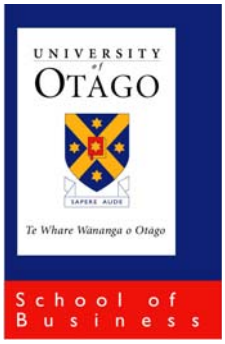

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Partial Ownership and Cross-Border Mergers[1]

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Abstract

Partial ownership can be used as a screening device by a foreign firm which wants to merge with a local firm whose productivity is private information. As partial ownership is confined to sharing future merger profits, it cannot achieve true revelation in all cases but improves expected merger gains also in an equilibrium which is not fully separating. The example of a Cournot target market in which a horizontal merger reduces marginal cost demonstrates the general results. If cost reduction is exogenous, a separating equilibrium exists. If cost reduction is endogenously determined by investment of the merged firm, equilibria exist which do not fully separate but imply partial ownership.
JEL-Classification: D82, F23.

Keywords: Partial ownership, merger, multinational firms, foreign direct investment, asymmetric information

1 Introduction

The global economy has witnessed an unprecedented surge in foreign direct investment (FDI) in the last decades. FDI can have different forms, either the form of a greenfield investment, of a joint venture or of a merger. Cross-border mergers have become a hotly debated issue since countries have experienced several merger waves. The World Investment Report estimates a value of US$ 297 billion of cross-border mergers and acquisitions in 2003, compared to US$ 151 billion in 1990 (see UNCTAD, 2004). It is not only this substantial figure but also the size of individual mergers which makes this FDI mode important. For example, the largest single FDI inflow to Germany was by far the takeover of Mannesmann Mobilfunk, a local cellphone company, by British Vodaphone in 2000.[1] The substantial share of cross-border mergers in FDI demonstrates that combining assets across countries has been expected to lead to large expected merger gains.[2] However, not all mergers are success stories, and even substantial merger losses do happen from time to time,[3] demonstrating that a foreign firm does not always know the size of after merger gains when specifying the merger proposal. The obvious reason is asymmetric information between a foreign firm and a local target, and this is the first starting-point of this analysis.[4] The second starting-point is the observation that mergers do not necessarily imply a complete takeover

[1]The US$ 183 billion deal was the largest corporate merger at that time and made the Vodafone group the largest company on the London stock market. The world's largest corporate merger between America Online and Time Warner was finalized in January 2001.

[2]If two existing firms merge in a market of strategic substitutes in the sense of Bulow, Geanakoplos and Klemperer (1985), a successful merger must reduce production costs substantially according to the merger paradox (see Salant, Switzer and Reynolds, 1983, Perry and Porter, 1985, and Farrell and Shapiro, 1990). The merger paradox is weakened by product differentiation (Lommerud and Sorgard, 1997) and if firms compete in a market of strategic complements (Deneckere and Davidson, 1985).

[3]For example, Vodaphone shares experienced a loss in value of nearly three quarters two years after the takeover. Gugler *et al* (2003) report a large proportion of profit reducing mergers, with no significant differences in patterns across countries.

[4]Asymmetric information seems to be important for mergers. For example, Shen and Reuer (2003) demonstrate that private targets are less preferred compared to public firms because they offer less information on assets.

Table 1: Japanese Foreign Direct Investment into Europe 1970–2001

Number of investments	4,510
Greenfield/WOS[5]	3,111
Non WOS	1,410
Japanese minority-owned	457
50–50 splits	229
Japanese majority-owned	719

* 95% cut-off, WOS = wholly owned subsidiary. For a description of the data set, see Raff, Ryan and Stähler (2005).

by the foreign firm. For example, Asiedu and Esfahani (2001) show that the degree of foreign equity participation rises with foreign assets. Desai, Foley and Hines (2002) investigate the determinants of partial ownership of foreign affiliates of U.S. firms. Partial ownership is a universal feature of FDI in general and mergers in particular, meaning that mergers are not equivalent to complete takeovers. Table 1 shows the structure of Japanese foreign direct investment to Europe and demonstrates that mixed ownership structures must not be ignored. In particular, the average principal investor's equity ownership share of investments which are not qualified as wholly owned subsidiaries was 55.05 % in this period. Note that Table 1 does only count the number of investments and thus underestimates the role of cross-border mergers as they are known to be larger in volume than other forms of foreign direct investment.

Given this background, this paper explains partial ownership by information asymmetries. The model is as simple as possible and applies to both vertical and horizontal cross-border mergers: A foreign firm considering the acquisition of a local firm does not know the productivity of the potential target, because it is private information of the target firm. The productivity of the target determines the scope of merger gains.[6] For the sake of simplicity, we will assume that the foreign firm has all the bargaining power, picks

[6]Even if we allow for partial ownership, the merger paradox continues to apply (see Reitman, 1994), so that cost reductions can still be expected to drive mergers.

one target firm and offers a set of contracts (as a take it or leave it offer).[7] If the foreign firm specified only the acquisition price, it would suffer from the lemons problem: unless the acquisition price is very high, only the bad productivities will accept, but the good productivities will reject.

Alternatively, the merger proposal could be made dependent on the future performance of the target, like future output. However, takeover contracts based on future performance are hard to find, and the reason is the limited liability of the previous owner. Since the future profitability of a target may be uncertain, it is sensible to assume that a previous owner cannot be held responsible for after merger losses so foreign firms cannot claim a part of the acquisition price back if their expectations are not met. But if performance-related contracts cannot be written, the foreign firm may still use partial ownership as a screening device. A productive target can be expected to accept a high share of after merger profits as a compensation for accepting partial ownership of the foreign firm even if the sales price for foreign partial ownership is not large. Conversely, a less productive target will not accept this offer, as it correctly anticipates that after merger profits will be small. Hence, leaving a part of the future after merger profit to the target may qualify for a proper incentive scheme. Thereby, our model combines the aspects of adverse selection and incomplete contracts, and discusses how partial ownership as a screening device may (partially) solve the problem.[8]

This is not the first paper dealing with cross-border mergers. The international economics literature has mainly dealt with the impact of mergers on international trade patterns. Barros and Cabrol (1994) and Horn and Levinsohn (2001) discuss the impact of trade policies on mergers. Neary (2004) discusses the role of mergers as a result of comparative advantages in a general equilibrium setting. Horn and Persson (2001) determine the equilibrium ownership of firms by a cooperative approach of coalition formation. Qiu and

[7]Keeping the model as simple as possible means also that we do not consider due diligence as a screening device. For the role of alliances and due diligence for acquisitions, see Arend (2003).

[8]We do not consider signaling in this model. The role of ownership structures as a signaling device for attracting venture capital has been discussed by the seminal paper of Levand and Pyle (1977).

Zhou (2005) discuss the effects of information sharing and/or output coordination on the performance of an international merger. Other papers have dealt with mergers as a certain mode of foreign direct investment and compare the merger incentive with greenfield investment or the incentive to form a joint venture (see Bjovatn, 2004, Raff, Ryan and Stähler, 2005). Kabiraj and Chaudhuri (1999) compare the welfare effects of domestic and cross-border mergers under different assumptions on market structures. There is also an extensive literature on cross-border joint ventures, pronouncing that shared ownership in joint ventures is important if the joint venture is subject to moral hazard and adverse selection (Balakrishnan and Koza, 1993, Chi, 1996), if agency costs increase in the foreign share of a joint venture (Nakamura and Yeung, 1994) or if foreign intangible assets are substantial (Nakamura and Xie, 1998).[9] The difference from this paper is that those papers do not consider different degrees of partial ownership whereas this paper will endogenize the degree of partial ownership.

Mergers have also received a lot of attention in the finance and industrial organization literature. One strand of this literature has dealt with the division of merger gains after a profitable target has been identified by an investor. Grossman and Hart (1980, 1981) found that acquisitions of profitable targets face a free rider problem in case of small shareholders. Small shareholders will sell only if they get the complete pro rata merger gains because their influence on the success of a complete takeover is marginal. Shleifer and Vishny (1986) have shown that this problem can be overcome if shareholders exist who hold a large share of equities.[10] However, Johnson *et al* (2000) demonstrate that large shareholders may imply tunneling, *i.e.*, transferring resources out of a company to the controlling shareholder at the disadvantage of other shareholders. Another strand of this literature has dealt with the optimal behavior of potential investors before a merger might be found profitable. For example, Burkart (1995) shows that a toehold leads to excessive bidding of its holder if the target is eventually sold in a second-price auction because the winner has to pay the loser's share. Bulow, Huang

[9]See also Desai, Foley and Hines (2002).

[10]See also Bagnoli and Lipman (1988) and Ferguson (1994).

and Klemperer (1999) have demonstrated that toeholds have a large impact in common value takeoever battles. Goldman and Qian (2005) discuss the size of optimal toeholds.[11]

This literature thus emphasizes the strategic effects of partial ownership *during* and *before* merger negotiations take place. However, partial ownership is not a part of the proposed merger deal and hence not a result of a merger as this paper will show. Our model has some features in common with share contracts (see Bhattacharyya and Lafontaine, 1995, Canjels and Volz, 2001, Dai, 2004, and for a general treatment of wealth-constrained agents, see Lewis and Sappington, 2000). The difference is that share contracts assume a binding wealth constraint for the partner who is (still) carrying out future actions, whereas our model considers a target whose owner does not take any future action once the merger deal is done, except of possibly participating in after merger profits. The paper is closest to Hviid and Prendergast (1993) who also consider a target with private information and a merger proposal as a take it or leave it offer. The difference is that both firms are already rivals in a market and both have private information, so the market performance can be given by a Bayesian equilibrium. A rejected proposal signals a high profitability of the target and increases the target's profit and decreases bidder's profit. In our model, the foreign firm is a newcomer to the market, and to our knowledge no paper has dealt with partial ownership as a screening device in a simple model of incomplete contracts and adverse selection.

The remainder of the paper is organized as follows. Section 2 introduces the model, and section 3 determines the equilibrium offer of the foreign firm. Section 4 presents two examples for a horizontal merger in a Cournot market, and section 5 concludes the paper.

[11] Partial ownership is also considered in models of vertical integration. Dasgupta and Tao (2000) show that equity participation by a downstream firm in an upstream firm can be beneficial if investment of the upstream firm can be either specific or general because it reduces the outside options of the upstream firm if this firm can also bargain with other downstream firms. See also Greenlee and Rascovich (2005) for a model of partial vertical ownership which demonstrates an invariance result of ownership structures if downstream firms have symmetric costs.

2 The model

The sequence of decisions is as follows. Applying the Harsanyi transformation, a Nature move picks the productivity of the target which is unknown to the foreign firm. In the first stage, the (risk-neutral) foreign firm determines the set of contracts which it will offer to the target firm. Each contract specifies a transfer T to the target firm in case of acceptance. Furthermore, it specifies a share s with $0 \leq s \leq 1$ as the share of after merger profits which will be left to the target.[12] If $s \in]0,1[$, the foreign firm will obtain a partial ownership if its offer is accepted. In the second stage, the target firm either accepts one of the offers or rejects them all. If a proposal is accepted, the deal is done on the basis of the terms of this proposal. If all contract proposals are rejected, the target remains independent and the game is over.

The efficiency of the target is measured by the parameter β with $\beta \in [b, B], b < B$. The target's efficiency is private information, but the probability that a firm is of type β or of a lower productivity is given by the c.d.f. $F(\beta)$ and is common knowledge. $M(\beta)$ denotes the after merger profit, and $\Pi(\beta)$ denotes the independent profit of the target if the target rejects the offer, so that $M(\beta) - \Pi(\beta)$ is the merger gain. All total derivatives with respect to the type β will be denoted by a dot. We will assume that $\dot{M} > \dot{\Pi} > 0$, so that both profits and the merger gain increase with productivity. For the sake of simplicity, we will assume also that a merger is always profitable irrespective of the type, *i.e.*, $M(\beta) > \Pi(\beta) > 0, \forall \beta$.[13] Both M and Π may reflect sums of discounted future profits.[14]

Suppose that the foreign firm's strategy is restricted such that only com-

[12] The case of $s = 1$ is equivalent to a license contract.

[13] Allowing merger losses would not change the main results except that an offer should bunch certain low productivity types such that these types will never accept any contract. Furthermore, any outside option of the foreign firm is irrelevant as long as it does not depend on the type of the target to which a merger offer is made. For example, a foreign firm could also enter a local market by a greenfield investment or by exports.

[14] However, we do not assume that the foreign firm does not learn the efficiency at some point, as this would lead to ratchet effects and the general impossibility of a fully separating equilibrium which is beyond the scope of this paper. For the ratchet effect in a dynamic procurement model with adverse selection and moral hazard, see Laffont and Tirole (1988).

plete takeovers are possible. In this case, the foreign firm faces the lemons problem as productive targets will agree to a takeover proposal only for a substantial transfer, but this substantial transfer will also be accepted by all less productive types. The transfer offered will determine the critical productivity β^* by $T = \Pi(\beta^*)$, as type β^* is indifferent between accepting the proposal and turning it down. All lower productivity types will accept the offer. The foreign firm maximizes its expected payoff

$$\tilde{V}(\beta^*) = \int_b^{\beta^*} M(\beta)dF(\beta) - F(\beta^*)\Pi(\beta^*) \text{ s.t. } b \leq \beta^* \leq B. \tag{1}$$

The expected payoff $\tilde{V}$ is the expected merger gain, reduced by the transfer times the probability that the proposal will be accepted. The first derivative is equal to

$$\frac{d\tilde{V}}{d\beta^*} = f(\beta^*)[M(\beta^*) - \Pi(\beta^*)] - F(\beta^*)\dot{\Pi}(\beta^*). \tag{2}$$

Note that $d\tilde{V}/d\beta^*(\beta^* = b) = f(b)[M(b) - \Pi(b)] > 0$ such that the optimal $\beta^* > b$. Given that $\tilde{V}$ is quasi-concave, the optimal offer implies

$$\begin{aligned} f(\beta^*)[M(\beta^*) - \Pi(\beta^*)] - F(\beta^*)\dot{\Pi}(\beta^*) \leq 0, \beta^* \leq B, \\ [f(\beta^*)[M(\beta^*) - \Pi(\beta^*)] - F(\beta^*)\dot{\Pi}(\beta^*)][\beta^* - B] = 0. \end{aligned} \tag{3}$$

According to (3), the foreign firm will make an offer which will be accepted by all types if and only if $f(B)[M(B) - \Pi(B)] \geq \dot{\Pi}(B)$. In all other cases, the lemons problem prevails and adverse selection will occur.

3 Equilibrium offers

In the previous section, the strategy of the foreign firm has been restricted to proposals of a complete takeover. We will now allow partial ownership. As the target's productivity is private information, the target is free to accept any contract. As common in the literature on contracts under asymmetric information, let $\hat{\beta}$ denote the announced type of the target which means that the target accepts a contract which the foreign firm has designed for type $\hat{\beta}$.

$U(\beta, \hat{\beta})$ denotes a β-type target's payoff of accepting a proposal designed for type $\hat{\beta}$:

$$U(\beta, \hat{\beta}) = T(\hat{\beta}) + s(\hat{\beta})M(\beta) - \Pi(\beta). \tag{4}$$

True revelation requires that

$$\forall \beta', \beta'' \in [b, B] : U(\beta', \beta') \geq U(\beta', \beta''), U(\beta'', \beta'') \geq U(\beta'', \beta'), \tag{5}$$

which leads to

$$(s(\beta') - s(\beta''))(M(\beta') - M(\beta'')) \geq 0 \Rightarrow \dot{s} \geq 0, \tag{6}$$

requiring that the share of after merger profits left to the target should not decrease with productivity. Less productive targets can be held back from picking a contract designed for a productive target only if productive targets are supposed to receive a higher share of after merger profits. However, Proposition 1 demonstrates that this evident requirement may be at odds with the foreign firm reaping merger gains completely.

Proposition 1 *If* $\ddot{\Pi}/\dot{\Pi} > \ddot{M}/\dot{M}$*, a fully separating equilibrium exists. If* $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$*, no fully separating equilibrium exists.*

Proof: True revelation is the optimal strategy of the target if

$$U_{\hat{\beta}}(\beta, \hat{\beta} = \beta) = \dot{T}(\beta) + \dot{s}(\beta)M(\beta) = 0, \tag{7}$$

leading to $\dot{T}(\beta) \leq 0$. The change in total payoff is

$$\dot{U} = U_{\hat{\beta}} \frac{d\hat{\beta}}{d\beta} + U_{\beta} = U_{\beta} = s(\beta)\dot{M}(\beta) - \dot{\Pi}(\beta). \tag{8}$$

The foreign firm maximizes its payoff by separating types such that $U(\beta) = 0$ which is equivalent to $U(b) = 0, \dot{U} = U_{\beta} = 0$ and requires

$$s(\beta) = \frac{\dot{\Pi}(\beta)}{\dot{M}(\beta)} \tag{9}$$

Due to $\dot{M} > \dot{\Pi}$, $s(\beta) < 1$, but (9) is feasible only if $\dot{s} \geq 0$:

$$\dot{s}(\beta) = \frac{\ddot{\Pi}\dot{M} - \dot{\Pi}\ddot{M}}{\dot{M}^2} \geq 0 \Leftrightarrow \frac{\ddot{\Pi}}{\dot{\Pi}} \geq \frac{\ddot{M}}{\dot{M}} \tag{10}$$

Appendix A.1 proves that s and T do not depend on β if $\ddot{\Pi}/\dot{\Pi} \leq \ddot{M}/\dot{M}$. □

Proposition 1 shows that partial ownership is not in all cases a successful device for separating types. We can demonstrate Proposition 1 by means of an example in which $\dot{\pi}(\beta) = \text{const.}$ and thus $\ddot{\Pi}(\beta) = 0$. In this case, a fully separating equilibrium exists (does not exist) if $M(\beta)$ is concave (convex), *i.e.*, $\ddot{M}(\beta) < (>)0$. Figure 1 shows both cases. Any separating equilibrium will make the target indifferent between acceptance and rejection. If M is convex, the share s has to decrease with β if the foreign firm wants to get hold of all merger gains. This can be seen from the left panel of Figure 1 which shows that, starting from b, the merger profit change becomes larger than the independent profit change, and hence only a permanent decrease in s could guarantee that no merger gains are left to the target. In order to make each type indifferent between acceptance and rejection, the foreign firm has to pay less out of the merger profits to a more productive target. But this is in conflict with the requirement that true revelation warrants that the share of after merger profits should increase with productivity. If merger gains are concave (see the right panel of Figure 1), both incentive compatibility and the complete transfer of merger gains to the foreign firm are possible because the merger profit change becomes less than the independent profit change so that s will be able to increase with productivity.

If $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$ across the whole range of productivities, the foreign firm will make only a "one size fits all" offer. This offer does not depend on types, and any equilibrium is at least partially pooling.[15] Let $\{T, s\}$ denote the contract offer in terms of transfer T and share s, such that the payoff of the target in case of acceptance is equal to

$$U(\beta) = T + sM(\beta) - \Pi(\beta). \tag{11}$$

[15]We will not consider cases in which $\ddot{\Pi}/\dot{\Pi} > \ddot{M}/\dot{M}$ for a certain range of productivities and $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$ for another range of productivities. In this case, the optimal policy would be a combination of a pooling strategy and a fully separating strategy.

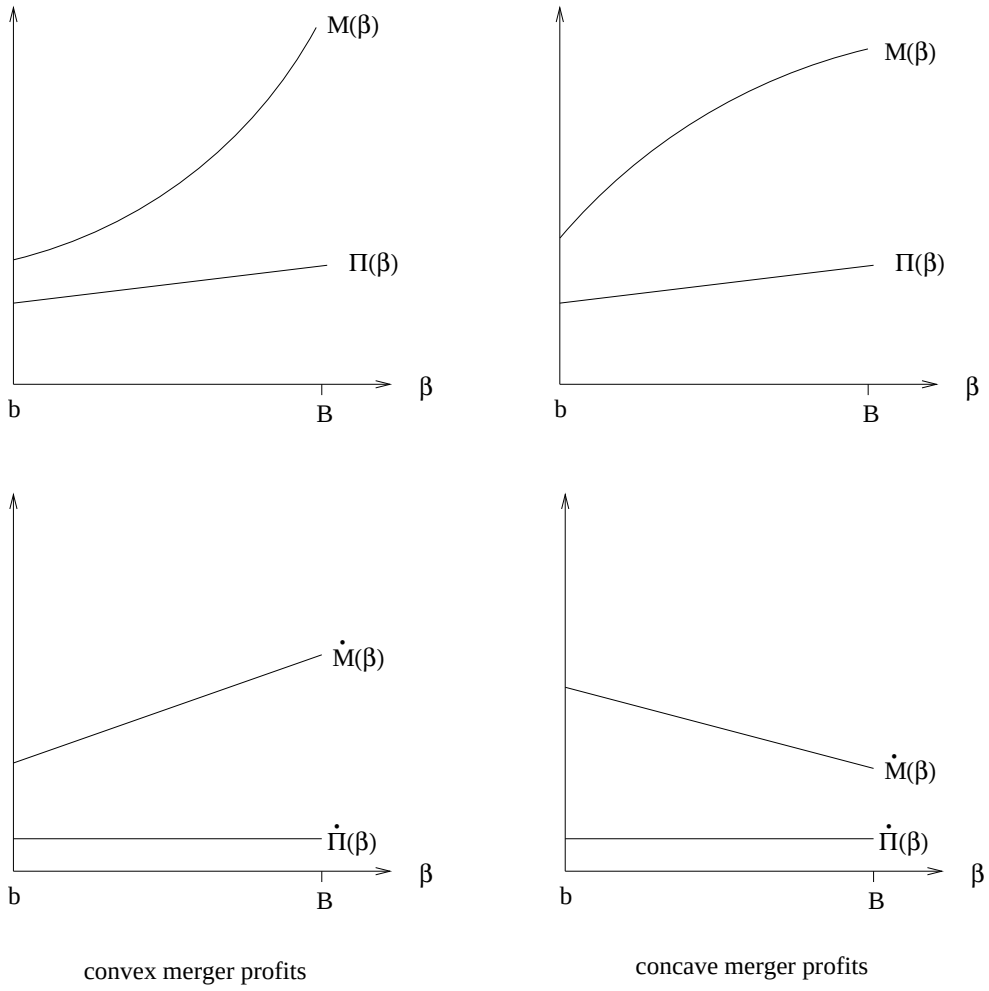

Figure 1: Convex versus concave merger profits

Based on (11), we are able to determine the target's payoff change with its productivity β and share s. Figure 2 shows the behavior of the target's payoff. For a given level of T, $\dot{U} = s\dot{M} - \dot{\Pi}$, and since $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$, the $\dot{U} = 0-$line decreases in the $\beta - s-$space. Since both $\dot{\Pi}(b)/\dot{M}(b)$ and $\dot{\Pi}(B)/\dot{M}(B)$ are less than unity, two bounds exist for the share: $\underline{s}(\overline{s})$ denotes the minimum (maximum) s for which the best (least) productivity's payoff change is zero.[16] Figure 2 is a bird's eye view as it shows the surface of the target's payoff dependent on s and β. The $\dot{U}$-line shows the valley of this payoff landscape,

[16]Note that $\dot{M} > \dot{\Pi}$ implies $\underline{s}, \overline{s} \in]0, 1[$.

and different levels of T determine the critical altitude above which a target will accept the offer. If the share is less (more) than $\underline{s}(\overline{s})$, the payoff will unambiguously decrease (increase) with productivity. The foreign firm may choose between the following options:

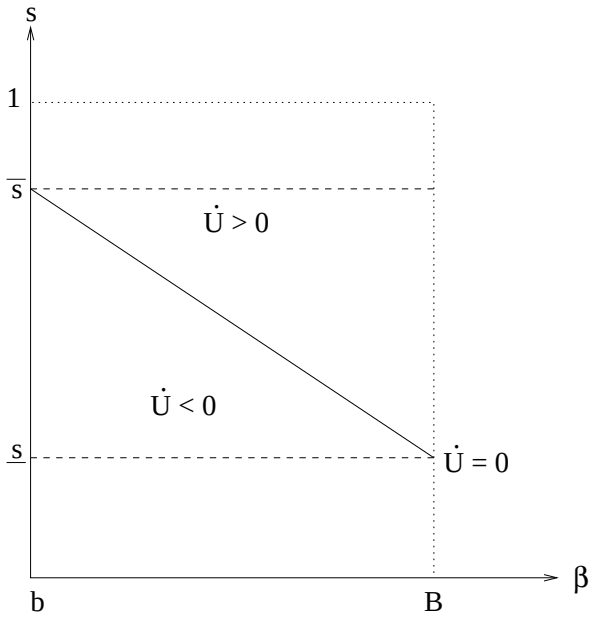

Figure 2: The target's payoff changes with β and s if $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$

- Specifying a contract $\{s, T\}$ such that $s \leq \underline{s}$ guarantees that the payoff of targets decreases with their productivity. In this case, the lemons problem is still prevalent but may be reduced by partial ownership. It depends on the size of T how many low productivity types will accept. If T is sufficiently large, all types will accept. We will refer to this case as *aiming at the low end* of productivities.

- Specifying a contract $\{s, T\}$ such that $s \geq \overline{s}$ is an option which is not available without partial ownership. A sufficiently high s will guarantee that the payoff of targets will increase with productivity. Once again, if T is sufficiently large, all types will accept the offer. However, if T is not, only high productivity types will accept. Thus, partial ownership allows discrimination against low productivity types, and therefore we will refer to this case as *aiming at the high end* of productivities.

- Finally, a contract $\{s, T\}$ could be offered with $s \in]\underline{s}, \overline{s}[$. In that case, all types will again accept if T is sufficiently large. However, if it is not, low and/or high productivity types will accept whereas intermediate productivity types will reject the offer. The reason is that the $\dot{U} = 0-$line represents a minimum payoff. If $s = 0, \dot{U} = -\dot{\Pi} < 0$, but as s increases, $\dot{U}$ increases and is equal to $\dot{M} - \dot{\Pi} > 0$ when s becomes unity. Accordingly, if the merger proposal specifies a share $s \in]\underline{s}, \overline{s}[$, the payoff of targets decreases with β until the $\dot{U} = 0-$line is reached and increases afterwards. We will refer to this case as *aiming at both ends* of productivities.

We cannot determine in general in which range we will find the foreign firm's best strategy.[17] However, we are able to show that partial ownership will occur if the foreign firm's expected payoff function is well-behaved: neither $s = 0$ nor $s = 1$ is an equilibrium strategy of the foreign firm. Proposition 2 shows that the foreign firm will never go to the extremes.

Proposition 2 *If* $\ddot{\Pi}/\dot{\Pi} < \ddot{M}/\dot{M}$ *and the foreign firm's expected payoff is quasi-concave in* β *and* s*,*

(i) the foreign firm will offer a share s^* *such that* $0 < s^* < 1$*,*

(ii) the foreign firm will offer a share $s^* = \underline{s}(\overline{s})$ *if aiming at the low (high) end of productivities maximizes its expected payoff.*

Proof: see Appendix A.2.

Hence, partial ownership will also play a role if no fully separating equilibrium exists. Furthermore, the equilibrium share will be either $\underline{s}$ or $\overline{s}$ unless aiming at both ends of productivities does best. The optimal strategy depends crucially on the distribution of types. For example, if the distribution of types is skewed such that the probability of facing high productivity types is much larger than facing low productivity types, it may be an optimal strategy to aim at the high end of productivities and to exclude low productivities by a contract offer which specifies a low T (and $\overline{s}$). If the distribution

[17] We will present the results of a simulation in the next section.

is skewed such that the probability of dealing with an intermediate productivity type is low, it may be the best strategy to make an offer which will be accepted by low and high productivity types only. The next section will explore these options further by presenting an example of a Cournot target market with two different assumptions on cost saving due to a cross-border horizontal merger.

4 The example of a Cournot target market

This section demonstrates the scope of partial ownership as a screening device for a Cournot target market. The setup is as simple as it can be for a potentially successful horizontal merger. The local market is assumed to be served by n heterogeneous firms. Heterogeneity implies that marginal costs differ across firms. For the sake of simplicity, we assume that the foreign firm can enter the market only by a merger.[18] The foreign firm has observed the local market and is well aware of aggregate output and equilibrium prices without merger. However, it cannot observe market shares, and it does not know the marginal cost of an individual target. In order to simplify matters further, we assume that marginal costs are common knowledge among local firms. All firms can be expected to behave in the Cournot fashion.[19]

The local firms serve the market of a representative consumer with quasi-linear preferences which give rise to an inverse demand function $p = 1 - Q$. Each local firm i produces with a constant marginal cost $c_i = 1 - \beta$ with

$$\frac{n(1-\bar{c})}{n+1} < \beta < 1. \tag{12}$$

$\bar{c}$ denotes the average marginal cost. Condition (12) guarantees that all firms produce and that any marginal cost is not negative. β denotes the individual

[18]Note that this section's model does not involve the merger paradox because we do not consider the merger of two already active firms in this market but the market entry of a foreign firm via merger and partial ownership.

[19]If marginal costs were not common knowledge among local firms, oligopolistic competition would result in a Bayesian Nash equilibrium. This would not change results substantially, but would make determining the equilibrium much more complicated.

productivity of a firm which reduces the individual marginal cost. The support of the c.d.f. $F(\beta)$ is given by restriction (12). The demand function, the c.d.f. and the number of firms are common knowledge. The foreign firm can observe the equilibrium price and hence knows equilibrium aggregate output, so it can determine the *sum* of marginal costs, C, and the average marginal cost $\bar{c} \equiv C/n$.[20] Without merger, solving for the first-order conditions and the optimal output levels yields the individual Cournot profit

$$\Pi(\beta) = \left(\frac{1 - (n+1)(1-\beta) + n\bar{c}}{n+1} \right)^2 \tag{13}$$

which – from the viewpoint of the foreign firm – depends on the observable number of firms, on the deducible average marginal cost and on the unobservable productivity of the target. Note that the independent profit (13) is monotically increasing and convex in β:

$$\dot{\Pi} = \frac{2[(n+1)\beta - n(1-\bar{c})]}{n+1} > 0, \ddot{\Pi} = 2 > 0. \tag{14}$$

$\dot{\Pi}$ and $\ddot{\Pi}$ will serve as the point of reference for the two different scenarios of horizontal cross-border mergers in the Cournot market which we will consider now. We will refer to the term which decides on the possibility of a fully separating equilibrium as Δ, *i.e.*,

$$\Delta_i \equiv \frac{\ddot{\Pi}}{\dot{\Pi}} - \frac{\ddot{M}_i}{\dot{M}_i}, \tag{15}$$

where the subscript $i \in \{1, 2\}$ denotes the merger scenario we consider. If Δ_i is positive (negative), a (no) fully separating equilibrium exists (see Proposition 1).

4.1 Exogenous cost reduction

The case of an exogenous cost reduction is the simplest case to deal with. The basic assumption is that combining both firms' assets leads to a certain

[20] This conclusion is the result of Bergstrom and Varian (1985) who show that the performance of a Cournot market does not depend on the distribution of individual constant marginal costs but on aggregate marginal costs only.

(exogenous) reduction in marginal cost. This reduction, of course, depends on the type of the target. This subsection assumes that the after merger marginal cost is equal to $1-\alpha\beta$ with $\alpha > 1$.[21] The merged firm will compete with the other rivals in the Cournot fashion, and its after merger profit will be equal to

$$M_1(\beta) = \left(\frac{1 - n(1-\alpha\beta) + n\bar{c} - (1-\beta)}{n+1}\right)^2. \tag{16}$$

Appendix A.3 shows that $\Delta_1 > 0$. Hence, if a merger in a Cournot target market reduces the marginal cost by a certain percentage, the foreign firm is able to reap the whole merger surplus. The optimal set of contracts will specify partial ownership such that the share s will increase with the productivity of the target. Due to (9), (14) and (A.9) of Appendix A.3, the optimal share to be offered is equal to[22]

$$s_1 = \frac{(n+1)((n+1)\beta - (1-\bar{c}))}{(n\alpha+1)((n\alpha+1)\beta - (1-\bar{c}))}. \tag{17}$$

Our specification allows us to do some comparative statics exercises. First, we observe that

$$\frac{\partial s_1}{\partial \bar{c}} = \frac{(\alpha-1)n^2(n+1)\beta}{(n\alpha+1)((n\alpha+1)\beta - n(1-\bar{c}))^2} > 0. \tag{18}$$

An increase in the average marginal cost will lead to a high powered incentive scheme. The share s_1 increases with $\bar{c}$ because a productive target's profits are larger the less productive all other rival firms are. Second, an increase in α will lead to a low powered incentive scheme:

$$\frac{\partial s_1}{\partial \alpha} = -\frac{n(n+1)((n+1)\beta - n(1-\bar{c}))(2(n\alpha+1)\beta - n(1-\bar{c}))}{(n\alpha+1)^2((n\alpha+1)\beta - n(1-\bar{c}))^2} < 0. \tag{19}$$

[21] Obviously, α and β are bounded above, *i.e.*, $\alpha\beta < 1$, because we continue to assume that all other $(n-1)$ rival firms will be active. The results would not change substantially if we allow for exit of rival firms, but the reaction functions would become complicated due to discontinuities. The lower bound requires $(n\alpha+1)\beta - n(1-\bar{c}) > 0$ which is always fulfilled due to condition (12).

[22] The optimal set of contracts is determined by $\{s_1(\beta), T_1(\beta)\}, \beta \in [n(1-\bar{c})/(n+1), 1]$ with $s_1(\beta)$ according to (17) and $T_1(\beta) = \Pi(\beta) - s_1(\beta)M_1(\beta)$ according to (13), (16) and (17).

An increase in α increases merger profits. Less of the merger profit has to be given away to the target in order to make the target indifferent between acceptance and rejection if the (exogenous) productivity of the merger increases.

4.2 Endogenous cost reduction

For the case of an endogenous cost reduction, we assume that it needs more than just combining assets but only an investment of the merged firm can achieve a cost reduction. Furthermore, the size of this cost-reducing investment is common knowledge before it comes to output decisions. In this sense, this subsection deals with a potential four-stage game: in the first stage, the foreign firm makes an offer (or a set of offers) to the local firm with unknown productivity, in the second stage, this offer will be accepted or rejected. In case of rejection, the game continues in the usual Cournot fashion. In case of acceptance, the type of the firm is revealed and the merged firm decides on the size of the cost-reducing investment. Once this investment is made and known by rival firms, all firms compete in the Cournot fashion.

The assumption that the type is revealed once the offer is accepted deserves some further discussion as it is less restrictive than it looks at first glance. From Propositions 1 and 2 we know that any accepted equilibrium offer will lead to a share $s \in]0, 1[$. Partial ownership implies that the previous owner is still in the boat, and has thus no interest in rocking it but would like to make sure that the optimal investment level will be realized. Otherwise, her part of the after merger profit will be lower. Therefore, true revelation after the merger deal is done seems to be obvious.

We have already solved the subgame subsequent to rejection. For the case of acceptance, this subsection assumes that the marginal cost in the last stage is equal to $1 - \beta - \phi x$, where x denotes the size of cost-reducing investment, and ϕ denotes the efficiency of this investment. The marginal cost is lower the larger the productivity and the investment are. Investment is costly for the merged firm, and we assume that this investment cost is linear-quadratic and equal to $\gamma x + \delta x^2/2$. Note that there is also an additional strategic effect

which goes beyond cost saving. The investment serves as a commitment to be more aggressive in the commodity market because a low marginal cost will steal business from other firms.[23]

Appendix A.4 has the details of this case and shows that $\Delta_2 < 0$. The reason why the change in merger profits increases more strongly than the change in independent profits with the target's productivity is the behavior of the optimal investment level with β (see A.15in Appendix A.4). An increase in productivity makes cost-reducing investment more profitable and thereby adds overproportionally to the increase in merger profits. The foreign firm is therefore not able to reap all merger gains and to separate types simultaneously, so that no equilibrium offer will be fully separating.

As mentioned in the previous chapter, we cannot determine the equilibrium strategy in general if no fully separating equilibrium exists. Table 2 shows the result of a simulation which assumes that the productivity β is uniformly distributed between 0.4 and 0.6.[24] The results of three different scenarios are reported. Without partial ownership, the foreign firm can only do terribly because the probability that its best $s = 0-$offer will be accepted is extremely low. The possibility of partial ownership changes this result drastically.[25] If the foreign firm aims at the high end, it will optimally discriminate against low productivities. Although the scope for this policy is not very large in this simulation, the improvement compared to the $s = 0-$case is tremendous. If it aims at the low end, it will optimally include all types which actually turns the result without partial ownership completely around. Aiming at the low end does best in this simulation.

[23]This effect is well known in the literature. For excessive R&D investment in a Cournot duopoly, see Brander and Spencer (1983).

[24]Further assumptions of the simulation are $\bar{c} = 0.5, n = 3, \gamma = 0.01, \delta = 2, \phi = 0.5$.

[25]Aiming at both ends leads to a corner solution in this range and is dominated by any other partial ownership arrangement. The simulation confirms that the optimal s is equal to $\underline{s}(\overline{s})$ if the foreign firm aims at the low (high) end of productivities. The details of the computations are available from the author upon request or can be downloaded from http://www.otago.ac.nz/economics/personal/fs_files/Partial_Ownership_simulation.pdf.

Table 2: Simulation results

Scenario	supported types	$V \times 10^{-3}$
$s = 0$	$\beta \in [0.4, 0.4005]$	0.000027
low end	$\beta \in [0.4, 0.6]$	2.47
high end	$\beta \in [0.487, 0.6]$	1.68

V : expected payoff of the foreign firm

5 Concluding remarks

This paper has demonstrated the role of partial ownership for cross-border mergers. It has shown that partial ownership will always help a foreign firm to improve on the expected merger gains, even if a fully separating equilibrium is not feasible. Our model could explain partial ownership in a simple model of adverse selection. On the one hand, the productivity of the target is private information, on the other hand, performance-related contracts of a complete acquisition are not possible due to the limited liability of the previous owner. In this environment, partial ownership serves both as a screening device and as a tool for maximizing the expected after merger gains of the foreign firm.

We could distinguish two cases. If the increase in independent profits with the productivity is larger than the respective increase in after merger profits, a separating equilibrium exists. The foreign firm offers a set of contracts which implies revelation of the local firm, and the foreign firm gets the whole merger gain. If the increase in independent profits with the productivity is less than the respective increase in after merger profits, no fully separating equilibrium exists. In that case, the type of the offer depends on the distribution of types. The foreign firm may aim at the low end of productivities and possibly discriminate against high productivity types, or aim at the high end of productivities and possibly discriminate against low productivity types, or aim at both ends of productivities and possibly discriminate against intermediate productivity types. The last two options are not available without partial ownership.

The model has assumed that the foreign firm makes a take it or leave

it offer which is either rejected or accepted by the target. This is obviously a shortcut which highlights the information asymmetry. Generalizing the model such that negotiations could involve several offers, and possibly counter-offers, would add much more complexity to the bargaining process. Models of bargaining under one-sided private information have made a lot of progress (see Kennan and Wilson, 1993, for a survey) so that any attempt to generalize this model is not hopeless, but has been beyond the scope of this paper. It is left to future research how more involved negotiation processes including due diligence and other screening devices affect the equilibrium ownership structure of merged firms.

Appendix

A.1 s and T in case of $\ddot{\Pi}/\dot{\Pi} \leq \ddot{M}/\dot{M}$

We will do the proof that both s and t do not depend on β if $\ddot{\Pi}/\dot{\Pi} \leq \ddot{M}/\dot{M}$ by contradiction. Assume that the foreign firm would maximize its expected payoff by separating types such that $\dot{s}(\beta) > 0$ at least over a certain subrange of $[b, B]$. The foreign firm's payoff of a merger deal with type β, denoted by V, is equal to

$$V(\beta) = [1 - s(\beta)]M(\beta) - T(\beta), \tag{A.1}$$

and its change is

$$\begin{aligned} \dot{V}(\beta) &= [1 - s(\beta)]\dot{M}(\beta) - \dot{s}(\beta)M(\beta) - T(\beta) \\ &= \dot{M}(\beta) - \dot{s}(\beta)M(\beta). \end{aligned} \tag{A.2}$$

The last line follows from revelation condition (7). Eq. (A.2) shows that the foreign firm does best if $\dot{s}(\beta) = 0$, irrespective of the c.d.f., because the increase in V with the type is maximized if $\dot{V}(\beta) = \dot{M}(\beta)$, given that $\dot{s}(\beta) \geq 0$. Hence, (A.2) warrants $\dot{s}(\beta) = 0$ and contradicts the assumption that $\dot{s}(\beta) > 0$ does best over a subrange of $[b, B]$.

A.2 Proof of Proposition 2

It is sufficient to show that the optimal s is equal to $\underline{s}(\overline{s})$ if the range of feasible solutions is restricted such that $0 \leq s \leq \underline{s}$ ($\overline{s} \leq s \leq 1$). If $0 \leq s \leq \underline{s}$, $\dot{U} = s\dot{M} - \dot{\Pi} \leq 0$, irrespective of s and β. Let $\underline{V}(\overline{V})$ denote the expected payoff of the foreign firm aiming at the low (high) end of the market. Maximizing the expected payoff of the foreign firm aiming at the low end of the market is equivalent to

$$\max_{s,\beta^*} \underline{V}(s,\beta^*) = (1-s)\int_b^{\beta^*} M(\beta)dF(\beta) - F(\beta^*)[\Pi(\beta^*) - sM(\beta^*)] \quad \text{s.t. } s \leq \underline{s}. \tag{A.3}$$

The partial derivative w.r.t. the type is

$$\frac{\partial \underline{V}}{\partial \beta^*}(\cdot) = f(\beta^*)[M(\beta^*) - \Pi(\beta^*)] - F(\beta^*)\underbrace{[\dot{\Pi}(\beta^*) - s\dot{M}(\beta^*)]}_{\geq 0 \text{ for } s \leq \underline{s}}. \tag{A.4}$$

Note that $\partial \underline{V}/\partial \beta^*(\beta^* = b) > 0$. Given that $\underline{V}$ is quasi-concave, the optimal β^* in this range is determined by $\partial \underline{V}/\partial \beta^* \leq 0, \beta^* \leq B, (\partial \underline{V}/\partial \beta^*)(\beta^* - B) = 0$ for any $s \in [0, \underline{s}]$. The partial derivative w.r.t. s is equal to

$$\frac{\partial \underline{V}}{\partial s}(\cdot) = -\int_b^{\beta^*} M(\beta)dF(\beta) + M(\beta^*)F(\beta^*) > 0 \tag{A.5}$$

and is positive because of $\dot{M} > 0$ and Jensen's Inequality Theorem, so that the optimal s must be equal to $\underline{s}$ if $s \in [0, \underline{s}]$. Maximizing the expected payoff of the foreign firm aiming at the high end of the market is equivalent to

$$\max_{s,\beta^*} \overline{V}(s,\beta^*) = (1-s)\int_{\beta^*}^B M(\beta)dF(\beta) - [1 - F(\beta^*)][\Pi(\beta^*) - sM(\beta^*)] \quad \text{s.t. } s \geq \overline{s}. \tag{A.6}$$

The partial derivative w.r.t. the type is

$$\frac{\partial \overline{V}}{\partial \beta^*}(\cdot) = -f(\beta^*)[M(\beta^*) - \Pi(\beta^*)] - [1 - F(\beta^*)]\underbrace{[\dot{\Pi}(\beta^*) - s\dot{M}(\beta^*)]}_{\leq 0 \text{ for } s \geq \overline{s}}. \tag{A.7}$$

Note that $\partial\overline{V}/\partial\beta^*(\beta^* = B) < 0$. Given that $\overline{V}$ is quasi-concave, the optimal β^* in this range is determined by $\partial\overline{V}/\partial\beta^* \leq 0, \beta^* \geq b, (\partial\underline{V}/\partial\beta^*)(\beta^* - b) = 0$ for any $s \in [\overline{s}, 1]$. The partial derivative w.r.t. s is equal to

$$\frac{\partial\overline{V}}{\partial s}(\cdot) = -\int_{\tilde{\beta}}^{B} M(\beta)dF(\beta) + M(\tilde{\beta})[1 - F(\tilde{\beta})] < 0. \tag{A.8}$$

and is negative because of $\dot{M} > 0$ and Jensen's Inequality Theorem, so that the optimal s must be equal to $\overline{s}$ if $s \in [\overline{s}, 1]$.□

A.3 Merger profits with exogenous cost reduction

From (16), we can derive that the merger profits are also monotonically increasing and convex in productivities,

$$\dot{M}_1(\beta) = \frac{2(n\alpha + 1)[(n\alpha + 1)\beta - n(1 - \bar{c})]}{(n + 1)^2} > 0, \tag{A.9}$$

$$\ddot{M}_1(\beta) = \frac{2(n\alpha + 1)^2}{(n + 1)^2} > 0, \tag{A.10}$$

and that the after merger profits increase more with productivity than the independent profits:

$$\dot{M}_1 - \dot{\Pi} = \frac{2n(\alpha - 1)[2\beta + n(\beta(1 + \alpha) - (1 - \bar{c}))]}{(n + 1)^2} > 0. \tag{A.11}$$

This is a case for a fully separating equilibrium since the marginal merger profits do not increase more strongly with productivity than the marginal independent profits. $\Delta_1 > 0$ because

$$\Delta_1(\alpha = 1) = 0, \frac{\partial\Delta}{\partial\alpha} = \frac{(1 - c)n^2}{((n + 1)\beta - n(1 - \bar{c}))^2} > 0. \tag{A.12}$$

A.4 Merger profits with endogenous cost reduction

The parameters ϕ, γ and δ are all non-negative. Furthermore, assume that

$$\delta > \frac{\phi[2n(\phi\beta + \phi n\bar{c} - \gamma) - (n^2 + 1)\gamma]}{(n + 1)^2(1 - \beta)}, \gamma < \frac{2n\phi[(n + 1)\beta - n(1 - \bar{c})]}{(n + 1)^2}. \tag{A.13}$$

Condition (A.13) will guarantee that investment will not reduce the marginal cost below zero and that the investment level will be finite. Armed with these specifications, we are now able to solve the last stage of the game in case of acceptance of a merger proposal. Solving for the first-order conditions yields the profit of the merged firm, denoted by a tilde, as a function of its productivity and the size of the cost-reducing investment, taking into account the investment cost:

$$\tilde{M}_2 = \left(\frac{1-(n+1)(1-\beta)+n\phi x+n\bar{c}}{n+1} \right)^2 - \gamma x - \frac{\delta x^2}{2}. \tag{A.14}$$

Since the productivity of the target is revealed once the offer is accepted, the merged firm will maximize its profit (A.14) over x which leads to an optimal investment level of

$$x^* = \frac{2n(\phi\beta-\gamma)+n^2[2(\beta-(1-\bar{c}))-\gamma]-\gamma}{(n+1)^2\delta-2n^2\phi^2}. \tag{A.15}$$

Eq. (A.15) shows that the cost-reducing investment x^* increases with the productivity of the target. The optimal investment plan x^* leads to a merger profit of size

$$M_2 = \frac{2[(n+1)\beta-n(1-\bar{c})]\{\delta[(n+1)\beta-n(1-\bar{c})]-2n\phi\gamma\}+(n+1)^2\gamma^2}{2(n+1)^2\delta-4n^2\phi^2}. \tag{A.16}$$

The first and second deriatives w.r.t. the type are respectively equal to

$$\dot{M}_2 = \frac{2(n+1)\{\delta[(n+1)\beta-n(1-\bar{c})]-2n\phi\gamma\}}{2(n+1)^2\delta-4n^2\phi^2} > 0, \tag{A.17}$$

$$\ddot{M}_2 = \frac{2(n+1)^2\delta}{2(n+1)^2\delta-4n^2\phi^2} > 0. \tag{A.18}$$

Eqs. (A.17) and (A.18) demonstrate that merger profits are increasing and convex in β. Furthermore, the increase in merger profits is larger than the increase in independent profits:

$$\dot{M}_2 - \dot{\Pi} = \frac{2n\phi\{2n\phi[(n+1)\beta - n(1-\bar{c})] - (n+1)^2\gamma\}}{(n+1)[(n+1)^2\delta - 2n^2\phi^2]} > 0. \qquad \text{(A.19)}$$

Expression (A.19) is positive due to condition (A.13). However, we find that

$$\Delta_2 = -\frac{n(n+1)\phi\gamma}{[(n+1)\beta - n(1-\bar{c})][\delta[(n+1)\beta - n(1-\bar{c})] - n\phi\gamma]} < 0 \qquad \text{(A.20)}$$

because

$$\delta[(n+1)\beta - n(1-\bar{c})] - n\phi\gamma > [(n+1)\beta - n(1-\bar{c})]\left(\delta - \frac{2n^2\phi^2}{(n+1)^2}\right) > 0 \quad \text{(A.21)}$$

due to restriction (A.13).

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