MARKET ENTRY REGULATION AND INTERNATIONAL COMPETITION

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CESIFO WORKING PAPER NO. 979
CATEGORY 7: TRADE POLICY
JULY 2003

CESifo *Working Paper No. 979*

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Abstract

As a part of their industry or competition policies governments decide whether to allow for free market entry of firms or to regulate market access. We analyze a model where governments (ab)use these policy decisions for strategic reasons in an international setting. Multiple equilibria of this game emerge; and if the cost difference between domestic and foreign firms is 'significant', all equilibria induce the same allocation, where production exclusively takes place in the cost-efficient country. Moreover, these equilibria are Pareto efficient if this cost difference is 'substantial'. Only if cost differences are 'insignificant', may production take place in both countries in equilibrium.

JEL Code: D43, F12, L11, L51.

Keywords: intergovernmental competition, competition policy, entry regulation, free market entry, international trade.

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1 Introduction

Since trade-liberalization rounds have led to the abolition of tariffs and other direct trade barriers, governments are tempted to look for more subtle policies in order to pursue their national interests in an international environment. Among many potential trade-interfering policies, strategic regulation of market entry seems to be promising if one wishes to manage trade. While it is, even apart from trade considerations, not at all clear whether under free entry and imperfect competition too many or too few firms enter a given market,[1] the question of optimal market entry regulation becomes even more complicated in an international setting. This is particularly true when governments (ab)use their competition policies so as to strengthen their industries' competitiveness. In such a framework, trade-interfering aspects play an additional and frequently important role, and thus substantially affect competition policies. As a consequence, the political issue of whether to allow for market entry or to regulate market access by, for example, granting or auctioning licenses, is likely to be superimposed by trade-strategic considerations.[2]

Empirical evidence demonstrates that entry costs can be substantial. In a recent study, Djankov et al. (2002) describe the officially required procedures of entry regulation and their costs in 85 countries, and they find firm evidence for substantial entry costs in most countries.[3] Despite of this evidence, the impact of entry regulation on trade has, however, not yet received much attention in the theoretical literature. It is true that both the new trade theory and the strategic trade policy literature have emphasized the role of the market structure but they have not endogenized market entry regulation.[4] The few papers explicitly dealing with competition policy either consider mergers or feature linear demand,

[1] While Salop (1979) has shown that, under some limiting assumptions, socially excessive market entry emerges, other authors applying diverse frameworks conclude differently.

[2] For example, it seems that the last years' political debates in the EU countries about market liberalization — which is basically a decision between free market entry and entry regulation — of many sectors, such as telecommunication, electricity, public transport *etc.*, are significantly driven by strategic trade aspects.

[3] The actual entry cost are plausibly even higher as these authors do not take corruption costs and bureaucratic delays into account.

[4] See, for example, the reciprocal dumping model of Brander and Krugman (1983). Strategic trade policy in a third country duopoly model is examined by Brander and Spencer (1985)

constant marginal cost, and segmented markets.[5] We shall depart from these approaches substantially: First, we drop the assumption of segmented markets which is an impediment to competition on its own. Second, we employ a rather general model, and our results are not restricted to certain functional specifications of demand and costs. Third, we allow for heterogenous firms across countries. And fourth, we exclusively focus on competition policy, since discriminatory trade policy instruments have been banned for long.

In the present paper we endogenize a given industry's international market structure by formulating a model where governments decide about whether to allow for free market entry or to limit market access into local production by, for example, granting licenses. Given the governmental decisions about the principle rules of market entry, potential firms in either country decide whether to enter the market or not, and then these active firms engage in Cournot competition on the output market. Ultimately, this sequence of strategic decisions establishes a non-cooperative game in market structures, entry decisions, and output quantities, the sequential equilibrium of which we are interested in.

We focus on the two-country case, where within each country firms are supposed to be homogeneous but may employ different technologies across borders. Without loss of generality, we assume that firms of the home country require a lower break-even price to obtain a non-negative profit than foreign firms — and in this sense we call the domestic firms the low-cost firms. If the cost differential between domestic and foreign firms is 'significant',[6] there are two types of equilibria,

in a Cournot competition setting, and by Eaton and Grossman (1986) in a Bertrand competition setting. The strategic incentives in the reciprocal dumping model are examined by Brander and Spencer (1984) for a fixed market structure, and by Venables (1985) in an endogenous market structure context. Horstmann and Markusen (1986) have explored these strategic incentives when markets are integrated. Markusen and Venables (1988) have considered all these assumptions (endogenous and fixed market structures, and integrated and segmented markets).

[5]The seminal paper on horizontal merger is Farrell and Shapiro (1990). The impact of merger in an international trade setting is explored by Barros and Cabral (1994). Horn and Levinsohn (2001) and Richardson (1999) discuss the interaction between competition and trade policy.

[6]We shall define the notions of an *(in)significant* and *(in)substantial* cost difference later.

in each of which the domestic government regulates market entry by choosing the smallest number of licenses which suffices to deter market entry of foreign firms. The foreign government, however, either allows for free entry or restricts market entry. In the latter case it grants some number of licenses sufficiently large in order to prevent the domestic government from lowering its number of licenses.

Although there are two types of equilibria (literally this means that there is a continuum of equilibria), the resulting market equilibria (or allocations) coincide. In any equilibrium the low-cost firms serve the whole market, while the high-cost firms, though endowed with licenses, decide not to use their licenses but to abstain from market entry. Thus, with a significant cost difference between home and foreign firms complete monopolization of production emerges in the low-cost country. If the cost difference is not only significant but also 'substantial', we obtain the remarkable result that the induced allocation is Pareto efficient.

Even though we believe that those cases where firms differ across countries represent the more relevant ones, it is worthwhile to investigate the case where both types of firms feature similar cost structures — the case of an 'insignificant' cost difference. It turns out that in addition to the two types of complete-concentration equilibria, obtained in the case of a 'significant' cost difference, a third (type of an) equilibrium emerges when firms are sufficiently similar. In contrast with the first two equilibria, this additional equilibrium does not result in complete concentration of production, but induces production to take place in both countries. Moreover, neither of these equilibria is Pareto efficient.

2 The model

Consider two countries labeled 'home' and 'foreign'. We use lower- and uppercase letters to denote variables of the home and the foreign country, respectively. In each country there is some number of notional or potential firms, each of which may enter the market. Once a domestic [foreign] firm decides to enter market, it acquires the available technology at some fixed cost f $[F]$ — and becomes active. All active firms produce a single homogeneous output good for a common integrated world market. We assume that within each country firms employ the same technology, but firms of different countries may employ different technologies. Each firm's technology in the home country can be characterized by a cost function $c : \mathbb{R}_+ \to \mathbb{R}_+$; and each foreign firm's, by $C : \mathbb{R}_+ \to \mathbb{R}_+$. We assume c and C to be increasing with $c(0) = C(0) = 0$, (weakly) convex, and twice continuously differentiable. Let n and m denote the numbers of active firms in the home and in the foreign country, respectively, and let $q_1, \ldots, q_n$ and $Q_1, \ldots, Q_m$ represent their respective output quantities. Also, we denote by $y := \sum_{i=1}^{n} q_i$ and $Y := \sum_{i=1}^{m} Q_i$ the corresponding aggregate output levels of both countries.

The assumption of a single integrated market means that the 'law of one price' holds. Then, aggregate world demand is given by the sum of both countries' demand functions, $\tilde{x} : \mathbb{R}_+ \to \mathbb{R}_+$ and $\tilde{X} : \mathbb{R}_+ \to \mathbb{R}_+$. We assume $\tilde{x}$ to be strictly decreasing and continuously differentiable for all $\phi \in (0, p_0^{\tilde{x}})$, where $p_0^{\tilde{x}} := \min\{\phi : \tilde{x}(\phi) = 0\}$, and correspondingly for $\tilde{X}$ and $p_0^{\tilde{X}}$. Evaluating $\tilde{x}$ and $\tilde{X}$ at the same price yields $\tilde{z}(\phi) := \tilde{x}(\phi) + \tilde{X}(\phi)$, the inverse of which gives the inverse world demand curve, $p : (0, \tilde{z}(0)) \to (0, \max\{p_0^{\tilde{x}}, p_0^{\tilde{X}}\}) : z \mapsto p(z) := \tilde{z}^{-1}(z)$.[7] With respect to p we make the following assumption.

Assumption 1 *The inverse world demand curve satisfies* $z\, p''(z)/p'(z) > -1,\ \forall z \in (0, \tilde{z}(0))$.

Assumption 1 roughly says that the inverse world demand curve may not be 'too convex', implying that $p''(z)\check{z} + p'(z) < 0,\ \forall\, 0 < \check{z} \leq z$, from which we can infer that domestic and foreign output are strategic substitutes (see Bulow *et al.*, 1985).

All $n + m$ active firms engage in Cournot competition on the output market, *i. e.*, they play a game where their strategic variables are quantities and where each firm acknowledges its own impact on the market price. The number of each country's active firms depends on the industrial policies pursued by both governments: Either government decides whether to allow for free entry of firms or to regulate the number of entrants. If a government chooses the strategy *free entry* ($\mathfrak{F}$), it abstains from regulating market entry and firms subsequently enter the market until profit opportunities are eliminated in the respective country. If however, a

[7]Note that p is also twice continuously differentiable on its domain except possibly at $\min\{p_0^{\tilde{x}}, p_0^{\tilde{X}}\}$.

government chooses to follow an active industrial policy by *regulating market access* ($\mathfrak{R}$), it limits the maximal number of firms allowed to enter the market in its jurisdiction. This strategy is best to be understood as issuing a fixed number of licenses, where each license gives the holder (the respective firm) the option to enter the market, and thus to become active.[8] The possession of a license is indispensable, however, for a firm contemplating to enter the market. In this way the government may control the maximal number of active firms in its jurisdiction. Apparently, in either region the number of active firms may not exceed, but may well be less than the number of licenses issued by the respective government. We, therefore, must distinguish between the number of licenses issued by each country, denoted by $\mathfrak{n}$ and $\mathfrak{m}$, and the respective numbers of active firms, n and m. It is the latter which ultimately determines the allocation on the output market, and we must have $n \leq \mathfrak{n}$ [$m \leq \mathfrak{m}$] if the respective government follows strategy $\mathfrak{R}$.

Since either government may choose strategy $\mathfrak{F}$ or $\mathfrak{R}$, we obtain four possible policy scenarios, where a government adopting strategy $\mathfrak{R}$ must also determine the number of licenses to be issued. More formally, the strategy set of the domestic and the foreign government may be written as

$$\mathcal{S}_1 := \{\mathfrak{F}\} \cup \{(\mathfrak{R}, \mathfrak{n}) | \mathfrak{n} \in \mathrm{I\!R}_+\} \quad \text{and} \quad \mathcal{S}_2 := \{\mathfrak{F}\} \cup \{(\mathfrak{R}, \mathfrak{m}) | \mathfrak{m} \in \mathrm{I\!R}_+\},$$

respectively. Corresponding to the four policy regimes, we have four generic strategy tuples:

$$\big((\mathfrak{R}, \mathfrak{n}), (\mathfrak{R}, \mathfrak{m})\big), \qquad \big((\mathfrak{R}, \mathfrak{n}), \mathfrak{F}\big), \qquad \big(\mathfrak{F}, (\mathfrak{R}, \mathfrak{m})\big), \qquad \big(\mathfrak{F}, \mathfrak{F}\big).$$

Whenever the number of licenses is unspecified, we write $(\mathfrak{R}, \cdot)$ and $(\mathfrak{R}, \bullet)$.

Each government seeks to pursue an industrial policy so as to maximize its residents' aggregate utility. We assume that firms are completely owned by the respective country's residents. Then, in choosing its policy either government faces a trade off between consumer surplus and firms' profits. While the first effect tends to favor production, *i. e.*, to encourage higher supply, the second effect tends to restrict supply. In order to be able to weigh both welfare effects, we assume that utility is additively separable, that is, we abstract from income effects. Then,

[8] If the option to enter the market is left unexercised, it expires worthlessly.

domestic residents' welfare can be written as the sum of consumer surplus and profits:

$$w \;=\; \int_0^x p^H(\xi)d\xi - p(z)x + p(z)y - \sum_{i=1}^{n} c(q_i) - nf \;,$$

where $p^H := \tilde{x}^{-1}$ denotes the inverse demand curve in the home country, $z := y+Y$ represents aggregate production, and f stands for the fixed cost to be endured by each firm if and when established. (And similarly for the foreign country.)

Due to the presence of an international single market, both welfare components are, however, also affected by foreign firms' decisions. To acknowledge for this, each government, when maximizing its residents' aggregate welfare, takes into account the presumed responses of both domestic and foreign firms (entry and supply decisions), but takes any policy of the other government as exogenously given. In order to derive the subgame-perfect equilibrium of this sequential game, we proceed by backward induction: First, we analyze, for any given pair of licenses, firms' entry decisions in both countries, when active firms subsequently engage in Cournot competition on the output market. Then, given the respective equilibria on the output market, we derive both governments' best-reply correspondences, from which we finally infer the subgame-perfect Nash equilibria of this game.

3 Market equilibria and comparative statics

Any tuple of industry policies results in market entry of some firms and subsequently in some market allocation. It is this correspondence we wish to characterize in this section. More formally, we are looking for the correspondence $\mathcal{S}_1 \times \mathcal{S}_2 \to \mathbb{R}^2_+ : (s_1, s_2) \mapsto (n, m)$. This can conveniently be done for each type of policy regime separately.

3.1 Policy regime $\big((\mathfrak{N}, \cdot), (\mathfrak{N}, \bullet)\big)$

Within this section we assume that all licenses issued by both governments are exercised, and the number of active firms in each country coincides with the respective number of licenses, *i. e.*, we have $n = \mathfrak{n}$ and $m = \mathfrak{m}$. If either government were to issue such a high number of licenses that not all firms are willing to enter the market, we are effectively in the free-entry case, $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$ or $\big((\mathfrak{R}, \cdot), \mathfrak{F}\big)$. As these scenarios will be scrutinized below, we assume in this subsection that the zero-profit conditions are non-binding in both countries.

For any given numbers of active firms, n and m, each firm i determines its supply q_i by maximizing its profit,

$$p(z)q_i - c(q_i) + f\,,$$

with respect to q_i, where $z = q_i + \sum_{\substack{j=1 \\ j\neq i}}^{n} q_j + \sum_{j=1}^{m} Q_j$. (And correspondingly for the foreign firms.) As within each country firms are symmetric, our assumptions ensure that the equilibrium output decisions among firms of the same jurisdiction are identical. Then, for any fixed pair (n, m) the Cournot equilibrium of the output market is characterized by

$$p'(z)q + p(z) - c'(q) \;=\; 0\,, \tag{1}$$

$$p'(z)Q + p(z) - C'(Q) \;=\; 0\,, \tag{2}$$

$$nq + mQ \;=\; z\,. \tag{3}$$

with $q := y/n$ and $Q := Y/m$. By application of the implicit function theorem, eqs (1)–(3) yield each firm's and aggregate supply as a function of n and m. With slight sloppiness we refer to these functions as $q(n, m), Q(n, m)$, and $z(n, m)$. (We omit the arguments, however, whenever no confusion should arise.)

In order to see how the equilibrium of the output market changes as either the domestic or the foreign government increases the number of licenses, and hence the number of incumbent firms, differentiate eqs (1)–(3) to obtain

$$\frac{\partial z}{\partial n} \;=\; \frac{q(p' - C'')(p' - c'')}{|\mathbf{A}|} \;>\; 0\,,$$

$$\frac{\partial q}{\partial n} \;=\; -\frac{q(p' - C'')(p' + qp'')}{|\mathbf{A}|} \;<\; 0\,,$$

$$\frac{\partial Q}{\partial n} \;=\; -\frac{q(p' - c'')(p' + Qp'')}{|\mathbf{A}|} \;<\; 0\,,$$

$$\frac{\partial z}{\partial m} \;=\; \frac{Q(p' - c'')(p' - C'')}{|\mathbf{A}|} \;>\; 0\,,$$

$$\frac{\partial q}{\partial m} \;=\; -\frac{Q(p' - C'')(p' + qp'')}{|\mathbf{A}|} \;<\; 0\,,$$

$$\frac{\partial Q}{\partial m} \;=\; -\frac{Q(p'-c'')(p'+Qp'')}{|\mathbf{A}|} \;<\; 0\,,$$

where

$$|\mathbf{A}| \;=\; (p'-c'')(p'-C'') + n(p'-C'')(p'+qp'') + m(p'-c'')(p'+Qp'') \;>\; 0\,.$$

Straightforward calculations show that

$$\begin{aligned}
\frac{\partial y}{\partial n} &= \frac{q(p'-c'')}{|\mathbf{A}|}\big[(p'-C'') + m(p'+Qp'')\big] \;>\; 0\,,\\
\frac{\partial Y}{\partial n} &= m\,\frac{\partial Q}{\partial n} \;<\; 0\,,\\
\frac{\partial y}{\partial m} &= n\,\frac{\partial q}{\partial m} \;<\; 0\,,\\
\frac{\partial Y}{\partial m} &= \frac{Q(p'-C'')}{|\mathbf{A}|}\big[(p'-c'') + n(p'+qp'')\big] \;>\; 0\,.
\end{aligned}$$

Inserting firms' supply, $q(n,m)$ and $Q(n,m)$, into their objective functions gives domestic and foreign firms' profit as a function of n and m: $\pi(n,m) := p(z(n,m))\,q(n,m) - c(q(n,m)) - f$ and $\Pi(n,m) := p(z(n,m))\,Q(n,m) - C(q(n,m)) - F$, respectively. Correspondingly, we may write each countries' welfare as a reduced function depending on n and m exclusively:

$$w(n,m) \;:=\; \int_0^{x(n,m)} p^H(\xi)\,d\xi - p(z(n,m))\,x(n,m) + n\,\pi(n,m)\,, \tag{4}$$

where $x(n,m) := \tilde{x}\,(p(z(n,m)))$, and similarly for the foreign country.

In the $\big((\mathfrak{R},\cdot),(\mathfrak{R},\bullet)\big)$–regime, each government's best policy is determined by the number of firms which maximizes its welfare function for any given number of firms in the other country. Thus, the domestic and the foreign government's best policies are characterized by $\partial w(n,\bar{m})/\partial n \;=\; 0\;\forall \bar{m} \;>\; 0$ and $\partial W(\bar{n},m)/\partial m \;=\; 0\;\forall \bar{n} \;>\; 0$, respectively. Applying firms' first order conditions and omitting arguments, this implies for the domestic government

$$\frac{\partial w}{\partial n} \;=\; -(x-y)p'\,\frac{\partial z}{\partial n} - yp'\,\frac{\partial q}{\partial n} + \pi \;\overset{!}{=}\; 0\,. \tag{5}$$

Eq. (5) and a corresponding one for the foreign country characterize the *restricted best-reply curves* for the domestic and foreign government, respectively. They are restricted in the sense that they have been derived without regard to the participation constraints of the firms, under the implicit assumption that all licenses are used. It follows that these restricted best-reply curves coincide with the best-response curves of a hypothetical game where governments choose the numbers of incumbent firms directly, irrespective of the zero-profit conditions. We denote the point of intersection of these restricted best-reply curves by $N := (n_N, m_N)$ in the following.

The first term of eq. (5) represents the so called terms-of-trade effect, which is positive for a net-importing but negative for a net-exporting country. This term reflects a government's endeavor to encourage production through granting more licenses and thus to lower the output price when consumer surplus outweighs producer surplus, but to limit production and thus to increase the price when the burden of a higher output price is at least partially borne by foreign consumers. The second term results from imperfect competition. Since each firm produces, due to its non-competitive behavior, too little, the government does not seek to foster this tendency by allowing for excessive entry. Rather it wants to encourage each firm to produce a higher output, which can be achieved only by limiting the number of incumbent firms. Lastly, there is the beneficial profit effect of an additional firm. As long as market entry is restricted and thus firms obtain a positive profit, additional dividend income can be generated and distributed to consumers if a further license is given to a new entrant. In sum, the government chooses the number of active firms (or incumbents), implicitly given by eq. (5), such that the positive and negative marginal welfare effects outweigh each other. And this number is, *ceteris paribus*, the higher the more the country is dependent on imports, the higher are the profits obtained by incumbent firms, and the less the entrance of a new firm erodes the supply of its competitors.[9]

3.2 Policy regimes $\big((\mathfrak{R}, \cdot), \mathfrak{F}\big)$ and $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$

Next consider the case where either of both governments allows for free market entry, *i. e.*, it does not play any active industrial policy but lets firms freely enter the market, while the other government actively interferes with firms' decisions by restricting market access. In this case, the number of firms in the country with free

[9]It follows from eq. (5) that if, due to continued entrance of firms, π has fallen to zero, the home country must be a net-importer.

market entry is determined by a zero profit condition, whereas in the other country it is determined by the government. In order for this scenario to constitute a non-trivial problem, the firms of the country which regulates market entry through licensing should require a lower break-even price to obtain non-negative profits than the firms in the other country do. Otherwise the firms with the higher break-even price were never to enter the market, irrespective of their government's policy. Without loss of generality, we assume that the firms in the home country require a lower output price in order to acquire non-negative profits than the firms in the foreign country. And in this sense we call the domestic firms the *low-cost firms*, and the foreign firms the *high-cost firms* in the following. In order to express this assumption more formally, insert the aggregate demand function, $\tilde{z}$, into eq. (1) and use $p = \tilde{z}^{-1}$ to obtain $p'(\tilde{z}(\phi))q + \phi - c'(q) = 0$. Applying the implicit function theorem, this gives $q = q^p(\phi)$, which can be used to write the resulting maximally attainable profit as a function of the price alone: $\pi_p(\phi) := \phi\, q^p(\phi) - c(q^p(\phi)) - f$, and similarly for a foreign firm. Then our assumption about the cost structures can be expressed as $\min\{\phi : \pi_p(\phi) \geq 0\} \leq \min\{\phi : \Pi_p(\phi) \geq 0\}$.[10]

Given free market entry abroad and some number of domestic firms, the equilibrium of the output market is determined by eqs (1)–(3) and the zero-profit condition of the foreign firms,

$$p(z)Q - C(Q) - F \;=\; 0\,. \tag{6}$$

In this case, $m = \hat{m}(n)$ becomes a endogenous variable, and supply can be viewed as to be dependent on n alone: $\hat{q}(n) := q(n, \hat{m}(n)), \hat{Q}(n) := Q(n, \hat{m}(n))$, and $\hat{z}(n) := z(n, \hat{m}(n))$. Differentiating eqs (1)–(3) and (6) with respect to n and solving for the desired derivatives yields

$$\frac{d\hat{z}}{dn} = 0\,, \qquad \frac{d\hat{q}}{dn} = 0\,, \qquad \frac{d\hat{Q}}{dn} = 0\,, \qquad \frac{d\hat{m}}{dn} = -\frac{q}{Q}\,. \tag{7}$$

Any entrance (exit) of an additional competitor at home is compensated by a corresponding exit (entrance) of firms abroad such that aggregate supply remains constant. Notably, although we have not imposed any limiting assumptions such as

[10]Note that this assumption does *not* require that the domestic firms' average cost fall short of the foreign firms' average cost for all output levels below the minimum average cost — although this is a sufficient condition.

constant marginal cost, the government does neither exert any impact on aggregate supply nor on any firm's scale: Each firm continues to produce at the same scale as before and the necessary compensating change in incumbent firms' supply is exclusively achieved by an appropriate change in the number of foreign firms, such that aggregate supply remains at its initial level.

In this policy scenario, the domestic government chooses n so as to maximize domestic welfare, taking into account that foreign firms may enter or leave the market according to the emergence of profit opportunities. To characterize the domestic government's best policy under free entry abroad, we have to differentiate $\hat{w}(n) := w(n, \hat{m}(n))$ with respect to n. This yields

$$\frac{d\hat{w}}{dn} \;=\; -(x-y)p'\,\frac{d\hat{z}}{dn} - yp'\,\frac{d\hat{q}}{dn} + \pi \;\overset{!}{=}\; 0\,.$$

Note that this first order condition is seemingly identical to eq. (5). Yet, since the market response to an increase of n is different now, see eq. (7), we arrive at

$$\frac{d\hat{w}}{dn} \;=\; \pi \;>\; 0\,. \tag{5a}$$

Because free entry of foreign firms leads to a constancy of world-wide supply, the world-market price is independent of the actual choice of n, and thus any increase in n does not reduce a domestic firm's profit π as long as there is still some foreign firm serving the market.[11] Intuitively, as foreign firms can be prompted to leave the market by increasing the number of domestic competitors, the domestic government faces an incentive to increase n. In particular, it will exploit this profit-shifting opportunity until all foreign firms have been driven out of the market. For this reason a terms-of-trade effect does not appear in eq. (5a).

As a consequence, no interior solution for the domestic government's optimization problem exists, and it will choose some number of licenses where the domestic industry achieves an international monopoly. Let n_R denote the minimum number of domestic firms which suffices to make all foreign firms leave the market. Correspondingly we refer to $M_R := (n_R, 0)$ as the *entry-deterrence point* in

[11] Note that due to our assumption that the domestic firms require a lower market price in order to achieve a non-negative profit, domestic firms obtain a positive profit at any market equilibrium where (active) foreign firms earn zero profits.

the following. Then, any $\mathfrak{n} \geq n_R$ may be a candidate for the domestic government's best response to the foreign government's strategy $\mathfrak{F}$, when the domestic government chooses $\mathfrak{R}$. To find out which $\mathfrak{n}$ actually maximizes domestic welfare, we must compare $w(n_R, 0)$ with the maximal welfare level achievable when m equals zero, $\max_n w(n, 0)$. Let n_M denote the number of domestic firms which maximizes domestic welfare under complete absence of foreign firms.[12] Then, the corresponding *monopoly point* $M_M := (n_M, 0)$ represents the intersection point of the restricted best-reply curve with the horizontal axis in an (n, m)–diagram. Clearly, for our model of international competition in market entry regulation to make sense, it must be true that, given n_M active domestic firms, foreign firms were to obtain a positive profit, and are thus willing to enter the market. Accordingly, we make the following assumption.

Assumption 2 $n_M < n_R$.

Assumption 2 requires that the domestic country is not able to maximize domestic welfare without taking into account the behavior of the foreign country. Or equivalently, driving all foreign firms out of the market requires more than the presence of merely n_M domestic firms. If this were not the case, domestic firms would dominate the market in any case. Since at least potential competition between foreign and domestic firms should prevail, $n_R \leq n_M$ must be excluded.

As a consequence, once foreign firms have left the market, and the low-cost country has achieved an international monopoly, it is not to the benefit of the domestic country to increase n further. In particular, the domestic government has no interest in letting the number of active firms rise up to the point where its firms would obtain zero profits, say $n = n_F$ (free-entry market equilibrium). More formally, we have $w(n_R, 0) > w(n_F, 0)$. In sum, if the foreign government chooses

[12] Note that when no foreign firm is active, the comparative statics results of (7) do not apply. Rather the market behavior in response to changes of n is implicitly given by eqs (1) and (3), evaluated at $m = 0$. Thus, differentiating $w(n, 0)$ with respect to n and using eqs (1) and (3), we see that the domestic government's best policy is characterized by

$$\left.\frac{\partial w}{\partial n}\right|_{m=0} = -(x-y)p' \left.\frac{\partial z}{\partial n}\right|_{m=0} - yp' \left.\frac{\partial q}{\partial n}\right|_{m=0} + \pi \overset{!}{=} 0\,, \tag{5b}$$

to the root of which we refer as n_M.

strategy $\mathfrak{F}$ and the domestic government decides to choose $\mathfrak{R}$, then the latter will set $\mathfrak{n} = n_R$.

3.3 Policy regime $(\mathfrak{F}, \mathfrak{F})$

Finally consider the case where both governments allow for free market entry, *i. e.*, where the chosen strategy tuple equals $(\mathfrak{F}, \mathfrak{F})$. This is the simplest case, for once both governments have decided to play $\mathfrak{F}$, there is no additional policy variable to be determined by either government. And as long as the minimum-prices required to obtain non-negative profits for the firms in both countries differ, only the low-cost firms — here, the domestic firms — can survive. Hence, the equilibrium of the output market is characterized by the domestic firms' first order and zero-profit condition, given by (1) and

$$p(z)q - c(q) - f \; = \; 0\,, \tag{8}$$

respectively, as well as by the aggregate supply identity (3) with $m = 0$. This implies that under strategies $(\mathfrak{F}, \mathfrak{F})$ the induced market equilibrium is given by $M_F := (n_F, 0)$, to which we refer as the *free entry point.*

More generally, the domestic firms' zero-profit condition, $\pi(n, m) = 0$, determines, by application of the implicit function theorem, the domestic firms' zero-profit curve in the (n, m)–space: $m = \phi_1(n)$. Analogously, $\Pi(n, m) = 0$ gives the foreign firms' zero-profit curve $m = \phi_2(n)$.[13] Using the envelope theorem, we find that the slopes of both zero-profit conditions in the n-m–space coincide for all n

$$\frac{d\phi_1(n)}{dn} \; = \; -\frac{q}{Q} \; = \; \frac{d\phi_2(n)}{dn}\,.$$

Hence, the zero-profits curves are parallel, and they only coincide if the minimum prices both types of firms require to attain non-negative profits are identical, *i. e.*, if $\min\{\phi : \pi_p(\phi) \geq 0\} = \min\{\phi : \Pi_p(\phi) \geq 0\}$. Remarkably, this is true for any

[13] Note that the domestic zero-profit curve, ϕ_1, is a somewhat hypothetical object, since either zero-profit curve has been constructed under the assumption that the number of firms abroad can be varied parametrically. Yet, because the foreign firms are the high-cost firms, they cannot profitably stay in the market when the domestic firms obtain zero profits. Therefore, any point on ϕ_1 with $m > 0$ would require foreign firms to endure losses.

well-behaved cost function, and does not require constant marginal cost or an affine-linear demand curve.

4 An Investigation of Best Responses

Thus far we have analytically demonstrated how under each policy regime the number of licenses is determined by either government, and how many firms enter the market given the policies of both governments. As a next step, we have to scrutinize both governments' (equilibrium) behavior when each of them decides about its general policy: $\mathfrak{R}$ or $\mathfrak{F}$. In order to do this, it is convenient to complement our analysis by a diagrammatic representation. For this reason Figures 1 and 2 on pages 15 and 16 depict iso-welfare curves of the home and the foreign country, respectively, with welfare increasing in the direction of brighter areas. Either figure also shows both regions' restricted best-reply curves, implicitly given by eq. (5) for the domestic government. Naturally, along the home [foreign] country's restricted best-reply curve, labeled by $R_1(m)$ [$R_2(n)$], the slope of its iso-welfare curves equals zero [infinity].

Recall that N represents the point of intersection of the restricted best-reply curves, which have been derived under the implicit assumption that governments need not take into account the participation constraints (cf. p. 9).[14] In our framework, however, we do have to take into account that firms entering the market endure fixed costs which must be recouped through subsequent sales so as to make entry worthwhile. Because profits decrease with the number of incumbent firms, there are upper bounds on n and m characterized by the zero-profit curves, ϕ_1 and ϕ_2, which are included in Figures 1 and 2. Since the minimum market price required to guarantee a non-negative profit is lower for the domestic than for the foreign firms, the domestic zero-profit frontier lies to the North-East of the foreign zero-profit frontier. Hence, the area lying to the North-East of ϕ_1 is irrelevant, for it represents scenarios of excessive entry where all active firms endure losses.

Before turning to an investigation of both governments' equilibrium behavior, let us make some preliminary considerations. First, if more licenses are granted

[14] We may think of public firms or private firms which may be subsidized at any desired level.

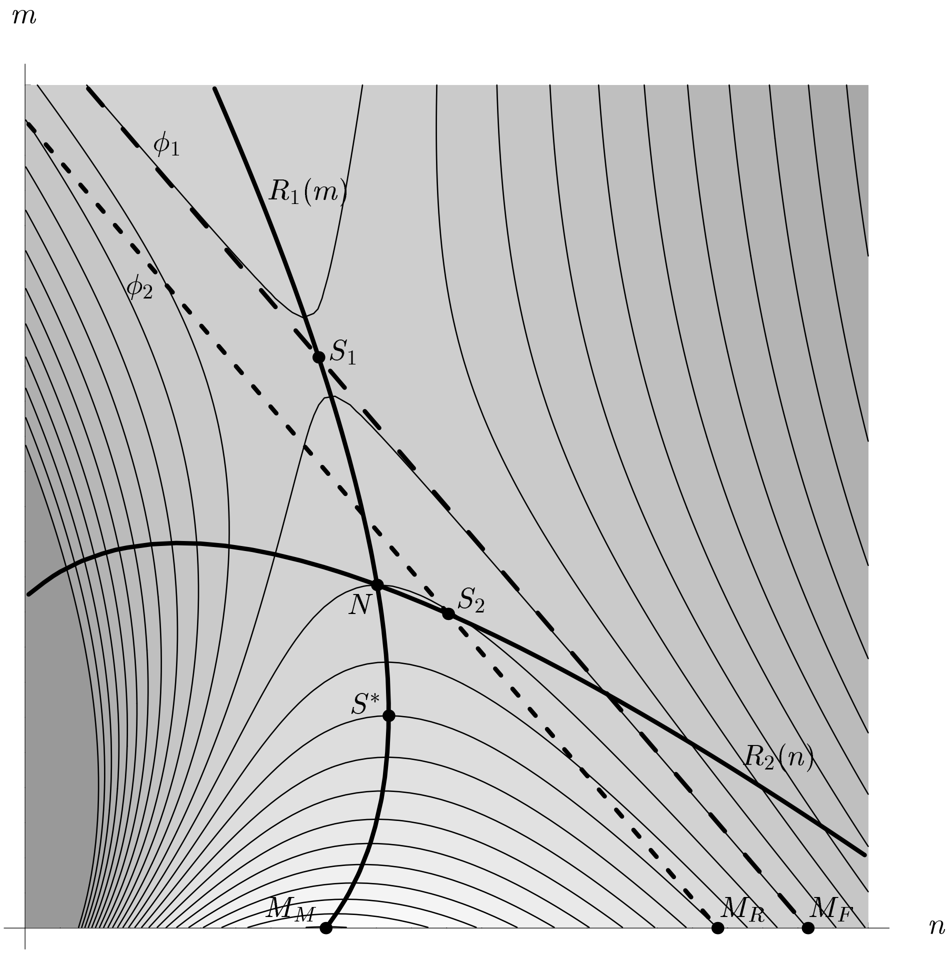

Figure 1: Possible policy scenarios with iso-welfare curves of the home country

than firms may survive with non-negative profits, some of the licenses given to firms with the highest break-even price remain unused. That is, some firms let their options to enter the market expire up to the point where the marginal entrant obtains zero profit. Correspondingly, if either of both governments chooses to allow for free entry, that is, it plays strategy $\mathfrak{F}$, the resulting equilibrium numbers of firms must either lie on the corresponding zero-profit curve (ϕ_1 or ϕ_2), or no firm enters the market in the $\mathfrak{F}$–playing country. Since under free entry the market price equals the average cost in the country which allows for free entry, the market price and, therefore, aggregate supply and consumer surplus must be constant along corresponding free-entry frontier. Hence, since for the country allowing for free entry both welfare components — profits (which are

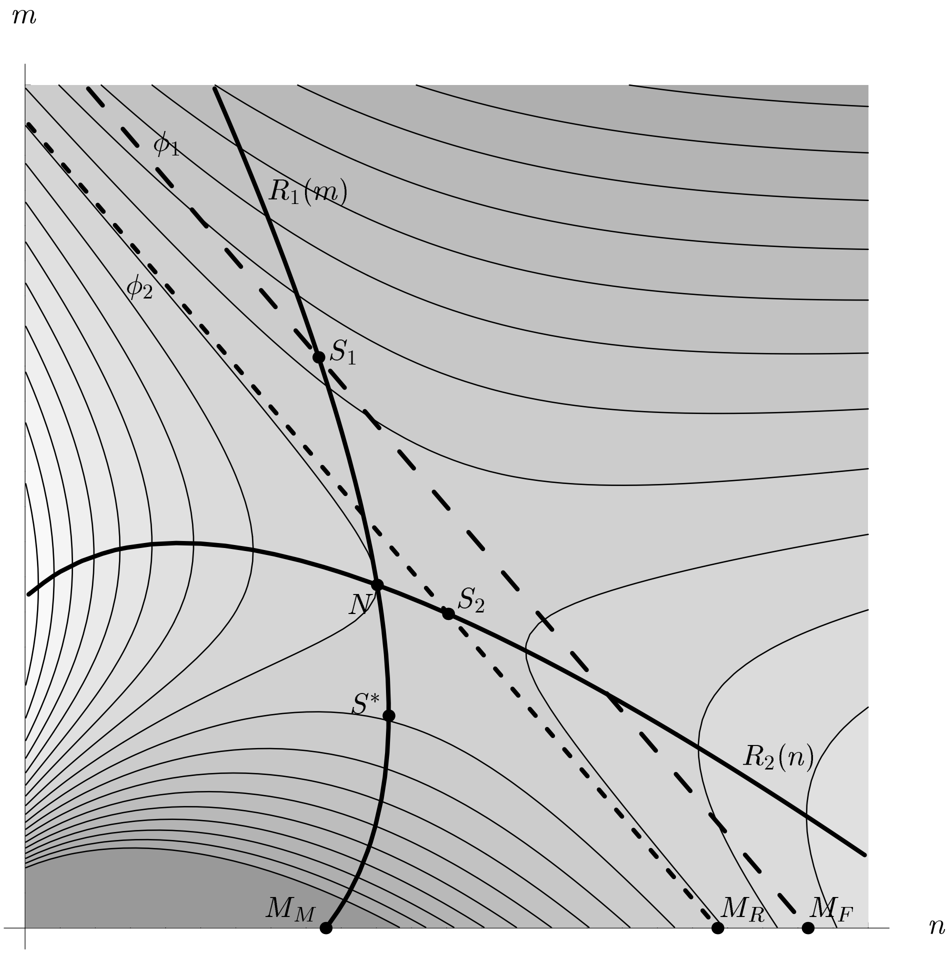

Figure 2: Possible policy scenarios with iso-welfare curves of the foreign country

equal to zero) and consumer surplus — are constant, welfare must be so as well. In other words, the ϕ_1– and the ϕ_2–curve also represent iso-welfare curves for the home and the foreign country, respectively. In particular, ϕ_1 and ϕ_2 represent minimum- or reservation-welfare curves, for either of both governments can induce some market equilibrium on its respective zero-profit curve by playing $\mathfrak{F}$. Next, observe that each welfare function has a saddle point, denoted by $S_i = (n_{S_i}, m_{S_i})$, $i = 1, 2$, which coincides with the point of intersection of the respective zero-profit curve with the restricted best-reply curve. Since S_i lies on both ϕ_i and R_i, we must have $R_1(m_{S_1}) = n_{S_1}$, $R_2(n_{S_2}) = m_{S_2}$, $w(n_{S_1}, m_{S_1}) = w(n_F, 0)$, and $W(n_{S_2}, m_{S_2}) = W(n_R, 0)$. Because either country attains its minimum reservation welfare level at S_i, it must also attain a minimum welfare level along

R_i. It follows that $w(n_N, m_N) \geq w(n_{S_1}, m_{S_1})$, $W(n_N, m_N) \geq W(n_{S_2}, m_{S_2})$, and $w(n_M, 0) \geq w(R_1(m), m) \geq w(n_{S_1}, m_{S_1})\, \forall m$ must hold. Due to continuity, we also infer that $\exists m^* : w(R_1(m^*), m^*) = w(n_R, 0)(\geq w(n_F, 0))$; we refer to this point as $S^* := (n^*, m^*)$, with $n^* := R_1(m^*)$. (All these points are included in Figures 1 and 2.)[15] Armed with these prerequisites, let us now scrutinize the existence and the nature of equilibria of the complete policy game.

4.1 Policy regime $(\mathfrak{F}, \mathfrak{F})$

We have already seen that in the $(\mathfrak{F}, \mathfrak{F})$–regime the resulting market equilibrium is achieved at $M_F = (n_F, 0)$. However, both governments anticipate that if they play $(\mathfrak{F}, \mathfrak{F})$, the market equilibrium will be at M_F — and either of them will unilaterally deviate from playing $\mathfrak{F}$ if it is beneficial to do so. Consider the domestic government. As long as the market price falls short of foreign firms' average cost, the domestic country faces a trade off between profits and consumer surplus. In fact, since $n_F > n_R (> n_M)$, reducing the number of domestic firms increases domestic welfare, provided that the market price does not increase too much such that excessive entry of foreign firms is induced. This is illustrated in Figure 1 showing that a movement from point M_F towards $M_R = (n_R, 0)$ increases domestic welfare. Thus, $(\mathfrak{F}, \mathfrak{F})$ does not constitute an equilibrium, for the domestic government would unilaterally deviate by playing, for example, $(\mathfrak{R}, \mathfrak{n})$ with $\mathfrak{n} \in [n_R, n_F)$.

4.2 Policy regime $((\mathfrak{R}, \cdot), \mathfrak{F})$

As we have seen, the government of the home country deviates from $(\mathfrak{F}, \mathfrak{F})$ by playing $\mathfrak{R}$. Then, the question arises whether $((\mathfrak{R}, \cdot), \mathfrak{F})$ for some appropriate choice of $\mathfrak{n}$ may constitute an equilibrium. When the foreign government plays $\mathfrak{F}$, only points on the ϕ_2–curve or on the horizontal axis between M_R and M_F are attainable. Among these the most preferred point for the home country is M_R. That is,

[15] It should be mentioned that N may lie above the ϕ_2–curve, implying that S_2 lies to the left of N on the R_2–curve. This occurs if the costs of the foreign firms are relatively high as compared with the domestic firms. Although this scenario is theoretically possible, it seems to be of limited practical relevance. However, it is worthwhile to note that our conclusions continue to hold even in this case, though.

given free market entry abroad, the domestic government chooses the minimum number of domestic licenses which suffices to prevent foreign firms from entering the market: n_R. Clearly, given $\big((\mathfrak{R}, n_R), \mathfrak{F}\big)$ all domestic firms holding a license are willing to enter. Also, neither the foreign government can beneficially deviate from $\big((\mathfrak{R}, n_R), \mathfrak{F}\big)$. Whatever number of licenses the foreign government may choose to grant, no foreign firm will enter, and thus the resulting market equilibrium will still be reached at M_R, implying that foreign welfare will not improve. Therefore, $\big((\mathfrak{R}, n_R), \mathfrak{F}\big)$ constitutes an equilibrium. At this point, domestic firms serve the full market and earn a positive profit, while aggregate market supply equals the quantity which would result under free-entry in the foreign country.

4.3 Policy regime $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$

As there is an equilibrium in the $\big((\mathfrak{R}, \cdot), \mathfrak{F}\big)$–regime, one might expect that there is a corresponding one in the $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$–regime. Yet, we shall argue that, independent of the number of licenses the foreign government may choose, the strategy tuple $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$ does not constitute an equilibrium for any $\mathfrak{m}$. Under free entry in the low-cost country, no foreign firm will obtain a non-negative profit, and, thus, the corresponding market equilibrium is represented by M_F. At this point, all domestic firms obtain a zero profit, while all foreign firms stay out of the market.[16]

In order to investigate whether there might be some $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$–equilibrium, suppose first that the foreign government selects some number $\mathfrak{m} \in [0, m_{S_1}]$. Then, the domestic government will cease to play $\mathfrak{F}$, and instead selects the corresponding point on its restricted best-reply curve if $\mathfrak{m} < m^*$, or selects $\mathfrak{n} = n_R$ if $\mathfrak{m} \in [m^*, m_{S_1}]$. Alternatively, suppose the foreign government chooses some $\mathfrak{m} > m_{S_1}$. In this case the corresponding points on the domestic government's restricted best-reply curve are not feasible, for these would imply negative profits. However, given $\mathfrak{m} > m_{S_1}$, the domestic government again prefers $\mathfrak{R}$ to $\mathfrak{F}$, because selecting some $\mathfrak{n}$ below the free-entry level n_F yields a higher welfare level. This may either continue to prevent entry of foreign firms if $n_R < \mathfrak{n} < n_F$, or results in partial entry of foreign firms if $\mathfrak{n} < n_R$. In the latter case, some of the foreign licenses remain unused, so

[16]This illustrated the somewhat hypothetical character of the ϕ_1–curve, as no other point than M_F can ever be reached on ϕ_1.

as to guarantee that the active foreign firms obtain zero profit. In both cases, domestic welfare exceeds the initial welfare level corresponding to the ϕ_1–curve, implying that the domestic government plausibly ceases to play $\mathfrak{F}$. For this reason $\big(\mathfrak{F}, (\mathfrak{R}, \bullet)\big)$ cannot constitute an equilibrium.

4.4 Policy regime $\big((\mathfrak{R}, \cdot), (\mathfrak{R}, \bullet)\big)$

Finally consider the case where both governments restrict entry by granting licenses. In order to characterize our results we apply the following condition.

Condition 1 *There exists some $n^\circ > n_R$ for which $w(n^\circ, 0) = w(n_N, m_N)$ holds.*

Condition 1 implies that the domestic country's welfare at $N = (n_N, m_N)$ is lower than at $M_R = (n_R, 0)$, *i. e.*, $w(n_N, m_N) < w(n_R, 0)$. Note carefully that Condition 1 can only be violated, if the ϕ_1– and the ϕ_2–curve are very close to each other, that is, if the minimum prices both types of firms require to achieve non-negative profits are very similar. We wish to rule out this for the moment and assume that, in this sense, the cost difference between the domestic and the foreign is 'not too low'.

Definition 1 *The cost difference between domestic and foreign firms is said to be* significant *if, and only if, Condition 1 holds; otherwise, it is said to be* insignificant.

Since we have $w(n^*, m^*) = w(n_R, 0)$ by construction, $w(n_R, 0) > w(n_N, m_N)$ by Condition 1, and $w(R_1(a), a) > w(R_1(b), b)$, $\forall a < b \leq m_{S_1}$ due to the saddle-point property of S_1, the cost difference is significant, if, and only if, S^* lies below N, which is equivalent to the domestic country preferring M_R to N. This can be verified by inspection of Figures 1 and 2.

Suppose the domestic government plays $(\mathfrak{R}, n_R)$. If the foreign government chooses to play $(\mathfrak{R}, \mathfrak{m})$ with $\mathfrak{m} < m^*$, the domestic government faces an incentive to deviate, since moving onto its restricted best-reply curve, R_1, yields, by definition of S^*, a higher welfare level than does the resulting market equilibrium at M_R. Thus, $\big((\mathfrak{R}, n_R), (\mathfrak{R}, \mathfrak{m})\big)$ with $0 \leq \mathfrak{m} < m^*$ cannot constitute an equilibrium. Also, $\big((\mathfrak{R}, R_1(\mathfrak{m})), (\mathfrak{R}, \mathfrak{m})\big)$ with $0 \leq \mathfrak{m} < m^*$ cannot be an equilibrium, for the foreign government would deviate by choosing $(\mathfrak{R}, R_2(R_1(\mathfrak{m})))$.

Yet, when the foreign government plays $(\mathfrak{R}, \mathfrak{m})$ with $\mathfrak{m} \geq m^*$, the domestic government continues to deter entry by playing $(\mathfrak{R}, n_R)$, rather than to move onto its restricted best-reply curve (or doing something else). The reason is that any point on the domestic restricted best-reply curve, $R_1(m)$, with $m > m^*$ yields, by construction of $S^* := (n^*, m^*)$, a lower domestic welfare level than does M_R. Clearly, also the foreign government cannot profitably deviate, as long as the domestic government plays $(\mathfrak{R}, n_R)$. Hence, all strategies $\big((\mathfrak{R}, n_R), (\mathfrak{R}, \mathfrak{m})\big)$ with $\mathfrak{m} \geq m^*$ represent equilibria of the game.

Another canonical candidate for an equilibrium might be the point where both restricted best-reply curves intersect, point N. However, since under Condition 1 the domestic government prefers M_R to N, the latter cannot represent an equilibrium, because the domestic government can guarantee itself the welfare level corresponding to point M_R by setting $\mathfrak{n} = n_R$. Thus, we obtain the remarkable result that the point of intersection of the restricted best-reply curves does not constitute an equilibrium of the game considered here.

5 Subgame-perfect equilibria of the game

We have seen that M_R is the focal point of this game. When the foreign government chooses to play either $\mathfrak{F}$ or $(\mathfrak{R}, \mathfrak{m})$ with $\mathfrak{m} > m^*$, and the domestic government regulates its industry by playing $(\mathfrak{R}, n_R)$, neither government faces an incentive to deviate from its selected policy unilaterally. Therefore, with a significant cost difference between domestic and foreign firms, we arrive at the following result.

Proposition 1 *Let the cost difference between domestic and foreign firms be significant. There are two types of equilibria:*

- $\big((\mathfrak{R}, n_R), \mathfrak{F}\big)$ *and*
- $\big\{\big((\mathfrak{R}, n_R), (\mathfrak{R}, \mathfrak{m})\big) | \mathfrak{m} > m^*\big\}$,

All equilibria induce the same market allocation characterized by $M_R = (n_R, 0)$.

Note carefully that although both types of equilibria are different, the resulting allocations coincide: Both lead to the allocation represented by M_R. Intuitively, in any equilibrium, the domestic government restricts market access by exactly granting that number of licenses where no foreign firm is willing to enter the market, while the foreign government creates a large number of potential market entrants by either allowing for free entry or by granting a sufficiently high number of licenses. Although in both cases no foreign firm actually enters the market, the foreign government credibly threatens that its firms will be ready to compensate for any supply shortage, should the domestic government further restrict market access and thereby limit supply. Thus, the notional presence of a substantial number of foreign firms has a significant impact on the equilibrium outcome. The mere threat of entrance of foreign (high-cost) firms forces the domestic government to allow for a larger number of domestic (low-cost) firms than it would do were its firms' market position not jeopardized.

6 Welfare analysis

We now explore the equilibrium welfare effects of our game in industrial policies. First, we compare M_R with N. Recall that the point S_i represents a minimum welfare level along the corresponding restricted best-reply curve for either country. As a consequence, while the foreign country obtains at S_2, by construction, the zero-profit welfare level represented by the ϕ_2–curve, it must attain a higher welfare level at N. Since the ϕ_2–curve ends at M_R, it follows that the equilibrium welfare level of the foreign country is lower than the welfare level it attains at N. Hence, given that the cost difference between domestic and foreign firms is significant, the home country prefers M_R to N, and a hypothetical transition from N to M_R does, therefore, not constitute a Pareto improvement.

Next, we explore whether and when the market equilibrium M_R will be efficient. For this purpose, we apply the following condition.

Condition 2 *There is no tuple* $(n', m') \neq (n_R, 0)$ *with* $n', m' > 0$ *such that* $w(n', m') = w(n_R, 0)$ *and* $W(n', m') = W(n_R, 0)$.

Condition 2 requires that the pair of utility levels obtained at the entry-deterrence point, M_R, cannot be achieved at some other point. Graphically this means that the domestic country's iso-welfare curve through M_R does not meet the corresponding foreign iso-welfare curve at some point other than M_R. This requires that the ϕ_1– and the ϕ_2–curve may not be too close. Thus, we define:

Definition 2 *The cost difference between domestic and foreign firms is said to be* substantial *if, and only if, Condition 2 holds; otherwise, it is said to be* insubstantial.

In view of Condition 2, it follows that for a substantial cost difference the entry deterrence point, M_R, is Pareto efficient.

Proposition 2 *The allocation represented by $M_R = (n_R, 0)$ is Pareto efficient if, and only if, the cost difference between domestic and foreign firms is substantial.*

Thus, with a substantial cost difference all equilibria are efficient. Or conversely, only if the cost difference is insubstantial, does the equilibrium allocation M_R not be Pareto efficient. Efficiency of M_R holds, because any iso-welfare curve of the home country starting on the horizontal axis to the left of M_F is flatter than the ϕ_1–curve (in absolute terms); and since the latter is parallel to the ϕ_2–curve, the iso-welfare curve originating at M_R is at that point flatter than the ϕ_2–curve. And if the cost difference is substantial, these two iso-welfare curves will not meet again at some other point to the North-West of M_R. Hence, given the welfare level the foreign country achieves at M_R, the domestic country's welfare cannot be increased by selecting some other point than M_R, and *vice versa.*

Remark 1 *Condition 2 implies Condition 1, and hence an insignificant cost difference is also insubstantial.*

It follows that with an insignificant cost difference both countries prefer point N to M_R and, thus, the former is Pareto superior to the latter — yet still not Pareto efficient.

In sum, the game in market structures, as considered here, has multiple equilibria. Assuming a significant cost difference between the domestic and the foreign firms, all of these equilibria, which can be sub-divided into two types, result in the same market allocation where production exclusively takes place in the cost-efficient country. And if the cost difference is not only significant but substantial, this allocation is Pareto efficient.

7 The case of 'similar' firms

So far we have assumed that the cost difference between both types of firms is significant. Although we think that cost differences represent the typical framework in an international setting, it is nevertheless interesting to consider the limiting case where the cost difference is small, *i. e.*, insignificant. According to Figure 1, the iso-welfare curve of the low-cost (domestic) country passing through point N has a common point with the zero-profit curve of the high-cost (foreign) country. This holds as long as the cost difference is significant, but as the cost difference gets smaller, the domestic iso-welfare curve through N eventually intersects the horizontal axis at some point to the left of M_R, say at $(n^\circ, 0)$. In economic terms, if the cost difference is insignificant, and thus $n^\circ < n_R$, the low-cost country prefers point N to M_R. Diagrammatically, this means that the point S^* shifts to the North of N.

With an insignificant cost difference we obtain the following results. As before, whenever the foreign country plays $(\mathfrak{R}, \mathfrak{m})$ with some $\mathfrak{m} \in [0, m^*]$, the domestic government prefers the corresponding point on its restricted best-reply curve, R_1, to the point M_R. But with an insignificant cost difference, we have $m_N \in [0, m^*]$, implying that the strategy tuple $\big((\mathfrak{R}, n_N), (\mathfrak{R}, m_N)\big)$ now also constitutes a Nash equilibrium. It is easy to verify that the two other types of equilibria obtained in the case of a significant cost difference, continue to represent equilibria also in this case. Thus, with an insignificant cost difference we have three types of equilibria. Note also that Remark 1 implies that whenever N can be supported in equilibrium (insignificant cost difference), M_R is not Pareto efficient; while whenever M_R is Pareto efficient, N cannot be reached as a Nash equilibrium. Hence, we arrive at the following proposition.

Proposition 3 *Let the cost difference between domestic and foreign firms be insignificant. There are three types of equilibria:*

- $\big((\mathfrak{R}, n_R), \mathfrak{F}\big)$,
- $\big\{\big((\mathfrak{R}, n_R), (\mathfrak{R}, \mathfrak{m})\big) | \mathfrak{m} > m^*\big\}$, *and*
- $\big((\mathfrak{R}, n_N), (\mathfrak{R}, m_N)\big)$.

Neither of these induces a Pareto efficient allocation.

With an insignificant cost difference a third type of equilibrium emerges: the strategy tuple $\big((\mathfrak{R}, n_N), (\mathfrak{R}, m_N)\big)$. While the first two types of equilibria both induce the market allocation characterized by M_R, the new equilibrium leads to the allocation characterized by $N = (n_N, m_N)$. Since Condition 1 is necessary for Condition 2, the market allocation M_R cannot be Pareto efficient under an insignificant cost difference — and so neither equilibrium yields an efficient allocation.

8 Conclusion

As a part of their industrial policies, governments have to decide whether they wish to allow for free market entry or they prefer to restrict market access by, for example, granting licenses. While the choice between market liberalization and market regulation is already an interesting topic for a closed economy, it becomes even more challenging in an international, non-cooperative framework. When two governments seek to pursue their national interests by means of their industrial policies, industry structure is endogenously determined in an international setting. In this paper we have dealt with this topic and investigated the equilibrium consequences of international competition when, for a given industry, governments decide about the mode of competition between domestic and foreign firms. The decisions between free versus regulated entry and about the number of licenses to be granted are substantially affected by each government's endeavor to interfere with trade according to its own interest.

Assuming that the minimum output prices necessary to acquire non-negative profits for the domestic and the foreign firms differ significantly, we show that there are two types of equilibria: In either case the government of the low-cost firms (home country) restricts market entry and grants the lowest number of licenses which suffices to drive all foreign firms out of the market. The government of the high-cost firms (foreign country), however, either allows for free entry or grants some number of licenses sufficiently large such that the other government cannot dare to reduce the number of low-cost firms, for that would result in a fall of its firms' market share and would thus reduce welfare. Intuitively, in any equilibrium low-cost firms are allowed to enter the market until the market price has fallen to such an extent that no high-cost firm could obtain a non-negative profit. As a consequence, the whole market is completely served by the low-cost firms, and aggregate supply equals the quantity the high-cost firms could maximally supply without enduring losses. In effect, although the high-cost firms actually stay out of the market, the mere presence of a large number of potential entrants imposes a substantial threat on the home country: Foreign firms were to acquire some market share, should the home government reduce the number of firms in order to increase the output price. Thus, although the high-cost firms do not produce in equilibrium, their notional presence is strategically important so as to provide consumers with a relatively high supply level. Notably, the induced equilibrium monopolization of production in the low-cost country is Pareto efficient provided that the cost difference between domestic and foreign firms is substantial.

Most of our results carry over to the case where firms' cost structures are sufficiently similar, to which we refer as an insignificant cost difference. In particular, complete monopolization of production in the low-cost country continues to represent an equilibrium outcome. However, the uniqueness of the equilibrium allocation, obtained for a significant cost difference, disappears. Also, with an insignificant cost difference an additional equilibrium allocation emerges with production taking place in both countries. Moreover, while the game in market structures yields a Pareto efficient equilibrium outcome when the international cost difference is substantial, this property vanishes as the firms become more similar.

These findings demonstrate the following. Both the fact that governments may (ab)use their decisions about free entry versus regulation of market access and that they cannot subsidize its firms so as to induce individually non-profitable market entry, represent theoretically important and politically relevant features which must be acknowledged. Doing this, a game is established which is strategically as well as allocationally (in equilibrium) substantially different from the corresponding (hypothetical) game played in numbers of firms directly.

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