Born to be global and the globalization process

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Abstract

During the last decades we have witnessed a large number of entrepreneurial firms that reach the world market at a fast pace ("born global firms"). Our analysis suggests that the ongoing globalization process indeed implies that born to be global firms would be more prominent in the world economy due to the reduction of the cost of exploiting good business ideas globally. However, our analysis also suggests that entrepreneurial firms have incentive to sell their business to incumbents. Indeed we show that "born to be sold global firms" can be even more frequent as a result of trade liberalization, the international deregulation of the market for corporate control and the strengthening of international cartel policy.

1. Introduction

In the last decades have we have witnessed a large number of firms that become international leaders in a short time. Prominent examples are Google and Facebook which

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have generated exports revenues of substantial amount at impressive speed. Moreover, we observe inventions made by small entrepreneurs being acquired by incumbents which use them to gain a strong competitive advantage in the world market. Example of this type of process is Skype who first was acquired by Ebay and later by Microsoft. The success of these so called "born global firms" has spurred an interest in the determinants and welfare effects of these types of firms. The purpose of this paper is to contribute to the generation of such knowledge.

The starting point of the paper is that entrepreneurial firms with a global potential face considerable problems when trying to fully exploit the potential value of an invention or business idea internationally. Complementary assets such as distribution networks, marketing channels, financial resources, manufacturing know-how and brand names – i.e. assets typically held by large established firms - are often needed, and we observe a significant amount of inter-firm technology transfers, ranging from joint ventures and licensing to outright acquisitions of innovations.[1] Thus to understand the phenomena of born to be global firms we need to understand how the economic environment affects the incentive of business development for sale to incumbents relative business development for own export.[2]

[1] Granstrand and Sjölander (1990) present evidence from Sweden, and Hall (1990) evidence from the US that firms acquire innovative targets to gain access to their technologies. Bloningen and Taylor (2000) find evidence from US high-tech industries of firms making a strategic choice between the acquisition of outside innovators and in-house R&D. In the biotech industry, Lerner and Merges (1998) note that acquisitions are important for know-how transfers.

[2] Andersson and Lööf (2012) examines innovation among very small firms and find that affiliation to a domestically owned multinational enterprise group increases the innovation capacity of small businesses, and that small firms' innovation is closely linked to participation in international trade and exports to the G7-countries.

Raff and Wagner (2010) examines the relationship between imports and productivity for Germany. They find evidence for a positive impact of productivity on importing, pointing to self-selection of more productive enterprises into imports, but no evidence for positive effects of importing on productivity due

To this end, we construct a model with the following ingredients: There are several incumbent firms competing in oligopoly fashion in the world market. Moreover, there is a domestic entrepreneur outside this market who invests in an innovative activity that could lead to the creation of a unique business idea (invention), which increases the profit of the possessor and decreases the profits of the rival firms. The interaction takes place in three periods. In the first period, the entrepreneur decides on how much to invest in the innovative activity, where more investments increase the probability of a successful business idea (invention). In the second period, the incumbent firms compete to acquire the entrepreneur's business idea (invention) or, if no sale occurs, the entrepreneur either sells only locally in its home country, or expands in order to also export to the world market. Finally, in the third stage, firms compete in oligopoly fashion on the world market and the entrepreneur generates profits locally if it does not sell her business.

The starting point of the analysis is the process of international integration of product and ownership markets in the last few decades, which has been driven both by policy changes such as WTO agreements (e.g. TRIPS) and the EU single market program and by technology advances reducing international transportation and transaction costs. How will international market integration affect the commercialization choice (entry or sale) and incentive international entrepreneurship?

We first establish that a trade liberalization (reduction in trade cost), in absence of an acquisition market, implies that it is more likely that an entrepreneurial firm with a successful invention goes global. The reason is that the cost of exploiting the entrepreneurial invention decreases as the cost of trade per unit has decreased.

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to learning-by-importing.

Halldin and Braunerhjelm (2012) investigates whether born global firms perform differently compared to other newly founded manufacturing firms. Born global firms are found to have higher growth in employment and sales per employee but no such effect is found when performance is measured by profitability or labor productivity.

However, we then show that despite trade liberalization implying that the incentives for entrepreneurs to create born to be global firms increases, it is not clear that the amount of born global firms increases. The reason is that when market integration is not complete, the incentive to sell the entrepreneurial firms to incumbents are stronger than those for entering the market. Why? The incumbents have a substantial amount of market power when markets are not fully integrated and are willing to pay a substantial amount to prevent the entrepreneurial firm from entering the market. When market integration becomes more complete the incumbents have less market power and are not willing to pay so much for entry deterring. As a result the entrepreneurial firm will enter the world market. Consequently, only at sufficiently complete market integration will the amount of born global firms increase.

How do a trade liberalization affect the incentive to create entrepreneurial firms then? The incentive to create born to be global entrepreneurial firms will increase. First the cost of exploiting the entrepreneurial invention in the world market will decrease since the trade cost per unit of sales decreases. Moreover, even if entry does not occur, the bidding competition among the incumbents over the entrepreneurial invention implies that the entrepreneur will capture the trade cost reduction in the form of a higher sales price of its firm (invention).

We then proceed to other important parts of the international market integration process. One is the change in restrictions on foreign acquisitions of domestic firms. The attitude was gradually becoming more positive until the very end of the twentieth century when a return of protectionism could be observed in the policy debate. Large privatization and liberalization programs started in the UK in the late 1970's and spread around the world. Moreover, the development of a well-functioning global capital market in the 1980's and 1990's affected the transaction cost of cross-border acquisitions substantially. We then argue that these developments imply that the transaction costs associated with selling entrepreneurial firms has decreased and then show that these developments in the international market for corporate control reduce the amount of born to be global firms that actually go global themselves. The reason being that the number of born to be sold global firms is expanding at the born globals' expense.

A second prominent change is the strengthened practise of international cartel policy. In its 1997 Annual Report, the World Trade Organization (WTO) highlighted the growing significance of international cartels for policy makers, noting "there are some indications that a growing proportion of cartel agreements are international in scope." Evenett, Levenstein, and Suslow (2001) show that in a sample of 20 cartels prosecuted by the United States and European Union in the 1990s, the annual worldwide turnover in the affected products exceeded US$30billion. Connor (2004) examines the antitrust fines and private penalties imposed on the participants of 167 international cartels discovered during 1990-2003, and finds that more than US$ 10 billion in penalties has been imposed. Both Evenett, Levenstein, and Suslow (2001) and Connor (2004) argue that a series of reforms to national policies and steps to enhance international cooperation are needed to further strengthen the deterrents against international cartelization.

How then does a stricter enforcement of international cartel policy affect international entrepreneurship? We show that a stricter international cartel policy will reduce the profit from exporting relative to that from selling the entrepreneurial firm to an incumbent. Why? The reason is that when the cartel is broken up the importance of becoming the leading firm in the market increases and thus the bidding competition over the target firm increases.

Our study is related to the recent theoretical literature on international M&As in oligopolistic markets which, in contrast to the traditional FDI literature, emphasizes that greenfield investments and cross-border acquisitions are not perfect substitutes: the entry modes of FDI matter.[3] This literature do not explicitly studies the role played by entre-

[3] See, for instance, Blonigen (1997), Bjorvatn (2004), Bertrand and Zitouna (2005), Head and Ries

preneurs as challengers and suppliers to internationally leading incumbents, which is the focus of our study.

Our study is also linked to the theoretical literature on firm heterogeneity and entry modes in foreign markets.[4] We extend this literature by allowing entrepreneurs to expand internationally either by own expansion or by means of selling their business (inventions) to established firms, and by examining how the pattern of own expansion and expansion by sale depends on the degree of international market integration.

While this paper belongs to a large literature on competition and innovations[5] it is, to our knowledge, the first to analyze the effects on entrepreneurial innovation of international liberalization in a setting where both innovation for export and innovation for sale to incumbents is possible.

This paper can finally be seen as a contribution to the literature on entrepreneurship and innovations.[6] We extend this literature by allowing for the interaction between entrepreneurs and oligopolist in the innovation process and study how trade liberalization and international cartel policy affect the incentive for entrepreneurial innovations.

(2006), Mattoo *et al.* (2004), Norbäck and Persson (2008) or Raff *et al.* (2005). There is also a small theoretical literature addressing welfare aspects of cross-border mergers in international oligopoly markets. This literature includes papers by, for example, Falvey (1998), Head and Ries (1997), Horn and Persson (2001), Lommerud, Straume and Sorgard (2004), Neary (2007) and Norbäck and Persson (2007).

[4] See, for instance, Bernard, Eaton, Jensen, and Kortum (2003) and Helpman, Melitz and Yeaple (2004), and Nocke and Yeaple (2007, 2008).

[5] For overviews of the literature on innovation and competition see, for instance, Motta (2004), and recent contributions Norbäck and Persson (2012) and Vives (2008).

[6] For overviews, see Acs and Audretsch (2005), and Bianchi and Henrekson (2005). For some recent contributions on entrepreneurship and commercialization mode, see Gans, J.S. and S. Stern (2000), Gans, J.S., D.H. Hsu, S. Stern (2002), Gans, J.S. and S. Stern (2003), and Norbäck and Persson (2009).

2. The Model

Consider a market served by n symmetric firms located in their respective home country. Each firm produces two brands of their good. One of the brands is a low (local) quality brand which is produced with local inputs. We assume that each firm is a monopolist in their respective local home market. There is also a high quality brand, with which all firms compete on an integrated world market. To capture globalization in a very simple way, we assume that it is only possible to produce the international brand by using an intermediate input which needs to be imported at a trade cost t.

We then assume that there is an additional country where an entrepreneur, denoted e, invests in an innovative activity that could lead to the creation of a unique productive asset or invention, denoted $\bar{k}$. The entrepreneur can use this asset in production of the two brands, where again the low quality brand is sold exclusively in the domestic market without foreign competition and the second, high quality, brand can be sold under competition with the foreign incumbents in the world market.

The interaction is illustrated in Figure 2.1. In the first stage, the trade cost t is determined by nature (or by government policy). In the second stage, the domestic entrepreneur decides how much to invest in research, thereby affecting the probability of discovering the invention $\bar{k}$. In the a first period of the third stage, given successful innovation, one of the incumbents may acquire the entrepreneur's assets $\bar{k}$. If the entrepreneur does not sell the the invention, she can enter the domestic market or enter both the domestic and the world market where there is a fixed cost of entry G. Finally, in the fourth stage, firms compete in oligopoly fashion in the high quality brand integrated world market and sell the low quality brand under monopoly in their domestic market.

The next sections describe the product market interaction, the acquisition-entry game, and the innovation investment.

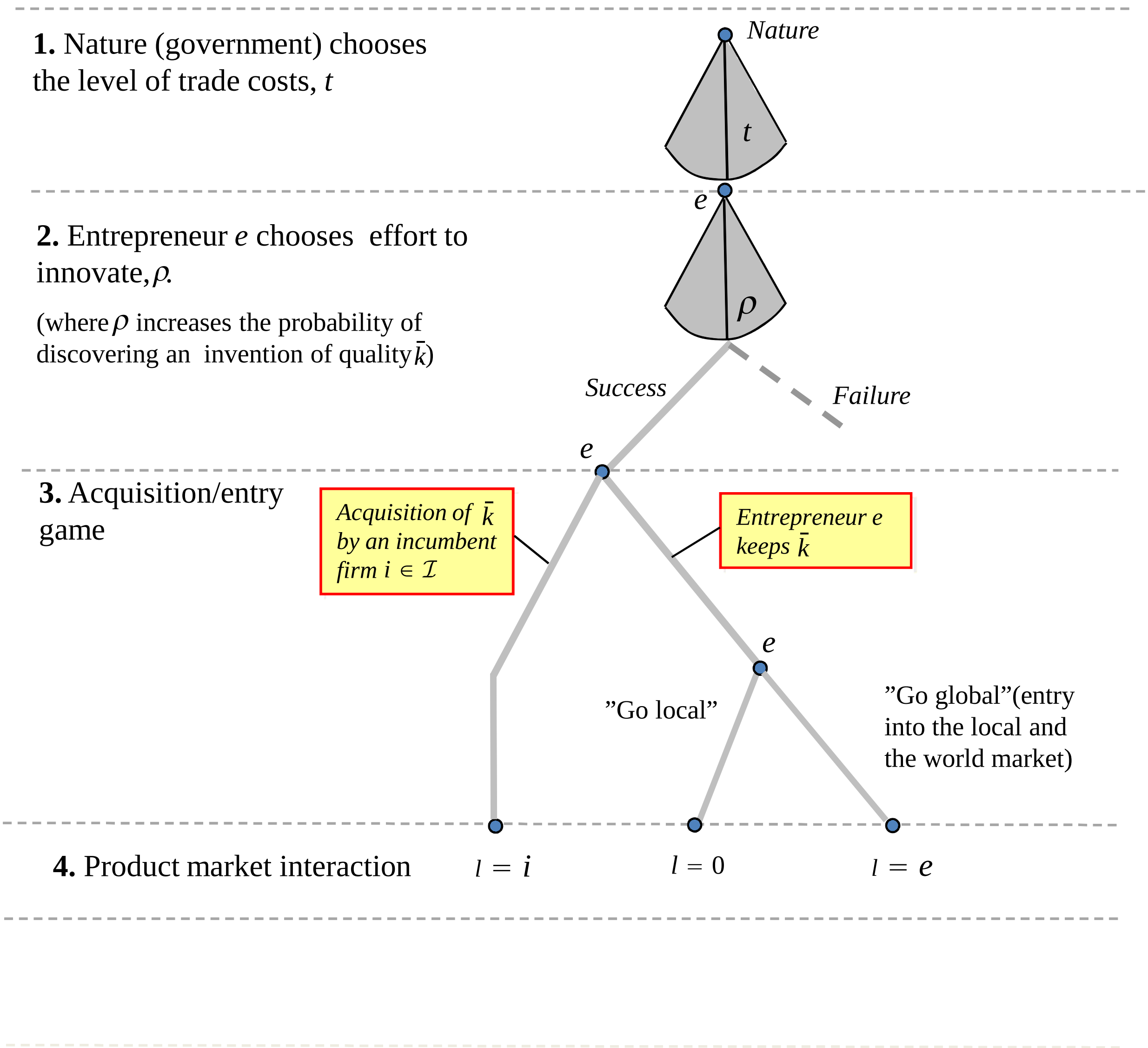

Figure 2.1: The sequence of the game.

2.1. Stage four: product market interaction

The integrated global market: The global market consists of n integrated countries in which there is one firm located in each. The product market profits in the global market will depend on the (potential) ownership of the innovation $\bar{k}$, given from the acquisition-entry game in Stage 3 and the innovation investment in Stage 2, and the trade cost t on intermediate inputs is determined by nature (or government policy) in Stage1. To capture this, we will work with the following notation: Let the set of firms in the industry be $\mathcal{J} = e \times \mathcal{I}$, where $\mathcal{I} = \{i_1, i_2, ..., i_n\}$ is the set of incumbent firms. Let the set of potential ownerships of the innovation, $\bar{k}$, be $l \in \mathcal{L}$, where $\mathcal{L} = \{e, 1, 2, ...i...n\}$.

Let $\pi_j(\mathbf{q},l) = [P - c_j(l)]q_j$ denote the product market profit of firm j, where $\mathbf{q} = (q_e, q_{i_1,...}q_{i_n})$ is the vector of output choices taken by firms in the product market interaction, and l keeps track of the identity of the firm owning assets $\bar{k}$. In order to produce the high quality good for the world market, production requires imports of an intermediate good which is associated with a trade cost t. $c_j(l) = c + t$ is then the marginal cost when firm j does not possess the invention ($j \neq l$) and $c_j(j) = c + t - \bar{k}$ is the marginal cost when firm j possesses the invention ($j = l$). In the world market, we assume that incumbents (or the incumbents and the entrepreneur) face inverse demand

$$P = a - q_j - q_{-j}, \tag{2.1}$$

Assuming Cournot competition the Nash-quantities in the product market interaction $\mathbf{q}^*(l) = (q_j^*(l), q_{-j}^*(l))$ are given from the first-order conditions, $\frac{\partial \pi_j}{\partial q_j}\left(q_j^*(l), q_{-j}^*(l)\right) = 0$. Let $\pi_j(l) = [P(\mathbf{q}^*(l)) - c_j(l)]q_j^*(l)$ be the reduced-form profit of firm j**,** where again**,** l indicates which firm owns the innovation $\bar{k}$.

The assumption that incumbents $i_1, i_2, ..., i_n$ are symmetric before the acquisition takes place implies that we need only distinguish between two types of ownership if the invention is commercialized in the world market; *entrepreneurial* ownership ($l = e$) and *incumbent* ownership ($l = i$). Note that there are three types of firms of which to keep track,

$h = \{E, A, NA\}$, i.e. the entrepreneurial firm (E), an acquiring incumbent (A), and non-acquiring incumbents (NA).

Given that a sale of innovation $\bar{k}$ occurs, $\pi_A(i)$ denotes the acquiring firm's reduced-form product market profit and $\pi_{NA}(i)$ the corresponding profit for a non-acquirer. If no sale occurs and the entrepreneur enters the market, $\pi_E(e)$ denotes the entrepreneurial firm's reduced-form product market profit and $\pi_{NA}(e)$ the corresponding profit for an incumbent. Finally, we let $\pi_{NA}(0)$ denote the incumbent profit if the innovation $\bar{k}$ is not commercialized in the world market.

It can be shown (see the Appendix) that reduced-form profits $\pi_h(l)$ in the world market have the following characteristics, which will be useful in the analysis below[7]:

Lemma 1. *The reduced-form profits in the world market have the following properties: (i)* $\pi_A(i) > \pi_E(e)$, $\pi_A(i) > \pi_{NA}(l) > 0$ *and* $\pi_E(e) > \pi_{NA}(e)$, *(ii)* $\pi_{NA}(0) > \pi_{NA}(i) > \pi_{NA}(e)$, *(iii)* $\dfrac{d\pi_h(l)}{dt} < 0$, *and (iv)* $\frac{d\pi_A(i)}{dt} < \frac{\pi_{NA}(l)}{dt}$.

In Part (i), $\pi_A(i) > \pi_E(e)$ shows that an incumbent receives a higher product market profit when acquiring the entrepreneur's innovation than the entrepreneur would herself receive by entering the market. The reason is that the entry by the entrepreneur increases the number of firms in the world market from n firms (the foreign incumbents) to $n+1$ firms. Moreover, $\pi_A(i) > \pi_{NA}(l) > 0$ and $\pi_E(e) > \pi_{NA}(e)$ capture that the possession of the invention $\bar{k}$ gives a competitive advantage over rivals in the world market.

In Part (ii), $\pi_{NA}(0) > \pi_{NA}(l)$ captures that non-acquiring are worse off when competition increases when the innovation is introduced by a rival. Non-acquiring rivals face the largest loss under entry by the entrepreneur, since not only do they face a low-cost rival, entry also adds another firm to the market, $\pi_{NA}(i) > \pi_{NA}(e)$.

Part (iii), $\frac{d\pi_h(l)}{dt} < 0$, shows that all firms' product market profits decrease when trade costs increase, since all firms' costs then increases. Finally, Part (iv) shows that the ac-

[7] Proofs available upon requests from the authors.

quiring incumbent is hurt more than non-aqcuiring incumbents when trade costs increase, $\frac{d\pi_A(i)}{dt} < \frac{\pi_{NA}(l)}{dt}$. The reason is that the acquiring incumbent has larger sales in equilibrium and hence faces a larger direct cost increase

The local market: Each firm will, in its home market, act as monopolist in the low quality brand market, obtaining profit. $\Pi_j(x_j, l)$ where x_j is the output. Profit maximization leads to the reduced form profit $\Pi_h(l)$. To highlight entry decision into the global market, we simply assume that without the invention the entrepreneur cannot be active in its home market, $\Pi_E(i) < 0$. All firms then make the same profit in their respective home market: $\Pi_D = \Pi_E(e) = \Pi_A(i) = \Pi_{ND}(l) > 0$. Note that the local profit is unaffected by trade costs, $\frac{d\Pi_D}{dt} = 0$, since there is no international competition in the market for the local brand.

2.2. Stage three: the acquisition game

In stage 3, there is a first period with an entry-acquisition game, where the entrepreneur chooses between selling the invention to one of the incumbents in the world market or keeping the invention. If the entrepreneur decides not to sell, then in a second period she faces a choice between entering into the local brand market, or to enter both the local brand market and the world market for the high quality brand.

The entry-acquisition game in the first period is depicted as an auction where the I incumbents simultaneously post bids and the entrepreneur then either accepts or rejects these bids, if it rejects the entrepreneur will export to the global market if and only if it is more profitable than only local brand sale. Each incumbent announces a bid, b_i, for the entrepreneurial firm. $\mathbf{b} = (b_1, ..b_i.., b_I) \in R^I$ is the vector of these bids. Following the announcement of $\mathbf{b}$, the entrepreneurial firm may be sold to one of the incumbents at the bid price, or remain in the ownership of the entrepreneur e. If more than one bid is accepted, the bidder with the highest bid obtains the entrepreneurial firm. If there is more than one incumbent with such a bid, each such incumbent obtains the entrepreneurial firm with equal probability. The acquisition is solved for Nash equilibria in undominated pure strategies. There is a smallest amount, ε, chosen such that all inequalities are preserved if ε is added or subtracted.

To highlight how trade costs affect the entrepreneur's decision to go global, we will assume that commercialization of the innovation does not affect the number of incumbents already present in the market n. Formally, we will assume that trade costs are limited in size, $t \in [0, t^{\max})$, where $\pi_{NA}(l : t^{\max}) = 0, l = \{i, e\}$.[8] The entrepreneur's entry into the world market is costly and requires a fixed cost G. This implies that the entrepreneur will only "go global" if trade costs are sufficiently low.

Lemma 2. *Assume that the entry cost G into the world market is not too high. Then, there exists a trade cost $t^W \in (0, t^{\max})$ such that $\pi_E(e) = G$ for $t = t^W$, $\pi_E(e) > G$ for $t < t^W$ and $\pi_E(e) < G$ for $t > t^W$.*

Thus, for high trade cost $t > t^W$ the entrepreneur cannot afford entry into the world market, whereas for low trade costs $t < t^W$ entry into the world market is profitable. Using this information of how the entrepreneur will commercialize in the second period, we can write down the different valuations in the first period which need to be considered to solve the acquisition game.

- v_e is the value, for the entrepreneur, of keeping the invention (firm):

$$v_e = \begin{cases} \underbrace{\pi_E(e) - G}_{\text{World market}} + \underbrace{\Pi_D}_{\text{Local}}, \text{ if } \underbrace{t < t^W}_{\text{Entry profitable}} \\ \underbrace{\Pi_D}_{\text{Local}}, \text{ if } \underbrace{t > t^W}_{\text{Entry not profitable}} \end{cases} . \tag{2.2}$$

This is the *reservation price* of the entrepreneur, i.e. lowest price at which the entrepreneur will sell the invention. If trade costs are high $t > t^W$, the entrepreneur cannot

[8] In the Appendix, we show that $t^{\max} = \Lambda = a - c$.

make a profit from entering the world market, $\pi_E(e) < G$. Then the only profit source is the local market which gives the profit Π_D which becomes the reservation price. When trade costs are low, $t < t^W$, entry into the world market is profitable and the reservation price adds up from the local and world market profits, $\pi_E(e) - G + \Pi_D$.

- v_{ie} is the value, for an incumbent, of obtaining entrepreneurial firm, when the entrepreneur would otherwise keep them.

$$v_{ie} = \begin{cases} \underbrace{\pi_A(i) - \pi_{NA}(e)}_{\text{World market}} + \underbrace{2\Pi_D - \Pi_D}_{\text{Local}} - T, \text{ if } \underbrace{t < t^W}_{\text{Entry profitable}}, \\ \underbrace{\pi_A(i) - \pi_{NA}(0)}_{\text{World market}} + \underbrace{2\Pi_D - \Pi_D}_{\text{Local}} - T, \text{ if } \underbrace{t > t^W}_{\text{Entry not profitable}} \end{cases} \tag{2.3}$$

This "*entry-deterring valuation*" v_{ie} also depends on whether or not the entrepreneur can enter into the world market. If trade costs are low, $t < t^W$, the entrepreneur would enter the world market when not selling. From Lemma 1(i), the first term $\pi_A(i) - \pi_{NA}(e)$ then captures the increase in profits for the acquiring incumbent in the world market; the second term $2\Pi_D - \Pi_D$ captures the increase in profit in the local market, under the assumption that an acquisition of the invention $\bar{k}$ gives the acquirer access to an additional local market (the "new" local market in the home country of the entrepreneur); finally, T is a transaction cost paid by the acquirer.

When trade costs are high, $t > t^W$, the entrepreneur cannot enter the world market. If the entrepreneur has not sold her the assets, they will only be used in the local market by the entrepreneur, and not in the world market. From Lemma 1(i), the lower line in (2.3), $\pi_A(i) - \pi_{NA}(0)$, then reflects the increase in profits on the world market from an acquisition.

- v_{ii} is finally the value for an incumbent of obtaining the entrepreneurial firm, when a rival incumbent would otherwise obtain the entrepreneurial firm.

$$v_{ii} = \underbrace{\pi_A(i) - \pi_{NA}(i)}_{\text{Profit increase: Export}} + \underbrace{2\Pi_D - \Pi_D}_{\text{Profit increase: Local}} - T \tag{2.4}$$

This "*preemptive valuation*", v_{ii} does not depend on the entry decision of the entrepreneur since the first term $\pi_A(i) - \pi_{NA}(i)$ depicts the increase in profit of an incumbent of buying the entrepreneurs assets when not buying would result in a rival acquisition.[9]

We can now proceed to solve for the Equilibrium Ownership Structure (EOS). Since incumbents are symmetric, valuations v_{ii}, v_{ie} and v_e can be ordered in six different ways, as shown in table 2.1. These inequalities are useful for solving the model and illustrating the results. We can state the following lemma:

Lemma 3. *The equilibrium ownership structure, the acquisition price and the entrepreneurial reward are described in table 2.1:*

Proof. See the Appendix. ■

Table 2.1: The equilibrium ownership structure and acquisition price.

Inequality:	Definition:	Ownership l^*:	Acquisition price, S^*:	Entrepreneurial reward, R_E :
$I1:$	$v_{ii} \geq v_{ie} > v_e$	i	v_{ii}	v_{ii}
$I2:$	$v_{ii} > v_e \geq v_{ie}$	i or e	v_{ii}	v_{ii} or v_e
$I3:$	$v_{ie} \geq v_{ii} > v_e$	i	v_{ii}	v_{ii}
$I4:$	$v_{ie} > v_e \geq v_{ii}$	i	v_e	v_e
$I5:$	$v_e \geq v_{ii} > v_{ie}$	e	.	v_e
$I6:$	$v_e \geq v_{ie} > v_{ii}$	e	.	v_e

Lemma 3 shows that when one of the inequalities $I1$, $I3$, or $I4$ holds, k is obtained by one of the incumbents. Under $I1$ and $I3$, the acquiring incumbent pays the acquisition

[9]See Lemma 1(i).

price $S = v_{ii}$, and $S = v_e$ under $I4$. When I_5 or I_6 holds, the entrepreneur keeps its assets. When $I2$ holds, there exist multiple equilibria.

2.3. Stage two: innovation activity

In stage 1, entrepreneur e undertakes an effort, ρ, to discover an innovation. Let innovation costs $y(\rho)$ be an increasing convex function in effort, i.e. $y'(\rho) > 0$, and $y''(\rho) > 0$. Let the probability of making an innovation be z and the probability of a failure $1 - z$, where $z \in [0, 1]$ and probability z is an increasing concave function of effort, i.e. $z'(\rho) > 0$ and $z''(\rho) < 0$. $\Psi_e(l) = z(\rho(l))R(l) - y(\rho(l))$ is then the expected net profit of undertaking effort for the entrepreneur, where $R(l)$ is the reward for a successful innovation, i.e.

$$R(l) = \begin{cases} v_e, \text{ under inequalities } I4,\ I5,\ \text{ or } I6, \\ v_{ii}, \text{ under inequalities } I1,\ I2 \text{ or } I3. \end{cases} \tag{2.5}$$

The entrepreneur then maximizes $\Psi_e(l)$, optimally choosing effort $\rho(l)$. The optimal effort $\rho^*(l)$ is given from the first-order condition, $\frac{d\Psi_e(l)}{d\rho} = 0$. Assuming that the associated second-order condition is fulfilled, it is straightforward to show that when the reward to innovation increases, the entrepreneur will provide more effort to innovate and hence the probability of a successful innovation will be higher.

We can state the following Lemma:

Lemma 4. *The equilibrium effort by the entrepreneur in stage 2, $\rho^*_E(l)$ and hence, the probability of a successful innovation, increases in the reward for an innovation $R_E(l)$, i.e.* $\frac{d\rho^*_E(l)^*}{dR_E(l)} > 0$.

Intuitively, the entrepreneur will try harder to succeed with $\bar{k}$ when there is a higher potential reward from succeeding.

2.4. Born to be global and reductions in trade costs

In this section, we examine how the mode of commercialization of the invention is related to trade costs, t. We can then derive the following result.

Proposition 1. *(i) A trade liberalization will lead to more born to be global firms. (ii) In markets with medium high trade costs the born to be global firms will be acquired by incumbents and in markets with low trade costs will the born to be global firms enter the world market themselves.*

The proposition is illustrated in Figure 2.2. Figure 2.2(ii) depicts how trade cost affects the entrepreneur's opportunities to enter the world market, as shown in Lemma 2. Figure 2.2(ii) depicts the reservation price of the entrepreneur, v_e, an incumbent's entry deterring valuation, v_{ie}, and the incumbent's preemptive valuation v_{ii}. We now show how these valuation can be used to derive Proposition 1.

The reservation price v_e in (2.2) is downward sloping in trade costs since the export profit $\pi_E(e)$ decreases in trade costs, as shown in Lemma 1. At $t = t^W$ the entrepreneur will not enter the world market. This produces the linear segment where the reservation price equals the profit in the local market Π_D.

Lemma 1(iii) implies that incumbents' valuations v_{il} in (2.3) and (2.4) decrease in trade costs, $\frac{dv_{il}}{dt} = \frac{d\pi_A(i)}{dt} - \frac{d\pi_{NA}(l)}{dt} < 0$. Due to the possession of the invention $\bar{k}$, an acquiring incumbent will face a larger direct loss in its profits than a smaller non-acquiring incumbent when trade costs increase. Using (2.3) and (2.4) and Lemma 1, we also have:

$$v_{ie} - v_{ii} = \begin{cases} \pi_{NA}(i) - \pi_{NA}(e) > 0, \text{ if } \underbrace{t < t^W}_{\text{Entry is profitable}}, \\ \pi_{NA}(i) - \pi_{NA}(0) < 0, \text{ if } \underbrace{t > t^W}_{\text{Entry not profitable}} \end{cases} \tag{2.6}$$

Equation (2.6) tells us that when the entrepreneur can enter the world market at low trade costs $t < t^W$, an incumbent is willing to pay more to deter entry than to preempt a rival, $v_{ie} > v_{ii}$. The reason is that an incumbent can free-ride on the market concentration effect of a rival's acquisition: the profit as non-aquirer under a rival acquisition is higher, $\pi_{NA}(i) > \pi_{NA}(e)$, as shown in Lemma 1(ii). However, when the entrepreneur cannot enter the world market at high trade costs $t > t^W$, the incumbent's willingness to pay to deter entry is lower than the preemptive valuation, $v_{ie} < v_{ii}$. As was explained in Lemma 1(ii), this is because when the innovation is not used in the world market the profit for the non-acquirer is high, $\pi_{NA}(0) > \pi_{NA}(i)$. From (2.3), we also note that the high profit for the non-acquirer when the innovation is not commercialized $\pi_{NA}(0) > \pi_{NA}(e)$ will imply that the entry-deterring valuation v_{ie} will jump down at the critical trade cost $t = t^W$.

Let us now solve for the equilibrium commercialization pattern. Note that Lemma 3 implies that a sale takes place if and only if $v_{il} - v_e > 0$. That is, in order to acquire the innovation an incumbent's willingness to pay must at least be as high as the reservation price. To proceed, define $v_{ie} - v_e$ as the the *net value for an incumbent of deterring entry*, and $v_{ii} - v_e$ as the *net value for an incumbent of preempting a rival* from obtaining the entrepreneur's invention.

High trade costs For high trade costs, $t > t^W$, (2.3) and (2.4) gives:

$$v_{il} - v_e = \begin{cases} v_{ie} - v_e = \pi_A(i) - \pi_{NA}(0) - T, & \text{if } t > t^W \\ v_{ii} - v_e = \pi_A(i) - \pi_{NA}(i) - T, & \text{if } t > t^W. \end{cases} \tag{2.7}$$

From Lemma 1(iv), higher trade costs reduces the profit for the acquirer $\pi_A(i)$ more than the profit for the non-acquirer $\pi_{NA}(l)$. It then follows that the net value of an acquisition $v_{il} - v_e$ is decreasing in trade costs:

$$v'_{il,t} - v'_{e,t} = \underset{(-)}{\frac{d\pi_A(i)}{dt}} - \underset{(-)}{\frac{d\pi_{NA}(l)}{dt}} < 0, \quad \text{if } t > t^W \tag{2.8}$$

where we use v'_t as the notation for the derivative, $\frac{dv}{dt}$. This is illustrated in Figure 2.2(ii) in the region $t > t^W$, where incumbents' valuations v_{ie} and v_{ii} decrease in trade costs,

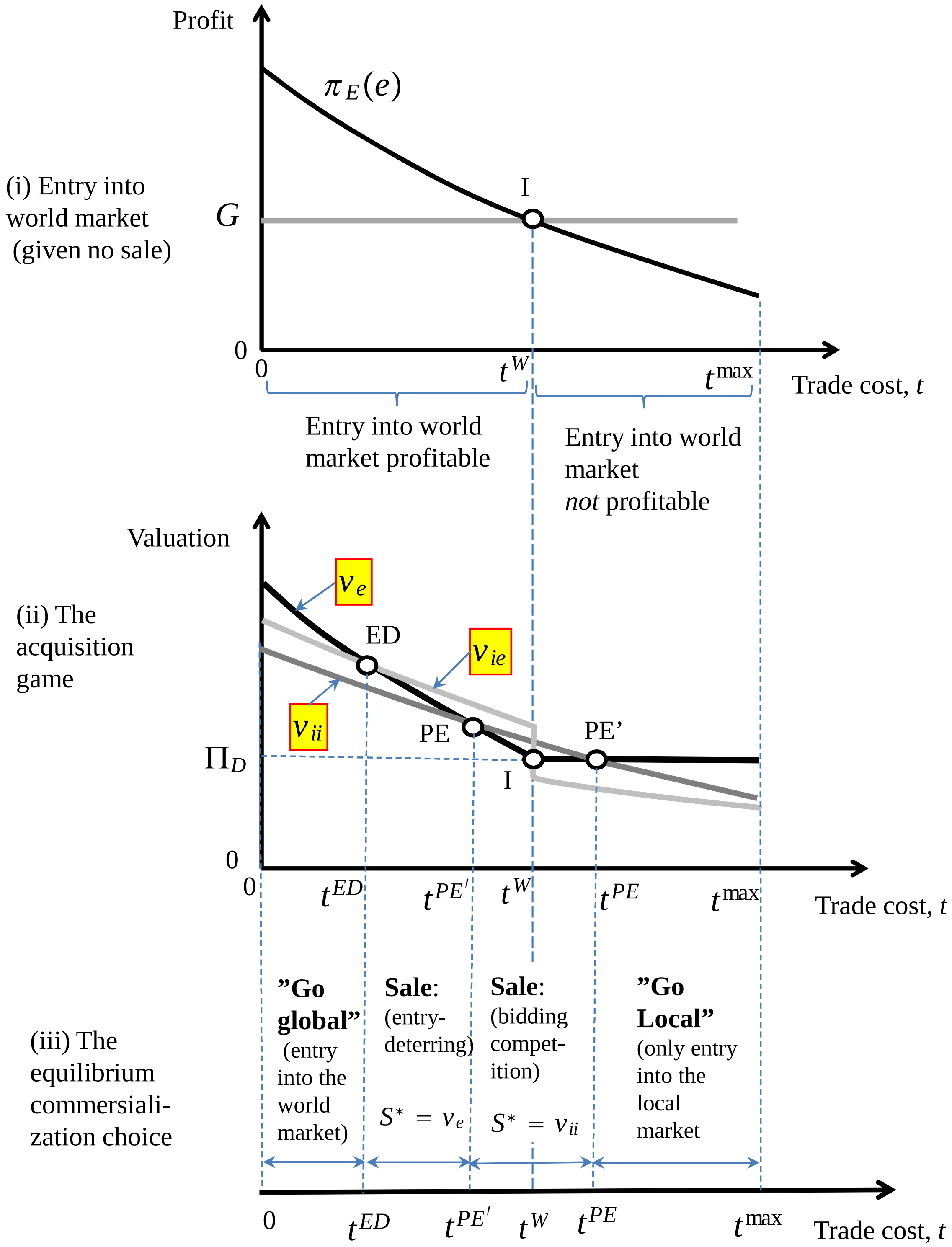

Figure 2.2: Solving the model.

whereas the reservation price v_e is not affected by trade costs. It then follows that if the transaction costs T is sufficiently high, incumbents willingness to pay v_{il} will be lower than the reservation price v_e at very high trade cost. Define the level of trade cost t^{PE} such that $v_{ii} = v_e$ holds. Then, as also shown in Figure 2.2(ii), there will be a region $t \in (t^{PE}, t^{\max})$ where $v_e > v_{ii} > v_{ie}$ holds, which implies that the entrepreneur will not sell the innovation. Since $t > t^W$ it also follows from Figure 2.2(i) that the innovation is only commercialized in the local home market. This is summarized in Figure 2.2(iii).

What happens if trade costs are t reduced? From (2.8), we know that incumbents willingness to pay v_{il} will increase whereas the reservation price v_e remains constant at the profit from local sales, Π_D. When the trade costs are reduced (slightly) below t^{PE}, the preemptive valuation v_{ii} will exceed the reservation price, $v_{ii} > v_e$. However, the entry deterring valuation remains below the reservation price $v_e > v_{ie}$. One the one hand, an incumbent is then willing to pay more than the reservation price if she thinks a rival would otherwise obtain the invention. On the other hand, she is willing to pay less than the reservation price if she thinks that the the entrepreneur would otherwise keep the invention and only use it in the local market.

From Table 2.1, we note that the inequality $I2$ or $v_{ii} > v_e > v_{ie}$ implies that there are multiple Nash-equilibria in the acquisition game. If an incumbent thinks that the entrepreneur will not sell to a rival, no acquisition takes place and the innovation is only commercialized in the local market. However, if the incumbent believes that a rival would buy the innovation if she does not, the fact that a rival will use the invention in the product market will increase the incumbent's willingness to pay above the reservation price, $v_{ii} > v_e$. The latter induces a bidding war between the foreign incumbents and the acquisition price is driven up to $S^* = v_{ii}$. The invention "goes global" - but it is not commercialized by the entrepreneur, it is commercialized by an incumbent.

Low trade costs If trade costs decreased even further, we know that at the trade cost t^W the entrepreneur will face profitable entry into the world market. Realizing that the entrepreneur can now enter the world market profitably, the entry deterring valuation increases discretely at $t = t^W$ and for a slightly lower trade cost than t^W, the entry deterring valuation v_{ie} will exceed the reservation price v_e - as well as the preemptive valuation v_{ii}. As explained above, the inequality $v_{ie} > v_{ii}$ follows since an incumbent is better off as a non-acquirer under a rival acquisition, where it can free-ride on a more concentrated market. But then with both incumbent valuations exceeding the reservation price, $v_{ie} > v_{ii} > v_e$, an incumbent acquisition must be the unique equilibrium. Since the value of preempting a rival acquisition is higher than the reservation price, it also follows that bidding competition drives up the price to $S^* = v_{ii}$.

In Figure 2.2(iii), it is now shown that incumbent acquisitions will occur at the price $S^* = v_{ii}$ in the region $t \in (t^{PE\prime}, t^W)$, and at the reservation price $S^* = v_e$ in the region $t \in (t^{ED}, t^{PE'})$. To see this, first note (2.3) and (2.4) imply that the net value of an acquisition for low trade costs becomes:

$$v_{il} - v_e = \pi_A(i) - \pi_E(e) - \pi_{NA}(l) + G - T, \text{ if } t < t^W \tag{2.9}$$

Differentiating the net value $v_{il} - v_e$ in trade costs t, we show in the Appendix that:

$$v'_{il,t} - v'_{e,t} = \underset{(-)}{\frac{d\pi_A(i)}{dt}} - \underset{(-)}{\frac{d\pi_E(e)}{dt}} - \underset{(-)}{\frac{d\pi_{NA}(l)}{dt}} > 0 \tag{2.10}$$

For low trade costs, incumbents' willingness to pay for the invention is less sensitive to trade costs than the entrepreneur's reservation price. As shown in Figure 2.2(ii), this implies that if trade costs t decrease incumbents' willingness to pay, v_{il} will increase less than the reservation price v_e. To see why, note that lower trade costs imply that the term $\pi_A(i)$ in $v_{il} = \pi_A(i) - \pi_E(e) - \pi_{NA}(l) + \Pi_D - T$ increases in similar magnitude as the term $\pi_E(e)$ decreases in $v_e = \pi_E(e) - G + \Pi_D$. However, the profit of a non-acquirer $\pi_{NA}(l)$ in v_{il} also increases when trade costs decrease, which implies smaller increase in the incumbents willingness to pay.

Since the entry deterring valuation v_{ie} is larger than the preemptive valuation v_{ii}, and since the incumbent valuations increase less than the reservation price v_e when trade costs t are reduced, the entry deterring valuation v_{ie} will intersect with the reservation price v_e at a unique trade cost t^{ED} and the preemptive valuation will intersect with the reservation price at a unique trade cost $t^{PE'} > t^{ED}$. As shown in Figure 2.2(iii). in the region $t \in (t^{PE'}, t^W]$, the equilibrium is an incumbent acquisition under bidding competition $S^* = v_{ii}$, since both incumbent valuations exceed the reservation price $v_{ii} > v_{ie} > v_e$. However, when trade costs are reduced even further into the region $t \in (t^{ED}, t^{PE'}]$, the preemptive valuation is below the reservation price, $v_{ii} < v_e$. Since the entry deterring valuation is still higher than the reservation price $v_{ie} > v_e$, one incumbent will buy the invention at the reservation price v_e. Other incumbents will not attempt to preempt a rival acquisition since the net value of preemption is negative, $v_{ii} - v_e < 0$. As shown in Figure 2.2(iii), the entrepreneur will then commercialize by sale ($l^* = i$) at price $S^* = v_{ii}$ in this region.

Finally, when trade costs are reduced below the level t^{ED} incumbents valuations will be below the reservation price, $v_{il} < v_e$. As shown in Figure 2.2(iii), the entrepreneur will not sell the invention but commercialize it on the world market. Hence, for sufficiently low trade costs $t \in [0, t^{ED})$ the entrepreneur "goes global" commercializing the invention on her own.

Innovation incentives Let us now turn to how the a trade liberalization, reduction in trade cost t, affects the incentive for entrepreneurs to bring innovations to the market. It follows immediately from Lemma 1(iii) that the entry profit $\pi_e(e)$ will increase when trade costs t are reduced.

Turning to the effect of trade liberalization on innovation incentives under innovation for sale, we can use Lemma 1(iv) to get:

$$\frac{dR_E(i)}{dt} = \frac{dS^*}{dt} = \frac{dv_{ii}}{dt} = \frac{d\pi_A(i)}{dt} - \frac{d\pi_{NA}(i)}{dt} < 0.$$

In equilibrium, the acquisition price S^* of the invention is a non-acquiring incumbent's willingness to pay v_{ii}, which consists of two profit terms: the product market profit for this firm if it were instead to obtain the invention $\pi_A(i)$, and the corresponding profit when not buying, $\pi_N(i)$, i.e. $S^* = \pi_A(i) - \pi_N(i)$. The first term increases more from an decrease in trade cost than does the second term according to Lemma 1(iv) and thus the reward to innovate for sale increases when trade cost decreases.

Proposition 2. *Trade liberalization increases the incentive for innovation for entry by reducing the cost of exploiting the new invention on the world market and increases the incentive for innovation for sale by increasing the bidding competition over the invention for sale.*

2.5. Deregulation of the Market for Corporate Control

Restrictions on foreign acquisitions of domestic firms are still common (Mattoo et al., 2004). However, the attitude was gradually becoming more positive until the very end of the twentieth century when a return of protectionism could be observed in the policy debate. Large privatization and liberalization programs started in the UK in the late 1970's and spread around the world.[10] In Sweden, firms have faced lower costs of acquiring firms located in other EU countries since the implementation of the single market program and the Swedish EU membership in 1995. The deregulation of financial markets in many countries and the development of a well-functioning global capital market in the 1980's and 1990's have also made cross-border acquisitions less complicated and costly relatively to greenfield investments.

[10] In Sweden, for instance, the restrictions on foreign acquisitions were rigorous in the 1970's, but were basically abolished by the first half of the 1990's; see Henrekson and Jakobsson (2003).

Lemma 3 states that an acquisition takes place if and only if $v_{il} - v_e > 0$. Then from (2.2), (2.3) and (2.4) it follows that v_{il} decreases in transaction cost T and v_e is independent of T. This in turn implies that the reward from innovation for sale is decreasing in T and the incentive for innovation for entry is independent of T.

Consequently, we can state the following result:

Proposition 3. *A reduction in takeover transaction costs will (i) make sale more likely over entry and (i) increase the incentives for innovation for sale .*

3. International Cartel policy

We here study international cartel policy which is often used in the practice of competition law. We may then think of a Stage 0 where the government decides on what is considered to be illegal cartel behavior and how much resources to spend on detecting cartels. In stage 1 firms then decide whether or not to form a cartel given the potential risk of being punished for illegal cartel behavior.[11]

To capture this in a very simple way, we assume that the n incumbents form an international output cartel through which each firm's output is reduced to q_h^C in order to achieve higher firm profits than in the Cournot-outcome, i.e. $q_h^C < q_h^*$. Note that the local low brand market is a monopoly so we can exclude it from the analysis.

More specifically, a cartel is assumed to be formed by the n incumbents, such that the firms retain their market shares, i.e. all firms in the cartel produce a share $\alpha \in [0,1]$ of their Nash quantities q_h^*, $(q_h^C = \alpha q_h^*)$, under the restriction that all firms make a higher profit in the cartel than outside the cartel, $\pi_h^C(l) > \pi_h(l)$.[12] A strict cartel policy is

[11] See Motta (2004) for an overview.

[12] The assumption of constant market shares is consistent with the observed behavior of some actual cartels. For instance, the (in)famous lysine-cartel used the market share they had before the introduction of the cartel as the "rule-of-thumb" allocation of production rights.

then assumed to increase $\boldsymbol{\alpha} = [\alpha, \alpha, ..., \alpha]$ and force a more aggressive competition among firms (or prevent firms from forming the cartel in the first place), i.e. all firms increase their output from the agreed cartel outputs, whereas a non-strict cartel policy would not interfere with the cartel behavior.

To highlight the effects of breaking up the cartel, we further assume that if entry takes place not all incumbents can remain in the market and generate profits and we simply assume that two of them will merge. The entry deterring valuation, assuming low trade costs $t < t^W$ in (2.3), then becomes

$$v_{ie} = \pi_A^C(i) - \left(\frac{n-1}{n}\right)\pi_{NA}^C(e) + 2\Pi_D - \Pi_D - T \tag{3.1}$$

where $\left(\frac{n-1}{n}\right)\pi_{NA}^C(e)$ is the expected profit a non-acquiring incumbent anticipating a merger between two incumbents if entry occurs. With the cartel, the preemptive valuation is:

$$v_{ii} = \pi_A^C(i) - \pi_{NA}^C(i) + 2\Pi_D - \Pi_D - T \tag{3.2}$$

whereas the reservation price is:

$$v_e = \pi_E^C(e) - G + \Pi_D \tag{3.3}$$

It follows directly that $v_{ie} > v_{ii}$ holds. Since the number of firms remains n, due to the ex-post merger, we have $\pi_A^C(i) = \pi_E^C(e)$ and the net value of an entry deterring acquisition in (2.9) now becomes:

$$\begin{aligned} v_{ie} - v_e &= \pi_A^C(i) - \pi_E^C(e) + \\ & \quad G - T - \left(\frac{n-1}{n}\right)\pi_{NA}^C(e) \end{aligned} \tag{3.4}$$

Let us now show that breaking up a cartel promotes a sale of the invention. From Lemma 3 and the fact that $v_{ie} > v_{ii}$, it follows that that entry takes place if and only if $v_e > v_{ie}$. The valuation, v_e in (3.3), must then decrease when the firms are forced to expand output, since $\pi_E(e) - \pi_E^C(e) < 0$. But, it follows that the first term in v_{ie} in (3.1), decreases by the same amount as v_e due to the same negative profit effect for the acquirer, $\pi_A(i) - \pi_A^C(i) = \pi_E(e) - \pi_E^C(e) < 0$. However, the profit of a non-acquirer also decreases, $\pi_{NA}(e) < \pi_{NA}^C(e)$ when firms are forced to expand. This implies that v_{ie} must decrease less than v_e when the cartel is broken up. We can then go from a situation where $v_e > v_{ie}$ holds under the cartel to a situation where $v_{ie} > v_e$ holds after breaking the cartel.

Consequently, we can state the following result:

Proposition 4. *The incentive for innovation for sale relative to innovation for entry will increase under a stricter international cartel policy.*

Innovation incentives It directly follows that the potential entrant's profit would be higher in the cartel equilibrium since a cartel is formed if and only if it is profitable for the participating firms. If the entrant does not participate in the cartel, it will benefit even more, since it can then choose its optimal response to the cartel behavior. Consequently, a strict cartel policy reduces the incentive for innovation for entry.

Let us now examine the effects of a strict cartel policy on the innovation for sale. We first examine how cartel profits depend on the level of α. The cartel profit for firm h is $\pi_h^C(l) = \left[P_h(\mathbf{q}^C) - c_h\right] q_h^C = \left[P_h(\alpha\mathbf{q}^*) - c_h\right] \alpha q_h^*$. Totally differentiate $\pi_h^C(l)$ in α to get:

$$\frac{d\pi_h^C(l)}{d\alpha} = \underbrace{\frac{\partial P_h^C}{\partial q_{-h}^C}\frac{dq_{-h}^C}{d\alpha}q_h^C}_{\text{Strategic effect (SE)}} + \underbrace{\left[P_h^C + \frac{\partial P_h^C}{\partial q_h^C}q_h^C - c_h\right]\frac{dq_h^C}{d\alpha}}_{\text{Indirect effect (IE)}}. \tag{3.5}$$

The first term is the *strategic effect* and is negative due to rival firms increasing their output $\frac{dq_{-h}^C}{d\alpha}$ when the cartel is (marginally) broken up, negatively affecting firm $h's$ price $\frac{\partial P_h}{\partial q_{-h}}$, thereby reducing revenues on the equilibrium sales q_h^*. The second term is the indirect effect which is positive due to the increase in own output, $\frac{dq_h^C}{d\alpha}$, thereby affecting profits through the positive marginal profit, $P_h + \frac{\partial P_h}{\partial q_h^C}q_h^C - c_h$. Note that due to the fact that firms are setting a quantity below the individually optimal quantity in the cartel, this effect is positive (i.e. the envelope theorem does not apply).

Now, turn to the effect on the acquisition price. Assuming $v_{ii} > v_e$, Lemma 3 implies that the acquisition price is $S^C = v_{ii} = \pi_A^C(i) - \pi_N^C(i)$. It follows that the change in the acquisition price hinges on the difference in the strategic effect, and the difference in the indirect effect between an acquiring and a non-acquiring incumbent. We can note the following: First, the negative strategic effect will be larger for the acquiring (efficient) firm, since a given price fall hits a larger output, i.e. $\frac{\partial P_A^C}{\partial q_{-A}^C}\frac{dq_{-A}^C}{d\alpha}q_A^C < \frac{\partial P_N^C}{\partial q_{-N}^C}\frac{dq_{-N}^C}{d\alpha}q_N^C$. Second, the difference in the indirect effect will be positive. The reason is two-fold. First, the acquiring (efficient) firm is further from its optimal output level and will benefit more from a given expansion, i.e. $P_A^C + \frac{\partial P_A^C}{\partial q_A^C}q_A^C - c_A > P_N^C + \frac{\partial P_N^C}{\partial q_N^C}q_N^C - c_N$. Second, this firm will expand more when the cartel is broken up, and will also benefit more from this, i.e. $\frac{dq_A^C}{d\alpha} > \frac{dq_N^C}{d\alpha}$.

Depending on the relative strength of the strategic effect and the output effect, the total effect on the acquisition price can either be positive or negative. In Figure 3.1, we illustrate this. Thus, it is illustrated how the cartel acquisition price $S^C(\alpha)$, the acquirer's cartel profit $\pi_A^C(i)$ and the non-acquirer's cartel profit $\pi_N^C(i)$ depend on α, in a specific example. There, we show the acquirer's and non-acquirer's different incentives to set α due to differences in marginal costs, $c_A < c_N$. $\alpha_A^{\max}$ denote the acquirer's optimal level and $\alpha_N^{\max}$ denotes the non-acquirers' optimal level, and it is shown in the Appendix that $\alpha_N^{\max} < \alpha_A^{\max}$. We assume that firms choose a level not below the non-acquirers' optimal level and not above the acquirer's optimal level, i.e. firms will agree on reducing outputs q_h^* to a share $\alpha \in [\alpha_N^{\max}, \alpha_N^{\max}]$. As proven in the Appendix, Figure 3.1(ii) then illustrates that there exists an $\alpha \in [\alpha_N^{\max}, \bar{\alpha}_S]$ such that breaking up the cartel would increase the acquisition price, i.e. $S^C(\alpha) < S^*$, and that there exists an $\alpha \in [\bar{\alpha}_S, \alpha_A^{\max}]$ such that breaking up the cartel would decrease the acquisition price, i.e. $S^C(\alpha) > S^*$.

Summing up, we have thus derived the following results:

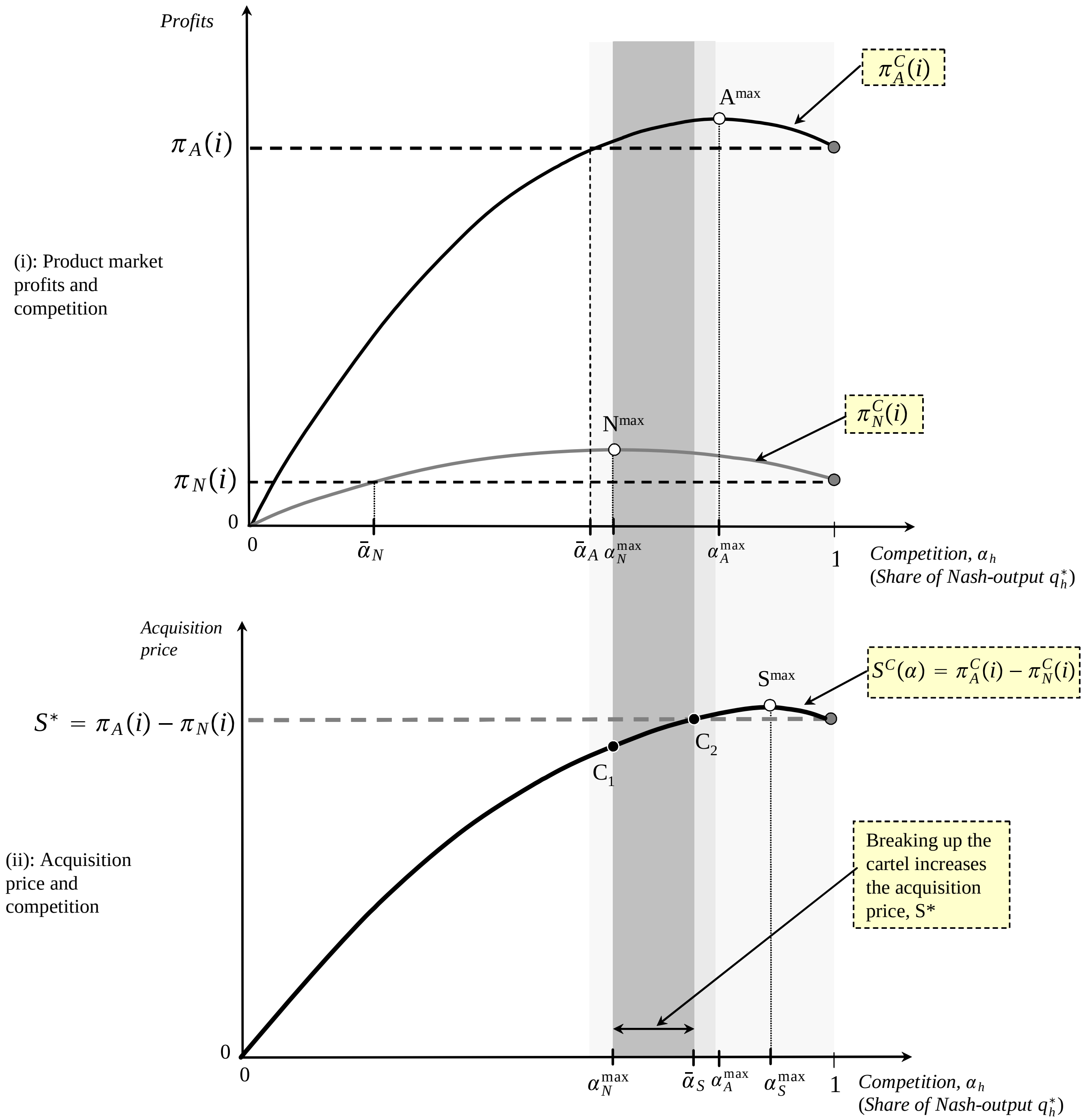

Figure 3.1: Illustrating Proposition 5. Profits and acquisition price under cartel policy. Parameter values at $\Lambda = a - c - t = 3$, $n = 3$ and $\bar{k} = 1$.

Proposition 5. *The incentive for innovation for export is reduced under a strict international cartel policy. (ii) The incentive for innovation for sale can increase as well as decrease under a strict international cartel policy in the constant market share cartel.*

Proof. See the Appendix. ■

We have thus provided an example where stricter international cartel policy creates an expansion in firms' outputs, such that being the most efficient firm becomes relatively more profitable. This, in turn, increases the acquisition price, thereby triggering more innovations by entrepreneurs.

4. Discussion

We here explore how our results are affected by allowing the entrepreneur to sell licences of a patent of its innovation and incorporating the issue of cartel stability into the model.

4.1. Exclusivity

In the analysis, we have assumed that the seller could only sell the innovation exclusively to one buyer. In many cases, when the innovation to a large extent consists of indivisible assets in terms of capital or human capital, such a setting is self evident. However, in some situations, several buyers might hold a licence to utilize the innovations. In such situations, the seller might consider how many licences to sell. This issue is studied in the literature on patent licensing. Kamien and Tauman (1986) assume that the independent innovator acts as a standard monopolist, by posting a price, and allowing the buyers to decide whether to buy a licence. Then, they show that the number of licences falls in the quality of the innovation in such a setting. Allowing the seller to commit to the number of licences to sell, Katz and Shapiro (1986) show that there exists an equilibrium where some potential buyers are left without a licence.

4.2. Cartel stability and input cartels

Cartel stability will not be of any central importance for our study under the assumption of the equal split rule or the constant market shares rule. To see this, note that we indeed ask how the break up of any stable cartel with such rules affects the incentive for innovation for sale or entry. Given that the cartel would be stable after a sale or an entry, under the assumption that the competition authority would not break it up, it directly follows that the stability of the cartel is then not an issue.[13]

However, in situations where the entrepreneur can choose between innovation for sale and innovation for entry, the stability of the cartel will be important. To see this, note that the innovator then needs to consider how the entry mode affects the stability of a cartel, where both asymmetries between firms and the number of firms in the market will affect the stability of cartels. Moreover, if the assumption of the equal split or constant market shares rule is relaxed, the sharing rule in the cartel might be designed so that it increases the stability of the cartel. As argued above, the constant market shares rule seems to be used in practice and our set-up seems be of relevance for those cases. Thus, it seems rewarding to better understand when this sharing rule is optimal and when other sharing rules will be used. However, this is an issue left to future research.

Let us finally note that we have studied output cartels. One could also think that the cartel also agreed to have a cartel when bidding for the innovation. Assuming also an input cartel would strengthen our results since the price of the innovation would then be even lower under cartelization. However, a cartel in the bidding competition over the innovation seems less likely since it requires either side payment or some ex post low price licensing from the winning incumbent.

[13] Note also that we assume that firms follow the cartel policy or, alternatively, the competition authority is 100 % efficient in breaking up cartels, i.e. we abstract from issues such as detection.

5. Concluding discussion

In this paper, we shown that the ongoing globalization process increases the incentive for international entrepreneurship by reducing the cost of exploiting good business ideas world wide. However, our analysis also suggest that the means by which the entrepreneurial firm will commercialize its business idea (invention), by entering the world market or by selling its business to incumbents, depends on how complete the international market process becomes. In partly integrated markets the entrepreneur might prefer selling their business since incumbents are then willing to pay high prices to protect their market power. In more integrated markets incumbents market power is lower and it is more profitable for entrepreneurs to commercialize by entry.

Our results also show that international market integration will increase the incentive for entrepreneurship by increasing the reward for entrepreneurs through lower trade costs and through a more efficient market for corporate control.

These result suggest that the ongoing international market integration process spurs international entrepreneurship and thereby growth in the world economy. Consequently further policies aiming at abolishing international barriers would not only likely benefit consumers through lower prices but also through new products developed by entrepreneurs all over the world.

These results can be related to existing policies to support entrepreneurship in the European Union and elsewhere. The Small Business Act for Europe (European Commission, 2008), for example, focuses on supporting entrepreneurial firms to expand their business. These developments are in general likely to be warranted since entrepreneurial activity are associated with large asymmetric information problems and with positive externalities on society. However, our analysis also suggest that focusing on "born global entrepreneurs" can be counterproductive since "born to be sold global entrepreneurs" can be more beneficial to society, by avoiding large entry costs.

A possible extension would be to undertake a fully fledge welfare analysis taking into account effects on consumers, firm owners and labour. Another extension would be to introduce a more complex set of contractual arrangements between entrepreneurs and financiers, where the incentives for all agents may be distorted by asymmetric information. For instance, heavy reliance on debt financing can lead to excessive risk-taking by entrepreneurs. Finally, the analysis could be extended to a dynamic model, in order to capture the growth-promoting effect that is a core reason for the policy support to entrepreneurship.

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A. Appendix

B. Cournot with linear demand and innovation

The profit of firm j is:

$$\pi_j = [P - c_j - t]\, q_j \tag{B.1}$$

Demand

$$P = a - Q \tag{B.2}$$

where $Q = \sum_{j=1}^{n} q_j$

The first-order condition (firms take consumers expectations as given):

$$P - c_j - t - q_j^* = 0 \tag{B.3}$$

Then (B.3) becomes:

$$a - Q - c_j - t - q_j^* = 0 \tag{B.4}$$

Define $\Lambda_j = a - c_j - t$ and rewrite

$$\Lambda_j - Q - q_j^* = 0 \tag{B.5}$$

Sum over all (n) firms and solve for Q^*

$$\sum_j \Lambda_j - nQ^* - Q^* = 0 \tag{B.6}$$

We then get:

$$Q^* = \frac{\sum_j \Lambda_j}{n+1} = \frac{\bar{\Lambda}}{n+1} \tag{B.7}$$

From (B.5), we now have:

$$q_j^* = \Lambda_j - Q^* \tag{B.8}$$

and finally from (B.1) and (B.3):

$$\pi_j^* = \left[q_j^*\right]^2 \tag{B.9}$$

Let $\Lambda_0 = a - c$. Then from (B.7), we have (noting that there are $n+1$ firms under entry)

$$Q^*(i) = \frac{n\left(\Lambda_0 - t\right) + k}{n+1},\ Q^*(e) = \frac{(n+1)\left(\Lambda_0 - t\right) + k}{n+2} \text{ and } Q^*(0) = \frac{n\left(\Lambda_0 - t\right)}{n+1} \tag{B.10}$$

From (B.8), we obtain equilibrium outputs:

$$\begin{aligned} q_A(i) &= \Lambda_0 - t + k - Q^*(i),\ q_N(i) = \Lambda_0 - t - Q^*(i),\ q_E(e) = \Lambda_0 - t + k - Q^*(e) && \text{(B.11)} \\ q_N(e) &= \Lambda_0 - t - Q^*(e),\ q_N(0) = \Lambda_0 - t - Q^*(0) && \text{(B.12)} \end{aligned}$$

From (B.9), we have $\pi_h(l) = \left[q_j^*\right]^2$. From the information in (B.10), (B.11) and (B.12) it is now straighforward to prove Lemma 1.

C. Proof of Proposition 5(ii)

Define $\Lambda \equiv a - c - t$. Let $\bar{\alpha}_h \in (0,1)$ be defined from $\pi_h^C(i) = \pi_h(i)$ and let $\bar{\alpha}_S \in (0,1)$ be defined from $S^C = S^*$. It can be shown that

$$\begin{aligned} \bar{\alpha}_A &= \frac{\Lambda + \bar{k} + \bar{k}n}{\Lambda(n+1) + \bar{k}} && \text{(C.1)} \\ \bar{\alpha}_N &= \frac{\Lambda - \bar{k}}{\Lambda(n+1) + \bar{k}} && \text{(C.2)} \\ \bar{\alpha}_S &= \frac{2\Lambda + \bar{k}n}{\Lambda(n+1) + \bar{k}}. && \text{(C.3)} \end{aligned}$$

It is then useful to derive the following Lemma:

Lemma 5. *$\pi_h^C(i)$ is strictly concave in α with a unique maximum $\alpha_h^{\max}$ and $S^C = \pi_A^C(i) - \pi_N^C(i)$ is strictly concave in α with a unique maximum $\alpha_S^{\max}$.*

Proof. Follows from expressions (C.4)-(C.9). ■

$$\left.\frac{d\pi_A^C(i)}{d\alpha}\right|_{\alpha=0} = \left(\Lambda + \bar{k}n + \bar{k}\right)\frac{\Lambda + \bar{k}}{n+2} > 0 \tag{C.4}$$

$$\frac{d^2\pi_A^C(i)}{d\alpha^2} = -2\left(\Lambda + \bar{k} + na - nc\right)\frac{\Lambda + \bar{k}n + \bar{k}}{(n+2)^2} < 0 \tag{C.5}$$

$$\left.\frac{d\pi_N^C(i)}{d\alpha}\right|_{\alpha=0} = \left(\Lambda + \bar{k}n + \bar{k}\right)\frac{\Lambda + \bar{k}}{n+2} > 0 \tag{C.6}$$

$$\frac{d^2\pi_N^C(i)}{d\alpha^2} = -2\left(\Lambda(n+1) + \bar{k}\right)\frac{\Lambda - \bar{k}}{(n+2)^2} < 0 \tag{C.7}$$

$$\left.\frac{dS^C(i)}{d\alpha}\right|_{\alpha=0} = \frac{1}{n+2}\left(\Lambda(n+3) + \bar{k}n + \bar{k}\right)\bar{k} > 0 \tag{C.8}$$

$$\frac{d^2S^C(i)}{d\alpha^2} = -2\left(\Lambda(n+1) + \bar{k}\right)\frac{\bar{k}}{n+2} < 0 \tag{C.9}$$

Solving $\alpha_h^{\max}$ from$\frac{d\pi_h^C(i)}{d\alpha} = 0$ and $\alpha_S^{\max}$ from$\frac{dS^C}{d\alpha} = 0$, we then obtain:

$$\alpha_A^{\max} = \frac{\left(\Lambda + \bar{k}\right)(n+2)}{2\left(\Lambda(n+1) + \bar{k}\right)} \tag{C.10}$$

$$\alpha_N^{\max} = \frac{\Lambda\,(n+2)}{2\left(\Lambda(n+1) + \bar{k}\right)} \tag{C.11}$$

$$\alpha_S^{\max} = \frac{\Lambda(n+3) + \bar{k}(n+1)}{2\left(\Lambda(n+1) + \bar{k}\right)}. \tag{C.12}$$

Using (C.1)-(C.3) and (C.10)-(C.12), it is straightforward to show that:

$$0 < \bar{\alpha}_N < \bar{\alpha}_A < \alpha_N^{\max} < \bar{\alpha}_S < \alpha_A^{\max} < \alpha_S^{\max} < 1. \tag{C.13}$$

Firms will agree on reducing Nash outputs q_h^* to $q_h^C = \alpha q_h^*$ where $\alpha \in [\alpha_N^{\max}, \alpha_A^{\max}]$. From $\bar{\alpha}_N < \bar{\alpha}_A < \alpha_N^{\max}$ and the strict concavity of $\pi_h^C(i)$ breaking up the cartel will reduce all firms' profits, i.e. $\pi_h^C(i) < \pi_h^*(i)$ for $\alpha = [\alpha_N^{\max}, \alpha_A^{\max}]$. From the strict concavity of S^C, it also follows that breaking up the cartel increases the sales price, $S^C > S^*$ in the region $\alpha \in [\alpha_N^{\max}, \bar{\alpha}_S)$, whereas breaking up the cartel reduces the sales price $S^C < S^*$ in the region $\alpha \in (\bar{\alpha}_S, \alpha_N^{\max}]$. This is illustrated in Figure 3.1.

C.1. Proof of Lemma 3

First, note that $b_j \geq \max v_{ml}$, $l = \{\mathrm{e}, \mathrm{i}\}$ is a weakly dominated strategy, since no incumbent will post a bid equal to or above its maximum valuation of obtaining the assets and that firm e will accept a bid in stage 2, iff $b_j > v_e$.

Inequality I1 Consider the equilibrium candidate $\mathbf{b}^* = (b_1^*, b_2^*, ..., yes)$. Then, $b_w^* \geq v_{ii}$ is not an equilibrium since firm w would then benefit from deviating to $b_w = v_{ii} - \varepsilon$. If all other incumbents have posted a bid below $v_{ii} - \varepsilon$, w obtains the assets but pays a lower price. If any other incumbent posts a bid above $v_{ii} - \varepsilon$, w is better off not obtaining the innovation. $b_w^* < v_{ii} - \varepsilon$ is not an equilibrium since firm $j \neq w, e$ then benefits from deviating to $b_j = b_w^* + \varepsilon$, since it will then obtain the assets and pay a price lower than its valuation of obtaining them. If $b_w^* = v_{ii} - \varepsilon$, and $b_s^* \in [v_{ii} - \varepsilon, v_{ii} - 2\varepsilon]$, then no incumbent has an incentive to deviate. By deviating to no, firm e's payoff decreases, since it foregoes a selling price exceeding its valuation, v_e. Accordingly, firm e has no incentive to deviate and thus, b^* is a Nash equilibrium.

Let $b = (b_1, ..., b_M, no)$ be a Nash equilibrium. Firm e will then say no iff $b_h \leq v_e$. But incumbent j will then have the incentive to deviate to $b' = v_e + \varepsilon$ in stage 1, since $v_{ie} > v_d$. This contradicts the assumption that $\mathbf{b}$ is a Nash equilibrium.

Inequality I2 Consider the equilibrium candidate $\mathbf{b}^* = (b_1^*, b_2^*, ..., yes)$. Then, $b_w^* > v_e$ is not an equilibrium since firm w would then benefit from deviating to $b_w = v_e$. $b_w^* < v_e$ is not an equilibrium, since firm e would then not accept any bid. If $b_w^* = v_e - \varepsilon$, then firm w has no incentive to deviate. By deviating to $b_j' \leq b_w^*$, firm j's, $j \neq w, e$, payoff does not change. By deviating to $b_j' > b_w^*$, firm j's payoff decreases since it must pay a price above its willingness to pay v_{ii}. Accordingly, firm j has no incentive to deviate. By deviating to no, firm e's payoff decreases since it foregoes a selling price above its valuation v_e. Accordingly, firm e has no incentive to deviate and thus, b^* is a Nash equilibrium.

Let $b = (b_1, ..., b_m, no)$ be a Nash equilibrium. Firm e will then say no iff $b_h \leq v_e$. But incumbent $j \neq e$ will have the incentive to deviate to $b' = v_e + \varepsilon$ in stage 1, since $v_{ie} > v_e$, which contradicts the assumption that $\mathbf{b}$ is a Nash equilibrium.

Inequalities I3 Consider the equilibrium candidate $b^* = (b_1^*, b_2^*, ..., no)$, where $b_j^* < v_e$ $\forall j \neq e$. It then directly follows that no firm has an incentive to deviate and thus, b^* is a Nash equilibrium.

Then, note that firm e will accept a bid iff $b_j \geq v_e$. But $b_j \geq v_e$ is a weakly dominating bid in these intervals, since $v_e > \max\{v_{ii}, v_{ie}\}$. Thus, the assets will not be sold in these intervals.