segmented industry that operates in two markets (1 and 2) and where goods are horizontally differentiated. Shipping product from one market to another – cross-hauling – incurs a unit trade cost $t > 0$. Each local market consists of a continuum of consumers distributed uniformly over the interval [0, 1]. The disutility from consuming a variety other than one's ideal variety is linear in the distance along this Hotelling interval, with slope $\theta > 0$. There are two firms, A and B, each firm producing one variety. In geographic space, firm A's plant is located in market 1 while firm B's plant is located in market 2. In product space, firm A's product is located at the left endpoint of the unit interval while firm B's product is located at the right endpoint. The marginal cost of production is $c \geq 0$ for both firms. Consumers purchase one unit or none. Let $x \in [0, 1]$ – the consumer's type – denote the distance from the left endpoint of the unit interval. A firm's price can vary across the two markets though not within a market. Consider either one of the local markets, and denote the vector of prices by $p = (p_A, p_B)$; for simplicity, we momentarily omit market subscripts. Finally, let V denote the reservation price for a consumer's ideal product. Then, a consumer located at x has utility of $U_A \equiv V - \theta x - p_A$ from purchasing product A, and $U_B \equiv V - \theta(1 - x) - p_B$ from purchasing product B. We impose the two technical assumptions,

$$\text{A1: } t < 2\theta, \text{ and}$$

$$\text{A2: } 2(V - c) > t + 3\theta,$$

which ensure cross-hauling and full market coverage in equilibrium under both competition and collusion.[5] Thus, consumers to the left of $\tilde{x} \equiv 1/2 + (p_B - p_A)/(2\theta)$ will purchase product A, while those to the right will purchase product B.

In the competitive regime, the strategic interaction of the firms is separable across the two markets, given that marginal cost is constant in output. For market 1, the two firms choose prices to maximize $\Pi_{1A} = (p_A - c)\tilde{x}$ and $\Pi_{1B} = (p_B - c - t)(1 - \tilde{x})$, respectively (and similarly for market 2, which we will henceforth ignore). Equilibrium prices are given by $p_{1A}^C = c + \frac{1}{3}t + \theta$ and $p_{1B}^C = c + \frac{2}{3}t + \theta$, where the superscript C denotes the competitive equilibrium. These prices correspond to the market division given by $\tilde{x}_1^C = \frac{1}{2} + \frac{1}{6}\frac{t}{\theta}$, and yield profits of $\Pi_{1A}^C = \frac{1}{18\theta}(3\theta + t)^2$ and $\Pi_{1B}^C = \frac{1}{18\theta}(3\theta - t)^2$.

For the collusive regime, we derive the fully collusive outcome, taking as given that the firms can sustain it.[6] Even though we refer to joint-profit maximization as arising from collusion, we note that it is equivalent to a merger to monopoly. In a joint-profit maximizing outcome (denoted by the superscript JM), prices set by the firms leave the marginal consumer in each market with zero surplus (if not, both prices could be increased symmetrically to yield higher profit). Thus, fully collusive prices satisfy $U_A(p_A; \tilde{x}(p)) = 0$ (or equivalently $U_B(p_B; \tilde{x}(p)) = 0$), which can be rewritten as $2V - \theta - p_A - p_B = 0$. Then, the perfect cartel's problem

$$\max_{p_A, p_B} (p_A - c)\frac{\theta - p_A + p_B}{2\theta} + (p_B - c - t)\left(1 - \frac{\theta - p_A + p_B}{2\theta}\right)$$

$$\text{s.t.}\, U_A(p_A; \tilde{x}(p)) \geq 0$$

collapses to the univariate problem

$$\max_{p_A} (p_A - c)\frac{V - p_A}{\theta} + (2V - \theta - p_A - c - t)\left(1 - \frac{V - p_A}{\theta}\right),$$

yielding prices $p_{1A}^{JM} = V - \frac{1}{4}t - \frac{1}{2}\theta$ and $p_{1B}^{JM} = 2V - \theta - p_{1A}^{JM} = V + \frac{1}{4}t - \frac{1}{2}\theta$. The corresponding location of the marginal consumer is $\tilde{x}_1^{JM} = \frac{1}{2} + \frac{1}{4}\frac{t}{\theta}$, where $\tilde{x}_1^{JM} > \tilde{x}_1^C$.

Equilibrium profits are $\Pi_{1A}^{JM} = \frac{1}{16\theta}(2\theta + t)(4V - 4c - t - 2\theta)$ and $\Pi_{1B}^{JM} = \frac{1}{16\theta}(2\theta - t)(4V - 4c - 3t - 2\theta)$. A1 ensures that the home firm's share under collusion is less than 1.[7]

We compare social welfare across the competitive and collusive regimes. Given that all consumers purchase one unit of the good in both regimes, we need only consider (1) the different total cost of cross-hauling product between geographic markets, and (2) the different total disutility from consuming a variety other than one's ideal. The total cost of cross-hauling under price competition exceeds the cost from cross-hauling under full collusion, as there is more trade in the competitive regime. The total consumer taste disutility under price competition is $\int_0^{\tilde{x}_1^C}\theta x dx + \int_{\tilde{x}_1^C}^1 \theta(1 - x)dx = \frac{1}{2}\theta(2(\tilde{x}_1^C)^2 - 2\tilde{x}_1^C + 1)$, while that under full collusion is obtained similarly. The former is lower than the latter, as the marginal consumer in the competitive regime lies closer to the midpoint of the Hotelling interval than the marginal consumer in the collusive regime. Combining terms and taking the difference, we obtain $W^{JM} - W^C = \frac{7}{144}\frac{t^2}{\theta} > 0$. Thus, the first of the effects described above dominates the second, and welfare is higher under collusion. From the social point of view, the oligopolistically competitive equilibrium is characterized by 'excessive trade.' Collusion serves as a mechanism to correct this failure, but only partially, as we show in the subsequent section.

7.3 FIRST-BEST SOCIAL OUTCOMES IN THE BASIC MODEL

The immediate question then is how distortionary are the market-based behavioral regimes derived above? We now compute the set of first-best outcomes, where social welfare is maximal, and compare them to the competitive and collusive outcomes. As we explain, what characterizes a first-best social outcome is the price difference between the home good and the imported good, which is equal to the trade cost. We then provide price levels for two alternative (and extreme) first-best outcomes, where the division of surplus between producers and consumers is reversed: prices set by a 'business-friendly' social planner, and prices set by a 'consumer-friendly' social planner. To be clear, our planner's bias between pro-business and pro-consumer does not affect the price of the imported good relative to the home good, which determines the welfare trade-off between meeting consumers' love of variety and saving on trade costs.

Denote this first-best outcome by the superscript *FB* and consider market 1 (again market 2 is analogous). Express the location of consumer $\tilde{x}_1^{FB}$, who is indifferent between the two inside goods, as lying at a distance d to the right of the midpoint of the unit interval of product characteristics, that is, $\tilde{x}_1^{FB} = \frac{1}{2} + d$. For this marginal consumer to be indifferent to buying the home good or the imported good, the fact that she finds the home good less appealing must be offset by a price difference in its favor. The relative taste disutility of the home good is that of traveling a distance $2d$ (a distance d to the midpoint (1/2), and then another d), costing the marginal consumer $2d\theta$. Now, the social planner equates this relative disutility $2d\theta$ with the cost of cross-hauling t, that is, $2d\theta = t$, from which $d = t/(2\theta)$ and the location of the marginal consumer follows:

$$\tilde{x}_1^{FB} = \begin{cases} \frac{1}{2} + \frac{1}{2}\frac{t}{\theta} \text{ if } t < \theta \\ 1 \text{ otherwise.} \end{cases}$$

Relative to the competitive and collusive regimes, the social planner reduces wasteful cross-hauling, opting for less trade – and none at all when $\theta \leq t < 2\theta$ – and a greater share for the home good (for $t \geq \theta$ there is a corner solution). There is no price discrimination against a firm's home-market buyers, as the price difference is equated to the trade cost t, in contrast to the market-based regimes where price discrimination was substantial (that is, the price difference was as low as $(1/2)\ t$ under collusion and $(1/3)\ t$ under competition).

The market share of the imported good is plotted, as a function of t, in Figure 7.1, which summarizes the quantity cross-hauled (and the welfare) in each regime. The figure also covers values of t that extend beyond the restricted space of parameters. Consider for a moment raising the trade cost beyond the upper bound set by A1, $t < 2\theta$. For $t \geq 2\theta$ both the fully collusive cartel and the social planner would choose to not cross-haul at all, that is, in this region, $\tilde{x}_1^{JM} = \tilde{x}_1^{FB} = 1$. Social welfare under full collusion would then be maximal. Moreover, for $2\theta \leq t < 3\theta$, while collusion would eliminate cross-hauling, this would still not be the case under price competition. There would thus still be welfare gains from collusion relative to competition. Further raising t, for $t \geq 3\theta$, cross-hauling would now cease also in the competitive regime, $\tilde{x}_1^{C} = \tilde{x}_1^{JM} = \tilde{x}_1^{FB} = 1$, with competition now also yielding optimal social welfare. Notice the concavity of welfare differences across regimes with respect to trade costs. At the low end, as t goes to 0, all three regimes coincide in terms of the degree of cross-hauling and welfare – the consumer taste disutility is minimal, as each consumer acquires the good that is closest to her ideal. At the high end, as t reaches 3θ, all three regimes again coincide: there is no cross-hauling and both competition and collusion are first-best.

For the left-most region in Figure 7.1, where the parameter values satisfy both A1 and A2 and where cross-hauling is positive for all regimes, the welfare result is summarized in the following proposition.

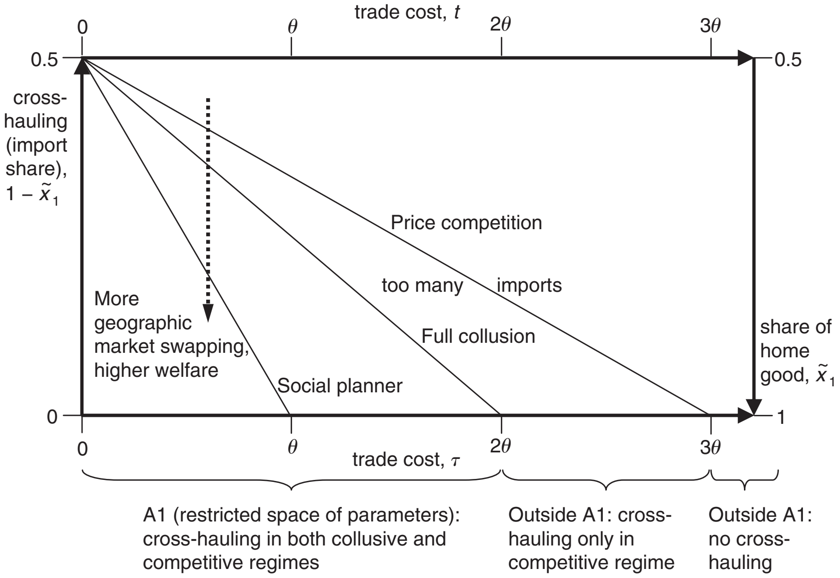

Figure 7.1 Import market shares and trade costs: market outcomes and the social optimum

Proposition 1 Social welfare under full collusion, though higher than under price competition, is suboptimal. Relative to the fully collusive outcome, a social planner would raise the price of the imported good relative to the price of the home good, further restricting the penetration of imports, that is, the social planner would further enhance geographic market-swapping at the expense of consumers' taste for variety.

Proof When $0 < t < \theta$, the (per market) increase in social welfare in a first-best outcome relative to full collusion is

$$\begin{aligned} W^{FB} - W^{JM} &= t(1 - \tilde{x}_1^{JM}) + \frac{1}{2}\theta(2(\tilde{x}_1^{JM})^2 - 2\tilde{x}_1^{JM} + 1) \\ &\quad - t(1 - \tilde{x}_1^{FB}) - \frac{1}{2}\theta(2(\tilde{x}_1^{FB})^2 - 2\tilde{x}_1^{FB} + 1) \\ &= \frac{1}{16}\frac{t^2}{\theta} > 0. \end{aligned}$$

This is increasing in t and decreasing in θ. When $\theta \leq t < 2\theta$,

$$W^{FB} - W^{JM} = \frac{1}{16\theta}(3t - 2\theta)(2\theta - t) > 0.$$

Notice that $\partial(W^{FB} - W^{JM})/\partial t = (4\theta - 3t)/(8\theta)$, which is positive for low t and negative for high t. Also, $\partial(W^{FB} - W^{JM})/\partial\theta = (3t^2 - 4\theta^2)/(16\theta^2)$, which is negative for low t and positive for high t.

Though an improvement over competition, the perfect cartel still imports too much. Seen from the socially optimal outcome, the cartel disproportionately raises the price of the home good, which has a large market share, leading to large revenue gains from the sales to the many inframarginal consumers. Now, to illustrate, consider alternative price levels within the set of first-best social outcomes. A pro-business ('pro-b') social planner, wishing to maximize producer surplus conditional on total welfare being optimal, would set prices such that the marginal consumer's surplus is fully extracted, $U_A(p_A; \tilde{x}_1^{FB}) = 0$, that is,

$$p_{1A}^{FB,pro-b} = V - \theta\tilde{x}_1^{FB} =$$

$$V - \frac{1}{2}\min(t+\theta, 2\theta), p_{1B}^{FB,pro-b} = p_{1A}^{FB,pro-b} + t = V + t - \frac{1}{2}\min(t+\theta, 2\theta).$$

Profits are then given by

$$\Pi_{1A}^{FB,pro-b} = \begin{cases} \frac{1}{4\theta}(\theta + t)(2V - 2c - t - \theta) \text{ if } t < \theta \\ V - c - \theta \text{ otherwise} \end{cases}$$

$$\Pi_{1B}^{FB,pro-b} = \begin{cases} \frac{1}{4\theta}(\theta - \mathrm{t})(2\mathrm{V} - 2\mathrm{c} - \mathrm{t} - \theta) \text{ if } t < \theta \\ 0 \text{ otherwise.} \end{cases}$$

A firm's total profit in this business-friendly first-best solution $\Pi_{1A}^{FB,pro-b} + \Pi_{2A}^{FB,pro-b}$ falls short relative to the fully collusive outcome:[8]

$$\Pi_{1A}^{FB,pro-b} + \Pi_{2A}^{FB,pro-b} - \left(\Pi_{1A}^{JM} + \Pi_{2A}^{JM}\right) =$$

$$\begin{cases} -\frac{1}{8}\frac{t^2}{\theta} < 0 \text{ if } t < \theta \\ -\frac{1}{8\theta}(2\theta - t)^2 < 0 \text{ otherwise.} \end{cases}$$

One might at first be surprised that, in an environment with no aggregate demand effects, the collusive allocation and the pro-business social planner's outcome differ. To understand why this is the case, recall that the marginal consumer earns zero surplus in both outcomes. However, on switching from pro-business first-best prices to the cartel's prices, the typical (that is, non-marginal) home good consumer is made worse off, while the typical imported good consumer is made better off (and by the same amount). Since there are more consumers who purchase the home good, the collusive regime leads to more surplus extraction than the pro-business social optimum. This additional surplus outweighs the increase in cross-hauling costs. This essentially follows from the envelope theorem: marginally shifting the marginal consumer to the left has a small effect on total welfare but a first-order effect on surplus extraction, and thus it is profitable for the cartel. Progressively larger shifts to the left yield incrementally smaller increases in surplus extraction (as the market shares become more equal) but they increase hauling costs linearly; at the cartel outcome, these effects cancel each other out at the margin.

Alternatively, a pro-consumer ('pro-c') social planner, wishing to maximize consumer surplus conditional on total welfare being optimal, would adopt marginal cost pricing:

$$p_{1A}^{FB,pro-c} = c, p_{1B}^{FB,pro-c} = p_{1A}^{FB,pro-c} + t = c + t$$

The inefficiency of oligopoly outcomes in markets with asymmetric firms has been noted previously in the literature. In our model, the source of inefficiency is the price discrimination against buyers whom a firm has an advantage in serving from the standpoint of lower trade costs.[9]

As one may expect, the inefficiency would disappear were firms able to price discriminate within markets. For every consumer x, a monopolist would compare $V - \theta x$ (the price it would charge for the home good and extract all the consumer's surplus) against $V - \theta(1 - x) - t$ (the price on the imported good that extracts all the consumer's surplus, minus the trade cost it incurs); equating the two expressions yields the first-best allocation $\tilde{x}_1^{FB}$. As for a competitive duopoly, were firms to dispute every consumer separately (that is, there are no inframarginal consumers), the home firm would win consumers $x < \tilde{x}_1^{FB}$ while the importer would win consumers $x > \tilde{x}_1^{FB}$; to see this, note that both firms would be equally placed to win the consumer at $\tilde{x}_1^{FB}$ since the relative taste disutility from consuming the home good, $2(\frac{1}{2}\,\frac{t}{\theta})\theta$, equals the relative price discount offered by the home firm, t (there would be marginal cost pricing at $\tilde{x}_1^{FB}$ as the effects of product differentiation and cost asymmetry offset one another).

7.4 EXTENSION: THE EFFECTS OF HOME BIAS

Very often, consumers in a market favor locally sourced products over competing imports. Part of the reason may be national sentiment and concern over local jobs (witness the prominent 'Made in the USA' label on goods produced and sold in the American market), or environmental considerations (for example, the green movement promotes consumption of local produce in an attempt to curb greenhouse gas emissions generated from transportation). Similarly, local market knowledge may enable home brands to better appeal, on average, to national tastes.

We now ask what the effect of 'home bias' in consumer preferences would be in each of the three regimes. It is clear that if consumers favor the local brand, less cross-hauling will occur in all regimes. Less clear is which regime, if any, will be most affected. To fix ideas, we generalize the earlier set-up by specifying, for each consumer, an additional willingness to pay $h > 0$ for the home variety relative to the imported variety, that is, $V_{1A} = V_{2B} = V + h$ while maintaining $V_{1B} = V_{2A} = V$. The consumer who is indifferent between goods A and B is now located at

$$\tilde{x}_1^{hb}(p) = \frac{\theta - p_A + p_B + h}{2\theta}, \tag{7.1}$$

where superscript hb denotes the presence of home bias. (Restate restrictions A1' and A2', which define the space of interest, as $t + h < 2\theta$ and $2(V - c) > t + 3\theta - h$, respectively.) Repeating the derivations of the preceding sections (and again considering market 1), the competitive equilibrium is now characterized by prices

$$p_{1A}^{C,hb} = p_{1A}^{C} + \frac{1}{3}h, p_{1B}^{C,hb} = p_{1B}^{C} - \frac{1}{3}h$$

and home-good quantity share

$$\tilde{x}_1^{C,hb} = \tilde{x}_1^{C} + \frac{1}{6}\frac{h}{\theta}, \tag{7.2}$$

where the absence of hb in the superscript denotes the particular case where there is no home bias, h=0, seen earlier. As expected, increasing home bias (from zero) raises the share of the home good. The relative change in shares results, in equilibrium, in a reduction in the relative price of the imported good, $p_{1B}^{C,hb} - p_{1A}^{C,hb} = \frac{1}{3}(t - 2h)$. Similarly, prices and the quantity share of the home good in the fully collusive regime are now

$$p_{1A}^{JM,hb} = p_{1A}^{JM} + \frac{3}{4}h, p_{1B}^{JM,hb} = p_{1B}^{JM} + \frac{1}{4}h$$
$$\tilde{x}_1^{JM,hb} = \tilde{x}_1^{JM} + \frac{1}{4}\frac{h}{\theta}. \tag{7.3}$$

Comparing Equations (7.3) and (7.2), an increase in the home bias raises the share of the home good by more in the collusive regime than in the competitive regime. In other words, the presence of home bias results in more cross-hauling in the non-cooperative equilibrium relative to collusion, reinforcing our prior results. It is also easy to verify that, though home bias again raises price discrimination in favor of buyers of the imported good, it does so by less under collusion than under competition, reinforcing our finding of collusion as a (partial) correction mechanism. Finally, consider the socially first-best market allocation. As in Section 7.3, write the location of the marginal consumer as $\tilde{x}_1^{FB,hb} = \frac{1}{2} + d$. The relative taste disutility of the home good for this consumer is now $2d\theta - h$, which the social planner equates with the cross-hauling cost t, and thus $\tilde{x}_1^{FB,hb} = \frac{1}{2} + \frac{1}{2}(t + h)/\theta$, or

$$\tilde{x}_1^{FB,hb} = \begin{cases} \tilde{x}_1^{FB} + \frac{1}{2}\frac{h}{\theta} \text{ if } t + h < \theta \\ 1 \text{ otherwise.} \end{cases}$$

The equilibrium outcomes in market 1 (the home market of firm A) under all three regimes and in the presence of home bias are shown in Figure 7.2. Relative to the competitive and collusive outcomes, the effect of home bias – expanding the home-good share – is most pronounced under first-best $(+h/(2\theta))$, reinforcing our earlier result. To understand why, notice that $p_{1B}^{FB,hb} - p_{1A}^{FB,hb} = t$: as in the earlier set-up without home bias ($h = 0$), the planner equalizes each variety's price-cost margins across the two markets. In contrast, dumping is maximal – and increasing in h – in the competitive regime. The effect of h on the collusive market division is intermediate to the socially optimal and competitive regimes, as was the case for $h = 0$. For notational simplicity, we return to the case of no home bias for the remainder of this chapter.

7.5 CAN AUTARKY IMPROVE WELFARE OVER MARKET-BASED TRADE REGIMES?

Deltas et al. (2012) compare the consumer surplus under competition with that obtained in the absence of any cross-hauling, that is, under autarky. In this section, we compare the two regimes with respect to aggregate

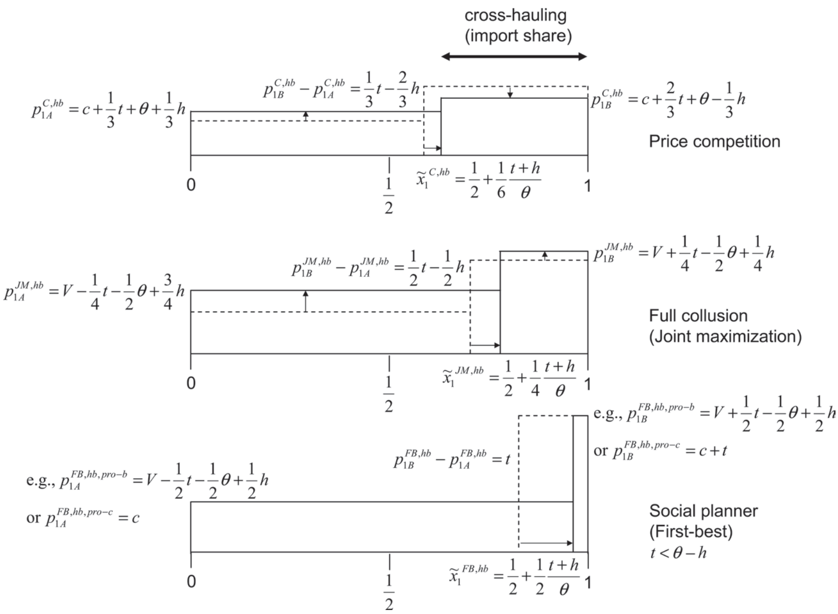

Figure 7.2 Competitive, collusive, and socially optimal prices and market shares in the presence of home bias

welfare. These comparisons are typical in the trade literature. We pose here the following question. Is it possible that certain (competitive or even collusive) markets lead to so much wasteful trade that society is better off in autarky? Instinctively, one would think not. Imagine the two markets initially shut off from each other. Why would a government forestall the entry in each market of a high-cost (importing) firm that better meets the tastes of some consumers and (recalling that a perfect cartel engages in trade) is privately profitable? We show, however, that the government can improve welfare over market-based trade regimes by directly imposing autarky. The reason is that once entry is allowed, the government cannot dictate the scale of entry. Though autarky can only be worse than allowing limited trade, under first-best, it can be better than allowing unrestricted trade. In other words, it is ideal if the government can somewhat limit trade, but if that is not possible (say because, in an international setting, only the blunt instrument of blocking entry through health/safety regulations is available, rather than the finer instrument of tariffs), then it may make sense to ban trade outright.

This paragraph, which follows Deltas et al. (2012), briefly derives the equilibrium under autarky. In the autarkic regime (denoted by the superscript $AUTK$) there are two kinds of monopoly outcomes. The first corresponds to V high enough that the autarkic monopolist fully covers the market. As can be verified below, this occurs for $V - c \geq 2\theta$. In this full coverage case, the monopolist sets price such that the consumer at $x = 1$ has zero surplus, that is, $V - \theta - p^{AUTK} = 0$, so $p^{AUTK} = V - \theta$ and thus $\Pi^{AUTK} = V - c - \theta$. In the second (complementary) case, where $V - c < 2\theta$, full coverage is not optimal for the monopolist. At the monopoly price, the consumer at $\check{x}^{AUTK} < 1$ is indifferent between the inside good and the outside good, that is, $V - \theta\check{x}^{AUTK} - p^{AUTK} = 0$, or $\check{x}^{AUTK} = (V - p^{AUTK})/\theta < 1$.[10] The monopolist's problem in this case is then:

$$\max_{p}(p - c)\frac{V - p}{\theta},$$

yielding $p^{AUTK} = \frac{1}{2}(V + c)$ and $\Pi^{AUTK} = (V - c)^2/4\theta$, and where the share of the inside good is $\check{x}^{AUTK} = (V - c)/2\theta < 1$. In summary, the autarkic price and per-market profit are given by

$$p^{AUTK} = \begin{cases} \frac{1}{2}(V + c) \text{ if } V - c < 2\theta \text{ (incomplete coverage)} \\ V - \theta \text{ otherwise (full coverage)} \end{cases}$$

and

$$\Pi^{AUTK} = \begin{cases} \frac{1}{4\theta}(V - c)^2 \text{ if } V - c < 2\theta \text{ (incomplete coverage)} \\ V - \theta - c \text{ otherwise (full coverage).} \end{cases}$$

The following proposition states regions in parameter space for which society would be better off under autarky relative to market-based trade regimes. Put simply, autarky welfare-dominates market-based trade regimes except when the trade cost t is low; for these low t cases, the welfare shortfall under autarky narrows as t is raised.

Proposition 2 For a sufficiently high unit trade cost, social welfare under autarky exceeds social welfare under full collusion (and, thus, exceeds social welfare under price competition). In particular, $W^{AUTK} > W^{JM}(>W^{C})$ holds (i) for $\theta \leq t(<2\theta)$ (here there is full market coverage under autarky); and (ii) for $\frac{2}{3}\theta < t < \theta$ and $V - c \geq 2\theta$ (that is, whenever there is full market coverage under autarky). Further, (iii) for $\frac{3}{5}\theta < t \leq \frac{2}{3}\theta$ and $V - c \geq 2\theta$, social welfare under autarky exceeds social welfare under price competition but is lower than social welfare under full collusion, that is, $W^{JM} \geq W^{AUTK} > W^{C}$. Outside these regions, any welfare shortfall under autarky relative to price competition (and thus relative to full collusion) narrows as the trade cost increases. In particular, (iv) for $t \le \frac{3}{5}\theta$ and $V - c \ge 2\theta$, increasing t raises both $W^{AUTK} - W^{C} \le 0$ and $W^{AUTK} - W^{JM} < 0$ toward zero; and (v) for $V - c < 2\theta$ (market coverage is incomplete under autarky, occurring for $t \le 2(V - c) - 3\theta < \theta$, increasing t raises both $W^{AUTK} - W^{C}$ and $W^{AUTK} - W^{JM}$ toward zero (and possibly beyond).

Proof Within the space of parameters defined by A1 and A2, we begin by examining the subspace where full market coverage obtains in autarky (this occurs if $V - c \ge 2\theta$), followed by the subspace where coverage in autarky is incomplete (that is, $V - c < 2\theta$). Consider A1: $t < 2\theta$. Notice that a sufficient condition for full coverage in autarky is $t \ge \theta$, since $V - c > \frac{1}{2}(t + 3\theta) \ge 2\theta$. For $t < \theta$, full coverage in autarky may or may not obtain, as $\frac{1}{2}(t + 3\theta) < 2\theta$ and thus $V - c$ can be either larger or smaller than 2θ. To emphasize, incomplete coverage ($V - c < 2\theta$) implies that $t < 2(V - c) - 3\theta < \theta$.

Now compute (per-market) social welfare under autarky. Consider the case of full coverage. Consumer surplus is $\frac{1}{2}\theta$ (the area of a triangle with height $V - p^{AUTK} = \theta$ and unit width) and producer surplus is $\Pi^{AUTK} = V - c - \theta$, the sum of which yields social welfare: $W^{AUTK} = V - c - \frac{1}{2}\theta$. Next, consider the case of incomplete coverage. Consumer surplus is $(V - c)^2/(8\theta)$ (the area of a triangle with height $V - p^{AUTK} = \frac{1}{2}(V - c)$ and width $\check{x}^{AUTK} = (V - c)/2\theta)$ and producer surplus is $\Pi^{AUTK} = (V - c)^2/(4\theta)$, with welfare totaling $W^{AUTK} = 3(V - c)^2/(8\theta)$.

Next compute social welfare in each of the two trade regimes (for these regimes and range of parameters, the market is fully covered and cross-hauling occurs). Consumer surplus is calculated as explained in Section 7.2. Producer surplus is given by the sum of a firm's profit on home sales and its profit on foreign sales, as stated in Section 7.2. For brevity, we simply state the sum of consumer surplus and producer surplus in each regime:

$$W^{C} = (36V\theta - 36c\theta - 18t\theta + 5t^2 - 9\theta^2)/(36\theta) \text{ and}$$

$$W^{JM} = (16V\theta - 16c\theta - 8t\theta + 3t^2 - 4\theta^2)/(16\theta).$$

We now calculate welfare differences across regimes, first considering parameter values for which there is full coverage under autarky. We compute $16\theta(W^{AUTK} - W^{JM}) = -3t^2 + 8t\theta - 4\theta^2$, which, being concave in t and having roots $t = \frac{2}{3}\theta, 2\theta$, is strictly positive over the interval $\frac{2}{3}\theta < t < 2\theta$: hence (recalling prior results) we have $W^{AUTK} > W^{JM} > W^{C}$. This proves statements (i) and (ii). Further, proof of the second part of statement

(iv) follows from noting that $-3t^2 + 8t\theta - 4\theta^2$ is negative for $t < \frac{2}{3}\theta$, but increasing in t. Similarly, we compute $36\theta(W^{AUTK} - W^C) = -5t^2 + 18t\theta - 9\theta^2$, which is strictly positive over the interval $\frac{3}{5}\theta < t < 3\theta$. So for $\frac{3}{5}\theta < t \leq \frac{2}{3}\theta$ we have $W^{JM} \geq W^{AUTK} > W^C$, proving statement (iii). Proof of the first part of statement (iv) follows, similarly, from noting that, for $t \leq \frac{3}{5}\theta$, $-5t^2 + 18t\theta - 9\theta^2$ is non-positive and increasing in t.

We now prove statement (v), pertaining to incomplete market coverage in autarky. We compute $16\theta(W^{AUTK} - W^{JM}) = 2(V - c)(3V - 3c - 8\theta) + (-3t^2 + 8t\theta + 4\theta^2)$. Since $V - c > 0$ and $V - c - 2\theta < 0 \Leftrightarrow 3V - 3c - 6\theta < 0 \Rightarrow 3V - 3c - 8\theta < 0$, the first bunch of terms is negative and invariant in t. Noting that, over the interval $0 < t \leq 2V - 2c - 3\theta < \theta$, the parabola defined by $-3t^2 + 8t\theta + 4\theta^2$ is positive and increasing in t, it follows that $W^{AUTK} - W^{JM}$ can be either positive or negative and that $W^{AUTK} - W^{JM}$ increases in t. Similarly, we compute $16\theta(W^{AUTK} - W^C) = 2(V - c)(3V - 3c - 8\theta) + \frac{4}{9}(-5t^2 + 18t\theta + 9\theta^2)$ where the same first bunch of terms is negative and, over the interval $0 < t \leq 2V - 2c - 3\theta < \theta$, the parabola $\frac{4}{9}(-5t^2 + 18t\theta + 9\theta^2)$ is positive and increasing in t. It follows that $W^{AUTK} - W^C$ can be either positive or negative and increases in t. This proves (v). With incomplete coverage under autarky, we further show that as $t \to 0^+$, $(W^{AUTK} - W^{JM} <) W^{AUTK} - W^C < 0$. The left inequality follows from prior results. The right inequality follows from noting that as $t \to 0^+$, $8\theta(W^{AUTK} - W^C) \to (V - c)(3V - 3c - 8\theta) + 2\theta^2 < 0$. To see this, notice that $(V - c)(3V - 3c - 8\theta) + 2\theta^2 < 0 \Leftrightarrow -(3V - 3c - 8\theta)(V - c) > 2\theta^2$, and that $V - c < 2\theta \Leftrightarrow -(3V - 3c - 8\theta) > 2\theta > 0$ and $V - c > \frac{1}{2}t + \frac{3}{2}\theta > \theta > 0$. Also, with incomplete coverage under autarky, we show (by example) that as $t \to 2V - 2c - 3\theta < \theta$, $W^{AUTK} - W^C$ remains negative (for example, $V = 3$, $c = 1.2$, $\theta = 1$) or can be positive (for example, $V = 3$, $c = 1.05$, $\theta = 1$). Similarly, as $t \to 2V - 2c - 3\theta < \theta$, $W^{AUTK} - W^{JM} (< W^{AUTK} - W^C)$ remains negative or can be positive (see the same examples).

Notice that statement (i) of the proposition is quite intuitive. Recall that in the interval $\theta \leq t (< 2\theta)$ the first-best social outcome involves no cross-hauling – unlike the collusive regime, let alone the competitive regime, where cross-hauling obtains. Since in this region the autarkic monopolist would fully cover the market, autarky is thus first-best. Statements (ii) through (iv) pertain also to regions where there is full market coverage in autarky: conditional on full coverage, autarky is preferred to price competition (if not to full collusion) for t no less than $\frac{3}{5}\theta$ Statement (v) says that in the region where there is incomplete market coverage in autarky (this is a strict subspace of $t < \theta$), it may be that either $(W^{JM} >) W^C > W^{AUTK}$, $W^{JM} > W^{AUTK} \geq W^C$, or $W^{AUTK} \geq W^{JM} (> W^C)$; importantly, however, as t increases in this region (holding other parameters fixed) the undesirability of autarky relative to market-based regimes diminishes and may be reversed.

7.6 GOVERNMENT INTERVENTIONS: TAX AND SUBSIDY POLICIES, AND PRICE REGULATION

We now examine how the first-best can be implemented. We show that a social planner, rather than setting prices directly (as suggested in Proposition 1), can replicate the socially optimal market allocation through a system of taxes and subsidies. Say that a government, with oversight responsibility over the two local markets, can (in each market) impose a unit tax (tariff) $\tau \geq 0$ on sales of the imported good and a unit subsidy $\omega \geq 0$ on sales of the home good. The tax and subsidy policy is set prior to the firms setting prices. (Alternatively, in an international context, one can envision two countries coordinating to reciprocally tax imports and subsidize the domestically produced variety. Clearly, a government acting unilaterally and taking into consideration only domestic welfare, that is, attaching no value to foreign firms or consumers, would not choose the first-best tariff level.) For a market-based regime with either price competition or full collusion, Proposition 3 describes the symmetric tax and subsidy policy that yields the welfare-optimal market allocation.

Proposition 3 An appropriate tax and subsidy policy can be used to induce the market-based regime – either price competition or full collusion – to limit trade across geographic markets to the socially optimal level. In particular, an optimal unit tax on imports and unit subsidy on home-good sales pair (τ, ω) satisfies (i) $\tau + \omega = 2t$ in the competitive regime, and (ii) $\tau + \omega = t$ in the collusive regime.

Proof We start by considering the collusive regime. With the tax and subsidy (and assuming an interior solution), the perfect cartel's univariate problem of Section 7.2 changes to

$$\max_{p_A}(p_A - c + \omega)\frac{V - p_A}{\theta} + (2V - \theta - p_A - c - t - \tau)\left(1 - \frac{V - p_A}{\theta}\right).$$

This yields prices and profits

$$p_{1A}^{JM}(\tau, \omega) = V - \frac{1}{4}(t + \tau + \omega) - \frac{1}{2}\theta, p_{1B}^{JM}(\tau, \omega) = 2V - \theta - p_{1A}^{JM}(\tau, \omega) = V + \frac{1}{4}(t + \tau + \omega) - \frac{1}{2}\theta$$

$$\prod_{1A}^{JM}(\tau,\omega) = \frac{1}{16\theta}(2\theta + t + \tau + \omega)(4V - 4c - t - \tau + 3\omega - 2\theta)$$
$$\prod_{1B}^{JM}(\tau,\omega) = \frac{1}{16\theta}(2\theta - t - \tau - \omega)(4V - 4c - 3t - 3\tau + \omega - 2\theta).$$

The marginal consumer, who has zero surplus, is now located at:

$$\tilde{x}_1^{JM}(\tau,\omega) = \frac{1}{2} + \frac{1}{4}\frac{t+\tau+\omega}{\theta}.$$

For the first-best market allocation to attain, that is, in order for $\tilde{x}_1^{JM}(\tau, \omega) = \tilde{x}_1^{FB}$, it is clear from Section 7.6 that $(t + \tau + \omega)/(4\theta) = t/(2\theta)$ and thus a necessary condition for $\tilde{x}_1^{JM}(\tau,\omega) \to \tilde{x}_1^{FB}$ is $\tau + \omega = t$. As expected, $p_{1B}^{JM}(\tau,\omega) - p_{1A}^{JM}(\tau,\omega) = t$. To verify the example provided in the text, $(\tau,\omega) = (t, 0)$, notice that by construction of the cartel's univariate problem, the marginal consumer's utility is zero, while profits on both the home good and the imported good are non-negative.

For the equilibrium of the competitive regime with a tax and a subsidy, prices solve the system of first order conditions of profit maximization of both firms, yielding prices and profits

$$p_{1A}^{C}(\tau,\omega) =$$
$$c + \frac{1}{3}(t + \tau - 2\omega) + \theta, p_{1B}^{C}(\tau,\omega) = c + \frac{1}{3}(2t + 2\tau - \omega) + \theta$$
$$\prod_{1A}^{C}(\tau,\omega) =$$
$$\frac{1}{18\theta}(3\theta + t + \tau + \omega)^2, \prod_{1B}^{C}(\tau,\omega) = \frac{1}{18\theta}(3\theta - t - \tau - \omega)^2.$$

The equilibrium location of the marginal consumer is given by

$$\tilde{x}_1^{C}(\tau,\omega) = \frac{1}{2} + \frac{1}{6}\frac{t+\tau+\omega}{\theta}.$$

Similar to the above, for the first-best market allocation to attain, that is, in order for $\tilde{x}_1^{C}(\tau,\omega) = \tilde{x}_1^{FB}$, it follows that $(t + \tau + \omega)/(6\theta) = t/(2\theta)$ and thus a necessary condition for $\tilde{x}_1^{C}(\tau,\omega) \to \tilde{x}_1^{FB}$ is $\tau + \omega = 2t$.

Note that $p_{1B}^{C}(\tau,\omega) - p_{1A}^{C}(\tau,\omega) = t$. It is now straightforward to verify that the marginal consumer's utility is positive, as are the profits on both goods, for the example provided in the text, $(\tau,\omega) = (2t/3, 4t/3)$.

Still considering the competitive regime, for the cartel market allocation to attain, that is, for $\tilde{x}_1^{C}(\tau,\omega) = \tilde{x}_1^{JM}$, a necessary condition is $(t + \tau + \omega)/(6\theta) = t/(4\theta)$ or $\tau + \omega = t/2$ for $\tilde{x}_1^{C}(\tau,\omega) \to \tilde{x}_1^{JM}$, where, as expected, $p_{1B}^{C}(\tau,\omega) - p_{1A}^{C}(\tau,\omega) = p_{1B}^{JM} - p_{1A}^{JM} = 1/2t$. Verifying the example provided, $(\tau, \omega) = (t/4, t/4)$, profits on both home and imported goods are similarly positive, and the marginal consumer's utility is $U_A(p^C_{1A}(\frac{1}{4}t, \frac{1}{4}t); \tilde{x}^{JM}_1) = \frac{1}{2}(2V - 2c - t - 3\theta) > 0$. Thus individual rationality constraints are met. For this example, both consumer surplus and firm profits turn out to be higher relative to the tax-and-subsidy-free competitive outcome. Calculating $CS^C(\frac{1}{4}t, \frac{1}{4}t) = \int_0^{\tilde{x}^{JM}_1}(V - \theta x - p^C_{1A}(\frac{1}{4}t, \frac{1}{4}t))\,dx + \int_{\tilde{x}^{JM}_1}^1(V - \theta(1-x) - p^C_{1B}(\frac{1}{4}t, \frac{1}{4}t))\,dx$ and subtracting CS^C, it follows that $CS^C(\frac{1}{4}t, \frac{1}{4}t) - CS^C = \frac{5}{144}\,t^2/\theta > 0$. Also, each firm's profit increases by $\Pi^C_{1A}(\frac{1}{4}t, \frac{1}{4}t) + \Pi^C_{1B}(\frac{1}{4}t, \frac{1}{4}t) - \Pi^C_{1A} - \Pi^C_{1B} = \frac{5}{36}\,t^2/\theta > 0$.

The proposition states the necessary conditions for the first-best market allocation, $\tilde{x}^{FB}_1(>\tilde{x}^{JM}_1 > \tilde{x}^C_1)$, to be replicated in both competitive and collusive regimes. The reason why these conditions are not sufficient is that individual rationality constraints, for both firms and consumers, need to be satisfied as well. Consider an example, for each regime, of a policy that attains first-best. In the competitive regime, the social planner could optimally tax the imported good at $\tau = 2t/3$ and subsidize the home good at $\omega = 4t/3$. In the collusive regime, the social planner could optimally tax the imported good at $\tau = t$ and not subsidize the home good. Intuitively, an optimal tax and subsidy induces competitive or cartelized firms to set prices such that the price of the imported good exceeds the price of the home good exactly by t, which eliminates price discrimination and excessive cross-hauling.

A natural question concerns how government, facing the wasteful competitive regime, can implement a tax and subsidy policy to replicate the market allocation observed in the 'less wasteful' collusive regime $\tilde{x}^{JM}_1(>\tilde{x}^C_1)$ (that is, as calculated in Section 7.2, free of tax and subsidy). As we show in the proof of the preceding proposition, a necessary (though again insufficient) condition for government to replicate the cartel's market allocation is that the (τ, ω) pair satisfies $\tau + \omega = t/2$. For example, the competitive duopoly would be induced to cross-haul the same amount of product as the cartel would (or, equivalently, price discriminate just as the cartel would, $p^C_{1B}(\tau, \omega) - p^C_{1A}(\tau,\omega) = p^{JM}_{1B} - p^{JM}_{1A} = \frac{1}{2}t$) were, say, $(\tau, \omega) = (t/4, t/4)$. In this particular example, as we show, both consumer surplus and firm profits turn out to be higher relative to the tax-and-subsidy-free competitive outcome. In sum, tax and subsidy policies can be used in any regime to replicate another regime's market allocation scheme.

Finally, notice that as a potentially simpler alternative to the optimal tax and subsidy policy above, the government can induce the first-best market allocation by mandating mill pricing, that is, enacting 'anti-dumping' regulation. On prohibiting price discrimination for the same product across both markets – and it is likely that this form of price regulation would be more politically palatable than direct command-and-control pricing measures – a socially optimal outcome ensues. Intuitively, recalling that aggregate volume effects are assumed away, inefficiency arises solely from the fact that, absent intervention, a (competitive or cartelized) importer chooses to absorb a portion of the freight costs. Firms would now be required to either fully pass through transport costs to consumers or outsource shipping to a competitive third-party industry (which would, in equilibrium, charge a price equal to the transport cost).

7.7 CONCLUDING REMARKS

In the context of trade where aggregate demand effects are small, we have provided a model – that is robust to the introduction of home bias – where the following unconventional results obtain: (i) collusion reduces, though does not eliminate, trade relative to competition, leading to a cartel allocation consistent with the 'home-market principle'; (ii) this collusive reduction in trade enhances total welfare; (iii) the welfare gain from collusion occurs even when the trade cost is low; (iv) even collusion involves some degree of excessive trade relative to the welfare optimum; and (v) for a sufficiently high trade cost, even the prohibition of trade – that is, imposing autarky – improves welfare over the (tax-and-subsidy-free) competitive and collusive trade regimes. We believe these results may be useful in assessing international cartels which, as evidence suggests (for example, Levenstein and Suslow, 2004 selectively count 42 international cartels that were successfully prosecuted during the 1990s), are an important phenomenon in the contemporary global economy.

NOTES

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2. According to Harrington (2006), an implication of a market-sharing scheme such as this is that while '(i)n a competitive market, one would expect a rise in a firm's price . . ., to result in more imports . . ., an allocation scheme based on the home-market principle

would result in the combination of a higher price and *fewer* imports' (p. 36, original emphasis). Providing a vivid example, Röller and Steen (2006) examine an official Norwegian cement cartel, documenting the role of a common sales office whose task was to prevent cross-transportation and unprofitable competition (p. 324).

3. Friberg and Ganslandt (2008) extend Brander and Krugman's (1983) welfare analysis of autarky (the no-entry case) to a linear-demand differentiated-goods Bertrand oligopoly. When market structure is sufficiently concentrated, they find that trade competition is welfare-enhancing relative to autarky. It should be noted, however, that neither Brander and Krugman (1983) nor Friberg and Ganslandt (2008) are concerned with the welfare effect of collusion, the central motivation of this chapter.
4. We note that the argument that higher welfare can be attained through some form of coordination has been made previously. In Foros et al. (2002), firms internalize investment spillovers by colluding in an investment stage prior to competing in a product market stage. In Banal-Estanol (2007), merging parties share information.
5. We subsequently discuss the case $2\theta \leq t < 3\theta$, where cross-hauling occurs in the competitive regime but not in the collusive one.
6. Collusion that yields the joint-profit maximum can be supported as a subgame perfect equilibrium outcome of an infinitely repeated game with perfect monitoring if the discount factor is sufficiently high.
7. Outside A1, the perfect cartel does not cross-haul at all.
8. Since the price of the imported good rises relative to that in the fully collusive equilibrium, the price-cost margin remains positive. As there is no price discrimination, price-cost margins on the home and imported goods are now equal (unlike in the collusive and competitive regimes where the home good has a higher margin).
9. For example, In Bester and Petrakis's (1996) spatial model, price discrimination under imperfect competition reduces both efficiency and firm profits (for a generalization, see Liu and Serfes, 2004). Our chapter goes beyond this literature by examining the effects of collusion relative to both competition and first-best.
10. We use $\check{x}$ rather than $\tilde{x}$ since all along $\tilde{x}$ has denoted the location of the consumer who – when trade is allowed – is indifferent between either inside good A or B.

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