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TEMPORARY PARTNERSHIPS AS AN INFORMATION TRANSMISSION MECHANISM: FOREIGN INVESTMENT IN EMERGING MARKETS

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Temporary Partnerships as an Information Transmission Mechanism: Foreign Investment in Emerging Markets*

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Abstract

Asymmetric information and fear of acquiring a "lemon" may explain the paucity of foreign investment in emerging market economies. If investors are uncertain about the profitability of investments, intrinsically inefficient, temporary partnerships or joint ventures may serve as mechanisms through which information is transmitted. Temporary partnerships with joint investments by the domestic firm and the foreign investor, together with a buy-out option to the investor, can be used to separate good and bad investment prospects in equilibrium. However, non-revealing equilibria may exist. Implications for foreign direct investment are traced and briefly related to the experience of transition economies.

Keywords: investment, complementary assets, partnerships, joint ventures and licensing, costly signaling
JEL: D8, F2, L14, O12

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1. Introduction

Many observers have argued that the scale of direct investment by foreign firms in the manufacturing sectors of the transition economies, since the collapse of central planning, has *so far* been modest and disappointing. There may, of course, be several possible explanations of this paucity.[1] However, some empirical investigations (e.g. Kinoshita and Mody (1997), Møllgaard (1997), and Møllgaard and Schröder (1997, 1998)) point to the lack of firm specific information as an obstacle to foreign investment. This paper explores whether and when this is an equilibrium phenomenon in a formal, game theoretical framework.

We build a simple model where a potential foreign investor is at an informational disadvantage *vis a vis* the current owner or manager of a domestic firm. They control complementary assets, such that the profitability of the domestic firm would increase if its assets were combined with the assets of the investor. However, since the combination of the assets requires the foreign investor to *sink* investments initially, it may or may not be worthwhile for him to enter into a relationship with the domestic firm. Suppose, 1) that the value of the assets of the domestic firm is either high or low; 2) that if the potential investor knew that the value of the assets were high, then the optimal strategy would be to simply acquire this firm and transfer his complementary assets; 3) that if he knew that the value were low, then his optimal strategy would be to sink no resources by staying away; 4) that *ex ante* he is uncertain about the value of the assets of the domestic firm and thus faces a severe adverse selection problem. Clearly, if the investor simply asked the owner of the domestic firm to report the value of the assets, he would always get the answer that the value is high. So, talk is cheap, and both types of domestic firm would try to convince the investor that he should invest and buy the firm at a high price. The sophisticated foreign investor would be fully aware of these misrepresentation incentives, and as a result might be reluctant invest.

We ask whether there are ways in which the current owner of high valued assets can *credibly* transmit this information to the investor. Specifically, we ask whether a *temporary* partnership or joint venture may serve such a purpose. By a partnership or joint venture is simply meant that both parties somehow take a continued stake in the firm. That a partnership is temporary is taken to imply that the foreign investor has an option to completely buy out the domestic partner or walk away from the partnership at some later date. This perception

[1] Sinn and Weichenrieder (1997) argue that political and public resentment toward FDI may be an important explanatory factor. To prevent Western investors from acquiring the "family silver" at bargain prices, some governments have been reluctant to sell off assets in key manufacturing sectors. Berglöf (1995) notes that strong insider control reinforced by weak financial institutions and poor enforcement of property rights limits the ability of managers to raise needed funds for investment in new technology. Møllgaard and Overgaard (1998) provide a somewhat more detailed account of the motivation for the present study including some further references to related work.

of a temporary partnership is based on our interpretation of contractual arrangements that are frequently observed, e.g. in the case of Siemens's investment in a Slovenian switchboard manufacturer discussed by Møllgaard and Schröder (1997): Siemens has a minority stake in the Slovenian manufacturer that produces Siemens' switchboards under license. Siemens also hold an option to buy a majority stake, thus gaining complete control over the manufacturer. We study whether a temporary partnership, together with a buy-out option, may serve to separate good investment projects from bad ones and cause a delay in executed FDI.

We assume that *ex ante* the domestic firm and the foreign investor negotiate and may sign a binding contract. Negotiations and contracting serve two purposes: First, they serve as a mechanism through which the private information of the domestic firm may be transmitted to the investor. Secondly, they serve to split the surplus from the interaction between the two parties. Since the outcome might be highly dependent on the details of the bargaining set-up and on the kinds of enforcable contracts that can be written, we make additional assumptions to provide enough structure to allow a formal analysis.

We assume that all the bargaining and contracting take place *ex ante*, that is, before the private information is revealed to the foreign investor. We employ a fairly general bargaining setup in which (expected) gains are split according to some known formula, reflecting the relative bargaining powers of the parties. In terms of contract options, we assume the current owner of the domestic firm proposes one of two things. He can either propose an *immediate buy-out* to the foreign investor, or he can propose that a *temporary partnership* be formed, into which the foreign investor transfers its assets, and both parties temporarily contribute to the additional investments needed. This asset transfer and the investment contributions can be contracted at time zero. To complement a temporary partnership, the investor is offered an *option* to completely buy-out the current owner of the domestic firm at a later date. The exercise price of this option is specified in the contract written *ex ante*. When the time comes for the investor to decide whether to exercise the option, the private information will have been revealed to him.

We show that any equilibrium in which the current owner of the domestic firm is bought out immediately is necessarily a pooling equilibrium, since any acceptable buy-out price for the good type of the domestic firm would be mimicked by the bad type of the domestic firm. In contrast, an equilibrium with a temporary partnership may either be separating or pooling. In a separating partnership the investment shares and the exercise price offered by the good type of the domestic firm is such that it would be too costly to duplicate for the bad type, and it follows that the private information is credibly transmitted. The credible signaling by the good type of the domestic firm is accomplished by its offer to undertake a *large* investment share during the partnership period. This signaling is costly and inefficient from the point of view of both the good type of the domestic firm and the foreign investor, since the foreign investor has a comparative advantage in investing, and under full information the investment share of the domestic firm would be efficiently set to zero. However, it is relatively less costly for the good type of the domestic firm to undertake investments during a partnership than for the bad type, and this is what allows sorting of types via the investment shares of the domestic firm. An equilibrium with a temporary partnership may also be pooling, in which case the investment shares of the domestic firm and the exercise price of the buy-out option are type-independent. Thus the analysis points to different types of equilibria, and we analyse and discuss which of these is more likely.

Before continuing, a few remarks on our general mode of analysis seem in order. Our point of departure is based on *ex ante* asymmetric information between the domestic firm and the foreign investor and the associated adverse selection problem. An obvious, alternative avenue to pursue in an attempt to explain why foreign investors might be hesitant in their approach to firms in the transition economies would be based on relationship-specific investments, hold-up, incomplete contracting, but symmetric information (see e.g. Hart and Moore (1988) and Hart (1995)). As a general matter it is well-known that in such a setting the inability of the parties to sign comprehensive, long-term contracts may lead to underinvestment by either one or both parties in the relationship. Although incomplete contracting plays an implicit role in then present paper, we should stress that the main problem here is that (the good type of) the domestic firm is unable to directly and credibly transmit its private information.[2] [3] Even though the approaches might differ, they clearly have some elements in common, and we would consider them as complementary. Many out the issues involved are captured by Berglöf (1995, pp. 66-9 and 81-3, in particular) who discusses corporate governance in transition economies stressing problems related to property rights, control, hold-up, and information. Among other things, he notes that strong insider control, ambiguity of property rights, and a high level of general uncertainty have made the legal buying and selling of corporate assets difficult, and that the fundamental dilemma of insiders (current owners/managers) is that their strong control of assets make it very difficult for them to convince outsiders to contribute the necessary capital to realize the potential. To improve their credibility, the cash-constrained insiders must either *issue contingent ownership rights* to assets and cash-flows of the firm or give up some control of the investment decisions. However, the "scope for external finance is here limited by what is credibly contractable - that is, what can be enforced in court" (Berglöf (1995, p. 67)). It is

[2] In spirit and methodology, this paper is more closely related to Diamond (1991) who considers signaling via the maturity structure of debt when creditors are at an informational disadvantage *ex ante* and when contracts are incomplete.

[3] Option contracts play a distinctive role in the present paper, and to allow a (partial) comparison we should also alert attention to Nöldeke and Schmidt (1995) who study the extent to which simple option contracts alleviate the hold-up and underinvestment problem in Hart and Moore (1988).

further argued, that a "stylized fact" of many transition economies is that very few assets can be contracted, given the embryonic nature of financial institutions. In such an environment, control-oriented (as opposed to arm's-length) finance may be the only viable option. Finally, it is noted that internally generated funds remain a very important source of finance as long as outside institutions and the legal framework are weak. While Berglöf does not explicitly discuss temporary partnerships or joint ventures, they are clearly examples of control-oriented finance paired with inside financing out of retained earnings.[4] Our modelling broadly fits central elements of this description; outside institutions are weak and the space of contracts is severely circumscribed, the current management controls the cash-flows in a partnership, inside contributions to investments are central to the credible transmission of information, and a buy-out option is part of the agreement between the domestic firm and the foreign investor.

The rest of the paper is organized as follows. In Section 2 we set up a simple model that captures the essential features of the problem outlined above. Section 3 first considers the full information bench-mark, and then the adverse selection problem and the bargaining and contract setting is outlined. This section also introduces the basic equilibrium notion. Section 4 and Section 5 consider sequential and undominated separating and pooling equilibria, while Section 6 presents a further refinement. Discussion and concluding remarks are contained in Section 7. Proofs are in the Appendix.

2. A Model

Consider the interaction between two players, labelled domestic firm and foreign investor, respectively. The domestic firm is one of two types; a *good* type ($t = H$) and a *bad* type ($t = L$). The prior probability of the good type is μ^0, and we assume that μ^0 is *common knowledge*, whereas the actual type is privately known by the domestic firm.

A dynamic setting

Assume that the players interact over "two" periods. The first period, referred to interchangeably as *period 1* or "*the present*", will be defined below as the length of the partnership period or the period it takes the foreign investor to directly obtain the (initially) private information of the domestic firm. The second period will be referred to interchangeably as *period 2* or "*the future*". Thus, suppose a player has a stream of per-period payoffs R. If the future is just one period, the present value at the initial date (*ex ante*) will be $R + \Delta R$, where $\Delta \equiv \delta \in (0, 1)$ with δ being the discount factor between adjacent periods. Alternatively, if the future extends to infinity, then $\Delta \equiv \frac{\delta}{1-\delta} \in (0, \infty)$, i.e., Δ is just short-hand for the discounting of the stream of *future* R's back to the initial date. So, Δ represents "the weight of the future" and we assume that $\Delta \in \Re_{++}$.

[4] In contrast, the main focus of Berglöf is on the potential role of (local) commercial banks in corporate governance in the transition economies.

Current payoffs without foreign investment

Prior to the arrival of the potential investor on the scene, the domestic firm generates a constant stream of per-period profits π_t^0, $t \in \{L, H\}$. Hence, the status quo present value of a domestic firm of type t is $PV_t^0 = \pi_t^0 + \Delta\pi_t^0$, where the superscript captures that the foreign investor does not participate. We make the following assumption throughout.

Assumption 1. $\pi_H^0 > \pi_L^0 \equiv 0$

Essentially, the normalization of π_L^0 to zero is without any loss, and it eases the exposition below somewhat. For consistency, we shall also normalize the status quo payoffs of the potential foreign investor to zero.

Potential payoffs with foreign investment

Assume that there are two types of investment flows required to realize the potential of the existing domestic firm:

i) *Implementation.* A flow investment in equipment or training which can be undertaken by either the domestic firm, the foreign investor, or both (shared). *In each period* the required implementation investment is 1. The share of the domestic firm is d, the share of the foreign investor is f, and we require $d+f=1$; hence, $f \equiv 1-d$. In the analysis below, d can be any positive number. If $d > 1$, i.e., when the domestic firm puts up more than the required investment, we say that the excess is a (monetary) transfer to the foreign investor.

ii) *Know-how.* The foreign investor has to transfer his asset, which we might refer to as know-how. Generally, this know-how may relate to technology, organization, or strategy. The requirement is that *in each period* $k \geq 0$ units of this asset have to be tied up. The direct costs of this transfer are incurred by the the foreign investor, who may obviously be compensated later.

Investment costs are as follows. For the domestic firm, the cost per unit of implementation investment is $1 + \gamma_t$, $t \in \{L, H\}$.

Assumption 2. $\gamma_L > \gamma_H > 0$

Thus, if a domestic firm of type t puts up d, the direct outlay is $(1+\gamma_t)d$. For the investor, the cost per unit of investment is 1 (thus, in the notation above $\gamma_f \equiv 0$, which is just a normalization). If the domestic firm invests d, and the foreign investor transfers k units of its complementary asset, then the direct outlay of the investor is $(1-d)+k$. It follows that if $d > 1$, then the investor is compensated for some (if $d \in (1, 1+k)$) or all (if $d \geq 1+k$) the costs of the asset transfer.

There are many reasons why a foreign investor could be more efficient at financing and carrying out the necessary investments, the most important being the relative imperfection of capital markets in transition economies. Hence, under full information, all investments should be made by the foreign investor rather than by the domestic firm. To justify that a good domestic firm has a lower investment cost than the bad domestic firm, we argue that if investments by the domestic firm are to be financed (partly) out of retained earnings, then the bad type is likely to be more severely cash constrained than the good type (Assumption 1). Alternatively, a good type of domestic firm is one that has more (yet, unobservable) experience at implementing investment than a bad type; hence, the good type has to exert less effort per unit of investment.

Having outlined the necessary investments and the cost of investing for the two players, we turn to the description of payoffs (or investment returns). Given that the investor participates, we assume that the per-period *gross revenues* of the domestic firm are $\pi_t^1(d+f) = \pi_t^1(1) \equiv \pi_t^1 > 0$, where the superscript captures investor participation. The per-period *gross returns* when the domestic firm is of type t are $\pi_t^1 - (1+\gamma_t)d - f = \pi_t^1 - 1 - \gamma_t d$, where $\pi_t^1 - 1$ is the revenue net of the implementation investment, and where $\gamma_t d$ captures the inefficiency of the investments made by the domestic firm. Note that, for given d, the latter varies across the types of the domestic firm. The *net return* or *surplus* per period is given by $\pi_t^1 - (1+k) - \gamma_t d$, where k is essentially the per-period sunk cost associated with the transfer of the investor's asset to the domestic firm. Irrespective of the type of the domestic firm, the surplus is maximized when $d = 0$, and we shall refer to $\pi_t^1 - (1+k)$ as the *potential surplus* when the domestic firm is of type t. We make the following assumptions.

Assumption 3. $0 < \pi_L^1 < 1 + k$

Assumption 4. $\pi_H^1 - \pi_H^0 > 1 + k$

Combining Assumption 1 through 4, we have the following corollary.

Corollary 1. $\pi_H^1 > \pi_H^1 - \pi_H^0 > 1 + k > \pi_L^1 > 0 = \pi_L^0$

This captures two important features of the model. First, by construction, the potential surplus is greater if the domestic firm is of type H than if it is of type L. Secondly, the potential surplus is positive if and only if the domestic firm is of type H. Hence, under full information, the foreign investor would only want to enter a relationship with a domestic firm of the good type. This, together with an additional assumption (see Section 4), forms the basis of the possible sorting of types in equilibrium.

Finally, for ease of exposition, we make the following assumption.

Assumption 5. $(1 + \Delta)\pi_H^0 \geq \pi_H^1$

This assumption basically states that the value of future returns is such that a domestic firm of type H weakly prefers the status quo to one round of complete appropriation of the gross revenues associated with the transfer of the technology by the foreign investor followed by no future payoffs. Heuristically, the assumption requires that future payoffs are not discounted too much.

3. Full Information Bench-Mark, Incentives, and Contracting

In this section we first present the full information bench-mark, and then the structure of the game played when the domestic firm has private information about its intrinsic potential.

Full information bench-mark

For ease of exposition, we assume the future is just one period, which allows us to talk about an investment in period 2, rather than a complex sequence of future investments. Generally, the domestic firm might invest in both periods, $d(1)$ and $d(2)$, as might the foreign investor, $f(1)+k$ and $f(2)+k$, where $d(1)+f(1) = d(2)+f(2) = 1$. Then, if the domestic firm is of type t, the surplus *net of the status quo* is $(1+\Delta)(\pi_t^1-(1+k)-\pi_t^0)-\gamma_t(d(1)+\Delta d(2))$, where $\gamma_t(d(1)+\Delta d(2))$ is the "waste" associated with the investments made by the domestic firm. Thus, the net surplus is maximized when $d(1)=d(2)=0$, and the maximum potential gains from the interaction are, for $t \in \{L,H\}$, $(1+\Delta)(\pi_t^1-(1+k)-\pi_t^0)$. We have assumed that $\pi_L^1-(1+k)-\pi_L^0 = \pi_L^1-(1+k) < 0$ and $\pi_H^1-(1+k)-\pi_H^0 > 0$. Hence, it is worthwhile for the investor to buy out a type H domestic firm immediately for any price $P_H^b \equiv (1+\Delta)p_H^b$ such that $p_H^b \;\square\; \pi_H^1-(1+k)$. b is mnemonic for a *bid.* Also, assuming that the asset is transferred (at cost k), it is suboptimal for the investor to strike any deal with a type L domestic firm for a positive price since $\pi_L^1-(1+k) < 0$; hence, $p_L^b \;\square\; \pi_L^1-(1+k) < 0$. Similarly, a type t domestic firm would require a price $P_t^a \equiv (1+\Delta)p_t^a$ such that $p_t^a \geq \pi_t^0 \geq 0$. a is mnemonic for an *ask*. For a deal to be struck by the domestic firm and the foreign investor, we must have $p_t^a \;\square\; p_t^b$. By construction, this is possible if and only if $t=H$. Hence, the foreign investor does not invest or buy out the domestic firm if $t=L$, whereas any buy-out price $p=p_H^a=p_H^b \in [\pi_H^0, \pi_H^1-(1+k)]$ can be rationalized if $t=H$. Quite generally, we note that if

$$p \in [\pi_H^0, \pi_H^1-(1+k)] \tag{3.1}$$

then a contract between type H and the investor will be individually (and coalitionally) rational *ex post.*

Asymmetric information and incentives

In the full information bench-mark, we took for granted that the players somehow bargain to an efficient outcome, which seems reasonable since the efficient outcome is well-defined, there are no bargaining costs, and the players are fully informed. Let us briefly consider the incentives of the two types of the domestic firm when they are privately informed. The underlying problem is one of adverse selection: suppose the institutions are such that the *good* type of the domestic firms offers the deal (d_H, p_H), where $d_H = 0$ and $p_H \in [\pi_H^0, \pi_H^1-(1+k)]$, in the hope of convincing the potential foreign investor of its true identity. That is, the potential investor is offered to buy out the current owners at a price $P_H \equiv (1+\Delta)p_H$. Should the investor be persuaded by this offer? Clearly not, since any buy-out offer by type H with $p_H \in [\pi_H^0, \pi_H^1 - (1+k)]$ could be profitably mimicked by type L since $\pi_H^0 > \pi_L^0 \equiv 0$. Hence, even though efficient when the domestic firm is of the good type, an offer (d_H, p_H) with $d_H = 0$ cannot *sort* or *separate* the different types of the domestic firm. To credibly sort itself, the good type will have to send a signal or "post a bond" that is too costly for the bad type to duplicate. In the following, we detail which (*and* when) offers can be made and which contracts can be written, and then study which equilibria might arise.

Bargaining and contracting

We have in mind a setting where the contracting options of the players are severely limited so they are unable to write or enforce comprehensive contracts. It is essential below that the domestic firm be able to unilaterally appropriate a large fraction of the first period flow of revenues in a partnership. For these reasons we believe that our modeling is particularly relevant for some transition economies, whereas its descriptive relevance as a model of the problem facing e.g. a Japanese firm considering investing in a US firm may be more doubtful.

To justify the nature of the game analyzed below, let us heuristically describe the situation we have in mind. Nature (or History) has endowed the domestic firm with certain assets which constitute its type. The potential investor and the domestic firm then meet at the beginning of period 1 to negotiate the terms of the possible involvement of the investor. The bargaining at this stage would be relatively *free form*, but constrained by the kinds of contracts that can be written and enforced. However, for a given probability assessment of the foreign investor over the types of the domestic firm, the parties to the negotiation agree on the *expected* surplus from the interaction. Thus, following standard practice, we shall simply assume that this surplus is somehow split between the parties. The domestic firm appropriates a share $(1-\alpha)$, while the foreign investor gets α, where $\alpha \in [0, 1)$. Below, we show that the specific sharing of the surplus does not affect the qualitative results. To put sufficient structure on the *ex ante* negotiations, we assume that, when proposing a partnership, the domestic firm (on a take-it-or-leave-it basis) puts an amount $\widehat{d}$ "on the table" to finance the first period implementation investment. Having observed $\widehat{d}$, the foreign investor updates his beliefs and decides whether to enter the partnership. If the partnership is formed, the investor transfers his asset for one period (at cost k) and puts up his share of the additional investment $(1 - \widehat{d})$, which may be negative. Finally, the exercise price $\widehat{p}$ is uniquely determined by α and the posterior beliefs. The exercise price is assumed enforcable, and there can be no further negotiation between the two parties. If a partnership is formed, we assume that, until the option is exercised, the current owner of the domestic firm is in charge, in the sense that he can divert all first period revenues to his private account. This latter feature is meant to capture that the investor cannot get his hands on revenues in a partnership until he has learned the true identity of the partner, and, further, that no *ex ante* contracting on these revenues is possible.

Formally, we assume that the domestic firm can make two types of offers to the potential investor at the beginning of period 1:

(A) *Temporary partnership with a buy-out option*. At the *ex ante* bargaining stage the domestic firm makes the following offer to the foreign investor, where $(\widehat{d}, \widehat{p}) \in \Re_+ \times \Re$.

> "I will put up an investment share $\widehat{d}$ in the first period and appropriate all the first period revenues. You should put up an investment share $(1 - \widehat{d})$ in the first period and transfer your know-how for one period. In return, I will give you an option to buy me out at the beginning of the second period for a price of $\Delta\widehat{p}$."

However, as described above, for a given $\widehat{d}$ and probability assessment by the foreign investor, $\widehat{p}$ is uniquely determined by the bargaining "strengths", $(1-\alpha, \alpha)$, of the two parties. An offer of a temporary partnership may either separate, viz. $(\widehat{d}_H, \widehat{p}_H) \neq (\widehat{d}_L, \widehat{p}_L)$, or pool, viz. $(\widehat{d}_H, \widehat{p}_H) = (\widehat{d}_L, \widehat{p}_L)$, the two types of the domestic firm. If the offers are separating, the signal is in $\widehat{d}_t$, whereas $\widehat{p}_t$ merely determines how gains are split according to the "exogenously" given α.

(B) *Immediate buy-out*. At the *ex ante* bargaining stage, the owner of the domestic firm makes the following offer to the potential investor:

> "For a price of $(1 + \Delta)\widehat{p}$ you can buy me out now."

Implicitly associated with this immediate buy-out offer is $\widehat{d} = 0$. As noted already, an offer of immediate buy-out necessarily pools the two types of the domestic firm, since any such offer that a good type of domestic firm would willingly make will be copied by the bad type of the domestic firm.

Thus, all a third party (a *court*) ever needs to see is a signed document giving a priced and dated option to the foreign investor. The third party will never have to investigate whether certain (hard-to-verify) contingencies have arisen.

Equilibrium notions

Our basic equilibrium notion will be *sequential equilibrium* (Kreps and Wilson (1992)), and we restrict attention to pure strategy equilibria. The structure outlined above allows us to set up the interaction as a simple signaling game: Implicitly, Nature moves first by choosing the type of the domestic firm. Then, the domestic firm offers a deal to the potential foreign investor $(\widehat{d}, \widehat{p})$. The investor looks at this deal, updates his beliefs to $\mu(\widehat{d}, \widehat{p}) \in [0, 1]$, and decides whether or not to accept it. If the deal is accepted, the two parties contribute their investments according to the deal, and then the game basically ends. If the deal is not accepted, the game ends immediately. As explained above, the relevant signal is $\widehat{d}$, and it follows that we can write $\mu(\widehat{d}, \widehat{p}) = \mu(\widehat{d})$. For given $\widehat{d}$ and posterior beliefs, $\widehat{p}$ is uniquely determined by α.

As usual in this type of game, the required consistency of beliefs is unable to tie down the equilibrium outcome with any degree of precision. Hence, we introduce a couple of well-known refinements (Cho and Kreps (1987)).

4. Separating Equilibria[5]

In this section, the offers or contracts represented by the pairs (d_t, p_t) separate the two types, i.e. $(\widehat{d}_H, \widehat{p}_H) \neq (\widehat{d}_L, \widehat{p}_L)$. It follows that $\mu(\widehat{d}_H, \widehat{p}_H) = 1$ and $\mu(\widehat{d}_L, \widehat{p}_L) = 0$. The details of the offer made by the type L domestic firm are not important since a partnership between type L and the foreign investor is never formed. However, the offer associated with the type H domestic firm is essential and must satisfy the following four requirements simultaneously:

1. The exercise price $\widehat{p}_H$ leads to an *ex post* efficient outcome, that is $\widehat{p}_H \leq \pi_H^1 - (1+k)$. If $\widehat{p}_H > \pi_H^1 - (1+k)$, it will be too costly for the investor to take over the domestic firm even though both know that there are gains from trade. One would then expect the parties to renegotiate the exercise price. However, since all information is revealed in equilibrium, they could just as well agree on an ex ante price that need not be renegotiated.

2. The *good* type of domestic firm must weakly prefer $(\widehat{d}_H, \widehat{p}_H)$ to the status quo. This implies that the exercise price must be non-negative: $\Delta \widehat{p}_H \geq 0$.

3. The *bad* type of domestic firm must weakly prefer the status quo to accepting the contract $(\widehat{d}_H, \widehat{p}_H)$, from which it follows that $\widehat{d}_H$ has to satisfy

$$\widehat{d}_H \geq \frac{\pi_L^1}{1+\gamma_L} \equiv \underline{d} \tag{4.1}$$

4. The potential foreign investor must prefer $(\widehat{d}_H, \widehat{p}_H)$ to no contract.

Note that if the domestic firm is of type H, the gains from trade are

$$G^H(\widehat{d}_H) = (1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) - \gamma_H \widehat{d}_H \tag{4.2}$$

and the necessary condition for these to be positive is

$$\widehat{d}_H \leq \frac{(1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0)}{\gamma_H} \equiv \overline{d} \tag{4.3}$$

hence, puts an upper limit on the first-period investment that type H can propose. Existence of sequential separating equilibria requires $\underline{d} \leq \overline{d}$, and this can be rewritten as

Assumption 6. $\frac{\pi_L^1}{\pi_H^1 - (1+k) - \pi_H^0} \leq (1+\Delta)\frac{1+\gamma_L}{\gamma_H}$

Roughly, a sorting of types in equilibrium is facilitated by a high weight on future payoffs (a large Δ), a large difference in the relative investment efficiencies of the different types of the domestic firm (a large difference between γ_L and γ_H), and a large difference in the gross returns to the investment across the types of the domestic firm (a large difference between $\pi_L^1 - \pi_L^0$ and $\pi_H^1 - \pi_H^0$). We can state our first main result.

[5] Assumption 1 through Assumption 5 are made throughout, and proofs of the results presented in this and the following two sections are in the Appendix.

Proposition 1. *If Assumption 6 is satisfied, there is a unique undominated separating equilibrium outcome where* $\widehat{d}_H = \underline{d}$ *and* $\Delta\widehat{p}_H = \Delta(\pi_H^1 - (1+k)) - ((1+k) - \underline{d}) - \alpha G^H(\underline{d}) < \Delta(\pi_H^1 - (1+k))$*, with* $G^H(\underline{d}) = \gamma_H(\overline{d} - \underline{d})$*, and where* $(\widehat{d}_L, \widehat{p}_L)$ *is some pair which is rejected. If Assumption 6 is not satisfied, no separating equilibria exist.*

5. Pooling Equilibria

This section considers offers that fail to separate the two types, i.e. $(\widehat{d}_H, \widehat{p}_H) = (\widehat{d}_L, \widehat{p}_L) = (\widehat{d}, \widehat{p})$. Hence, the observed offer does not allow the investor to update his beliefs, and we have $\mu(\widehat{d}, \widehat{p}) = \mu^0$. We distinguish between two possible types of sequential pooling equilibria: Pooling with an immediate buy-out, that is, $(\widehat{d}, \widehat{p}) = (0, \widehat{p})$, where $\widehat{p} \in \Re$, and pooling with a temporary partnership and a buy-out option, that is $(\widehat{d}, \widehat{p}) \in \Re_+ \times \Re$.

Immediate buy-out

The *ex ante* expected gains are $E[G] = \mu^0(1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) + (1 - \mu^0)(\pi_L^1 - (1+k))$, where the latter term is negative by assumption. To ensure non-emptiness of the set of buy-out prices that are individually rational to both the investor and the domestic firms, the investor must be sufficiently optimistic. In other words, investor optimism is required when he is considering buying into a pool of "lemons" and "peaches". Formally, we require that

$$\mu^0 \geq \underline{\mu} \equiv 1 - \frac{\gamma_H \overline{d}}{\gamma_H \overline{d} - (\pi_L^1 - (1+k)) + (1+\Delta)\pi_H^0} \tag{5.1}$$

Given Assumption 1 and Assumption 3 it is easily seen that $\underline{\mu} \in (0,1)$; so, there is at least one system of prior beliefs according to which the investor is sufficiently optimistic to allow the existence of sequential pooling equilibria with immediate buy-out. To complete the posterior beliefs we set $\mu(\widehat{d}, \widehat{p}) = \mu(0, \widehat{p}) = \mu^0$ and $\mu(d,p) = 0, \forall (d,p) \neq (\widehat{d}, \widehat{p})$; that is, out-of-equilibrium beliefs are uniformly pessimistic. If $\mu^0 \geq \underline{\mu}$ holds, *ex ante* expected total gains, $E[G]$, are positive, and, since $\widehat{d} = 0$, the buy-out price, $(1+\Delta)\widehat{p}$, is *uniquely* determined by $(1+\Delta)\widehat{p} = (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0$.

Thus if $\mu^0 \geq \underline{\mu}$, then sequential pooling equilibria with immediate buy-out exist. With these equilibria is associated a unique outcome, $(\widehat{d}, \widehat{p})$, where $\widehat{d} = 0$ and

$$\widehat{p} = \frac{1-\alpha}{1+\Delta} E[G] + \mu^0 \pi_H^0 \tag{5.2}$$

If $\mu^0 < \underline{\mu}$, the investor is so pessimistic *ex ante* that no pooling equilibrium with immediate buy-out exists.

If Assumption 6 is satisfied; that is, if separating equilibria exist, a logical further step (Cho and Kreps (1987)) would be to require that both types (but type H in particular) of the domestic firm do better in expected terms in a pooling equilibrium than in the unique undominated separating equilibrium found in the previous section and characterized in Proposition 1. Comparing with the separating equilibrium payoffs, we conclude that for both types of the domestic firm to prefer a pooling equilibrium with immediate buy-out requires

$$\mu^0 \geq \underline{\mu}_1 \equiv 1 - \frac{\gamma_H \underline{d}}{\gamma_H \overline{d} - (\pi_L^1 - (1+k)) + \frac{(1+\Delta)}{(1-\alpha)}\pi_H^0} \tag{5.3}$$

Unless $\alpha = 0$ *and* $\underline{d} = \overline{d}$, this is a stronger requirement than (5.1), i.e. $\underline{\mu}_1 > \underline{\mu}$, but the qualitative result remains that, if the prior beliefs of the foreign investor are sufficiently optimistic, then an undominated pooling equilibrium outcome with immediate buy-out exists. The associated price is *uniquely* given in (5.2). If the prior beliefs of the foreign investor are such that (5.3) does not hold, there is no undominated pooling equilibrium with immediate buy-out.

Temporary partnership with a buy-out option

In a temporary partnership with a buy-out option, the offer is of the form $(\widehat{d}, \widehat{p}) \in \Re_+ \times \Re$. Obviously, the first period investment share of the domestic firm in a (pooling) partnership must be such that the no-mimicking constraint (4.1) is reversed, i.e. $\widehat{d} \,\square\, \underline{d}$. Total *ex ante* expected gains may now be written as $E[G(\widehat{d})] = E[G] - (\mu^0\gamma_H + (1-\mu^0)\gamma_L)\widehat{d}$. Some manipulation reveals that if

$$\mu^0 \geq \underline{\underline{\mu}}(\widehat{d}) \equiv 1 - \frac{\gamma_H(\overline{d} - \widehat{d})}{\gamma_H(\overline{d} - \widehat{d}) - (\pi_L^1 - (1+k)) + \gamma_L \widehat{d} + \frac{1+\gamma_L}{1-\alpha}(\underline{d} - \widehat{d})} \tag{5.4}$$

then there exist (systems of) prior beliefs according to which the investor is sufficiently optimistic to allow sequential pooling equilibria with a temporary partnership. In fact, there is a *range* of positive pooling equilibrium levels of the first period investment by the domestic firm, $\widehat{d}$, and with each $\widehat{d}$ is associated an exercise price given by

$$\Delta\widehat{p} = \Delta(\pi_H^1 - (1+k)) - \frac{(1+k) - \widehat{d}}{\mu^0} - \frac{\alpha}{\mu^0}E[G(\widehat{d})] \tag{5.5}$$

We can complete the description of equilibrium by postulating admissible, posterior beliefs as in the previous case. If (5.4) is not satisfied, no pooling equilibrium with a temporary partnership exists. Note that $\underline{\underline{\mu}}(\widehat{d})$ is strictly increasing in $\widehat{d}$ and define $\underline{\underline{\mu}} \equiv \underline{\underline{\mu}}(0)$. Hence, $\underline{\underline{\mu}} < \underline{\underline{\mu}}(\widehat{d})$, $\forall \widehat{d} > 0$.

As in the previous subsection on immediate buy-out, we can turn to the case where Assumption 6 is satisfied and find conditions for the existence of undominated pooling equilibria. Non-domination requires that

$$\mu^0 \geq \underline{\underline{\mu}}_1(\widehat{d}) \equiv 1 - \frac{\gamma_H(\underline{d} - \widehat{d})}{\gamma_H(\underline{d} - \widehat{d}) - (\pi_L^1 - (1+k)) + \gamma_L \widehat{d} + \frac{1+\gamma_L}{1-\alpha}(\underline{d} - \widehat{d})} \tag{5.6}$$

As in the case with immediate buy-out, we notice that the dominance argument embedded in (5.6) implies that, unless $\alpha = 0$ and $\underline{d} = \overline{d}$, the requirement is stronger than (5.4), that is, $\underline{\underline{\mu}}_1(\widehat{d}) > \underline{\underline{\mu}}(\widehat{d})$. We also note that $\underline{\underline{\mu}}_1(\widehat{d})$ is strictly increasing in $\widehat{d}$, and we define $\underline{\underline{\mu}}_1 \equiv \underline{\underline{\mu}}_1(0)$.

We can then state: Suppose $\underline{d} \,\square\, \overline{d}$. If $\mu^0 \geq \underline{\underline{\mu}}_1 (\geq \underline{\underline{\mu}})$, then undominated pooling equilibria with a partnership and a buy-out option exist. With each $\mu^0 \geq \underline{\underline{\mu}}_1$ is associated a range, $[0, d_1(\mu^0)]$, of equilibrium investment levels for the domestic firm, where $d_1(\mu^0) \,\square\, d(\mu^0) < \underline{d}$. With each $\widehat{d} \in [0, d_1(\mu^0)]$ is associated a unique option price given in (5.5). If $\mu^0 < \underline{\underline{\mu}}_1$, no undominated pooling equilibrium with a partnership and a buy-out option exists.

We can combine the results of this section to summarize the broader implications of the analysis of pooling equilibria.

Proposition 2. *If $\mu^0 < \min\{\underline{\mu}, \underline{\underline{\mu}}\} \in (0,1)$, then no sequential pooling equilibria with active participation by the foreign investor exist. If $\mu^0 \geq \min\{\underline{\mu}, \underline{\underline{\mu}}\}$, then sequential pooling equilibria with active participation by the foreign investor exist. If, further, $\underline{d} \,\square\, \overline{d}$ and $\mu^0 \geq \min\{\underline{\mu}_1, \underline{\underline{\mu}}_1\}$, then undominated pooling equilibria with participation by the foreign investor exist.*

Active participation by the foreign investor implies *either* that the current owners of the domestic firm are bought out immediately *or* that a partnership is formed into which the investor transfers the complementary assets needed to realize the potential of the domestic firm. Hence, Proposition 2 captures that pooling equilibria with active investor participation exist if and only if the prior beliefs of the investor with respect to the potential of the domestic firm are sufficiently optimistic. Also, if prior beliefs are sufficiently optimistic, then a pooling equilibrium outcome exists which is preferred by both types of the domestic firm to the separating equilibrium outcome (whenever a separating equilibrium exists). Combining this with the results in Section 4, it should also be noted that if the sorting condition in Assumption 6 *fails* to be satisfied, then all equilibria are necessarily pooling. In this case, active participation by the investor in any equilibrium requires a sufficient amount of optimism a priori; otherwise, all equilibria will involve inactivity by the foreign investor, and the domestic firm will continue operating with status quo payoffs. On the other hand, if Assumption 6 is satisfied then active participation by the foreign investor is guaranteed in equilibrium, irrespective of the prior beliefs, since at least the separating equilibrium with a temporary partnership exists.

6. Refinement and Separation

To complete the formal analysis, let Assumption 6 be satisfied. Given Assumption 6, Proposition 2 shows that undominated pooling equilibria exist if the prior beliefs of the foreign investor are sufficiently optimistic. We now argue that further scrutiny and refinement of the equilibrium notion along the lines suggested by Cho and Kreps (1987) will destabilize all such pooling equilibria. Formally, we demonstrate in the Appendix that when Assumption 6 is satisfied, no pooling equilibrium will survive the *equilibrium domination test*. Essentially, out-of-equilibrium beliefs are constrained by there being only one type (H) that could potentially gain by deviating (raising its co-financing share, d) from the strategies prescribed by a particular pooling equilibrium, be it of the immediate buy-out or the temporary partnership kind. We can summarize the analysis in the following uniqueness result.

Proposition 3. *If Assumption 6 is satisfied, the separating outcome characterized in Proposition 1 is the unique refined equilibrium outcome.*

7. Discussion

Let us first assume that separating equilibria exist. Then we have shown that there is a unique, refined equilibrium outcome, where the good type of the domestic firm separates via the *least-cost* signal $\underline{d} \equiv \frac{\pi_L^1}{1+\gamma_L}$. So far we have just referred to the relationship between the two parties as a partnership, but depending on the size of $\underline{d}$ we may go a little further in the interpretation. If $\underline{d} < 1$, then both parties contribute to the first period implementation investment, and we might, therefore, interpret the partnership as a *joint venture*. If, on the other hand, $\underline{d} \geq 1$, then only the domestic firm contributes financially in the first period, in the sense that 1 covers the implementation investment, and $\underline{d} - 1 \geq 0$ covers part of the cost of the transfer of know-how by the investor. In this case we could interpret the partnership as a *licensing agreement*, where $\underline{d} - 1 > 0$ is the *license fee* paid by the domestic firm. Note that the higher are the stakes from the point of view of the bad type of domestic firm, $\pi_L^1 - \pi_L^0 \equiv \pi_L^1$, in comparison with the signaling costs, γ_L, the more the partnership looks like a licensing agreement. Hence, as an empirical matter, one would expect that the stronger is the incentive of the domestic firm to temporarily fool the foreign investor, the more likely it is that the observed separating equilibrium contract looks like a licensing agreement rather than a joint venture. The main driving force of this result is that licensing provides better protection against "lemons" than do joint ventures, since joint ventures requires the foreign investor to *sink* more resources up front.

In a separating equilibrium the good type of the domestic firm takes on a strictly positive first-period investment share, while first best requires the investor to undertake all investments throughout. Hence, the model explains why foreign investments are (at least initially) slowed down by the presence of *ex ante* asymmetric information. This conforms well with the opening remark of the paper. Matters may be even worse in the case where separating equilibria fail to exist. Then, any equilibrium must necessarily be pooling, and if the prior beliefs of the foreign investor are sufficiently pessimistic, there is no equilibrium with participation by the foreign investor; clearly a disappointing level of foreign investment. In this case it should be noted, though, that the level of foreign investments may exceed the first best level. If the prior beliefs of the foreign investor are sufficiently optimistic, he may initially buy out or form a partnership with the domestic firm, only to realize subsequently that the domestic firm is of the bad type. The investor will then efficiently pull out again after having overinvested initially.

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Appendix

Proof of Proposition 1

The three basic conditions necessary for separation are: First, type H should prefer separation to the status quo,

$$\pi_H^1 - (1+\gamma_H)\widehat{d}_H + \Delta\widehat{p}_H - (1+\Delta)\pi_H^0 \geq 0 \tag{A1}$$

Rewriting this as $\Delta\widehat{p}_H \geq (1+\Delta)\pi_H^0 - \pi_H^1 + (1+\gamma_H)\widehat{d}_H$ and using Assumption 5, we immediately infer that $\Delta\widehat{p}_H \geq 0$ as claimed in the text. Secondly, the foreign investor should at least break even,

$$-(1+k) + \widehat{d}_H + \Delta(\pi_H^1 - (1+k)) - \Delta\widehat{p}_H \geq 0 \tag{A2}$$

Finally, type L should have no incentive to mimic type H,

$$\pi_L^1 - (1+\gamma_L)\widehat{d}_H + \min\Delta\{\widehat{p}_H, \pi_L^0\} - (1+\Delta)\pi_L^0 \;\square\; 0 \tag{A3}$$

which can be written as $\widehat{d}_H \geq \frac{\pi_L^1}{1+\gamma_L} \equiv \underline{d}$ ((4.1) in the text).

To span the set of separating offers consistent with a buy-out of type H, we specify pessimistic out-of-equilibrium beliefs; $\mu(d,p) = 0$, $\forall(d,p) \neq (\widehat{d}_H, \widehat{p}_H)$. Note that total gains, $G^H(\widehat{d}_H)$, from a partnership between type H and the investor (i.e., (4.2) obtained by adding the left-hand-sides of (A1) and (A2)) are independent of the exercise price, $\widehat{p}_H$, as long as the option is exercised.

Negotiations start with the domestic firm placing a non-negotiable investment proposal $\widehat{d}_t$. Then the parties negotiate how ex post gains should be divided by means of determining the exercise price, $\Delta\widehat{p}_t$. These negotiations are summarized in a simple bargaining set-up, where the investor appropriates a share $\alpha \in [0,1)$ of total gains, while the owner of the domestic firm gets $(1-\alpha)$. We do not allow for $\alpha = 1$ since this would hold the domestic firm to its reservation payoff and give it no incentive to undertake costly signaling.

Given $\widehat{d}_H$, the bargaining between type H and the investor results in a splitting of the gains such that $-(1+k) + \widehat{d}_H + \Delta(\pi_H^1 - (1+k) - \widehat{p}_H) = \alpha G^H(\widehat{d}_H)$. This determines the exercise price uniquely at $\Delta\widehat{p}_H = \Delta(\pi_H^1 - (1+k)) - (1+k) + \widehat{d}_H - \alpha G^H(\widehat{d}_H)$. Using (4.2) and the definition in (4.3), we can rewrite this as

$$\Delta\widehat{p}_H = \Delta(\pi_H^1 - (1+k)) - ((1+k) - \widehat{d}_H) - \alpha\gamma_H(\overline{d} - \widehat{d}_H) \tag{A4}$$

This exercise price is decreasing in the investor's bargaining strength, α,[6] the cost, k, of transferring the investor's asset, and the implementation investment, $(1-\widehat{d}_H)$, of investor in the first period. The exercise price is increasing in the discount factor, Δ, the two possible profitabilities of the domestic firm (π_H^1 and π_H^0), and the cost of signaling represented by $\gamma_H\widehat{d}_H$.

To separate, the non-negotiable part of type H's offer will thus have to fulfil $\widehat{d}_H \in [\underline{d}, \overline{d}]$, where $\overline{d}$ is the solution to $G^H(d) = 0$. Then the contract is

[6] Provided that 4.3 holds.

individually rational for both type H and the investor, while it is not profitable for type L to mimic type H. Existence of a separating equilibrium requires $\underline{d} \,\square\, \overline{d}$, and, using the definitions, this can be rewritten as Assumption 6: $\frac{\pi_L^1}{\pi_H^1-(1+k)-\pi_H^0} \,\square\, (1+\Delta)\frac{1+\gamma_L}{\gamma_H}$.

If Assumption 6 is satisfied (with inequality), a continuum of separating outcomes can be supported by sequential equilibrium strategies. However, since $G^H(\widehat{d}_H)$ is decreasing in $\widehat{d}_H$, the only undominated equilibrium (Cho and Kreps (1987)) will have $\widehat{d}_H = \underline{d}$, so that type H chooses the least possible investment that prevents type L from mimicking it. To see this, note that any offer with $\widehat{d} \in (\underline{d}, \overline{d}]$ is strictly dominated by the status quo from the point of view of type L.[7] The beliefs associated with any such offer should be concentrated on type H, and sequential rationality then requires type H to choose $\widehat{d}_H$ as closely as possible to $\underline{d}$. Allowing type H to maximize on the closure of the set, we shall say that this type chooses $\underline{d}$ to separate in least cost fashion. Note that $\Delta\widehat{p}_H$ is uniquely determined once $\widehat{d}_H$ is fixed, and that this price only affects the sharing of the ex-post gain, not the size of it. This completes the proof.

Proof of Proposition 2

Immediate buy-out

In this case $(\widehat{d}, \widehat{p}) = (0, \widehat{p})$, where $\widehat{p} \in \Re$, and the investor's expected payoff is

$$\mu^0(1+\Delta)(\pi_H^1 - (1+k)) + (1-\mu^0)(\pi_L^1 - (1+k)) - (1+\Delta)\widehat{p} \qquad \text{(A5)}$$

where the first term represents the value if the domestic firm is of type H, the second term the value if the domestic firm is of type L (on the assumption that the firm may always be operated with per-period profits $\overline{\pi}_L^0$ $(\equiv 0)$, should it prove to be a "lemon"), and the third term is the immediate buy-out price.

It must be individually rational for the domestic firm of either type to participate in the pool, and we require

$$(1+\Delta)(\widehat{p} - \pi_t^0) \geq 0, \, t = H, L \qquad \text{(A6)}$$

which implies $\Delta\widehat{p} > 0$. Further, Assumption 1 ensures $\pi_H^0 > \pi_L^0$, and we conclude that individual rationality will be satisfied for both types if it is satisfied for type H. Thus, non-emptiness of the set of buy-out prices that are individually rational to both the investor and the domestic firms requires $\mu^0(1+\Delta)(\pi_H^1 - (1+k)) + (1-\mu^0)(\pi_L^1 - (1+k)) \geq (1+\Delta)\pi_H^0$, or, equivalently,

$$\mu^0 \geq \underline{\mu} \equiv 1 - \frac{\gamma_H \overline{d}}{\gamma_H \overline{d} - (\pi_L^1 - (1+k)) + (1+\Delta)\pi_H^0} \qquad \text{(A7)}$$

[7] This would also be the case with separating offers associated with a partnership in which the buy-out option is not exercised by the foreign investor. Hence, if we had not explicitly ruled out such separating contracts above, they would have been eliminated at this point. Hence the restriction is without loss of generality.

where $\overline{d}$ is defined in (4.3). Given Assumption 1 and Assumption 3, we see that $\underline{\mu} \in (0,1)$; so, there exist prior beliefs for which the investor is sufficiently optimistic to allow existence of sequential pooling equilibria with immediate buy-out. To complete the posterior beliefs we set $\mu(\widehat{d},\widehat{p}) = \mu(0,\widehat{p}) = \mu^0$ and $\mu(d,p) = 0, \forall(d,p) \neq (\widehat{d},\widehat{p})$; that is, out-of-equilibrium beliefs are uniformly pessimistic. Further, if (A7) holds, the *ex ante* expected total gains

$$E[G] = \mu^0(1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) + (1-\mu^0)(\pi_L^1 - (1+k)) \qquad \text{(A8)}$$

are positive, and, since $\widehat{d} = 0$, the buy-out price, $(1+\Delta)\widehat{p}$, is *uniquely* determined by $\mu^0(1+\Delta)(\pi_H^1 - (1+k)) + (1-\mu^0)(\pi_L^1 - (1+k)) - (1+\Delta)\widehat{p} = \alpha E[G]$, where the left-hand-side is the *ex ante* expected payoff to the investor.[8] Hence, in *any* sequential pooling equilibrium with immediate buy-out, we have

$$(1+\Delta)\widehat{p} = (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 \qquad \text{(A9)}$$

and $\widehat{d} = 0$. We can summarize as follows.

Lemma 1. *If $\mu^0 \geq \underline{\mu}$, then sequential pooling equilibria with immediate buy-out exist. These equilibria give rise to a unique outcome, $(\widehat{d},\widehat{p})$, where $\widehat{d} = 0$ and $\widehat{p}$ is given in (A9). If $\mu^0 < \underline{\mu}$, no pooling equilibrium with immediate buy-out exists.*

If Assumption 6 is satisfied; that is, if separating equilibria exist, a logical further step (Cho and Kreps (1987)) is to require that both types of the domestic firm do better in expected terms in a pooling equilibrium than at the unique separating equilibrium outcome characterized in Proposition 1. For type L this is already implied by (A6). If a similar requirement is not satisfied for type H, then he can safely deviate to the separating equilibrium pair $(\widehat{d}_H, \widehat{p}_H)$ of Proposition 1. The payoffs to type H in a pooling equilibrium with immediate buy-out are simply given by the buy-out price in (A9), and the payoffs to type H associated with the separating equilibrium of Proposition 1 are given by

$$(1-\alpha)G^H(\underline{d}) + (1+\Delta)\pi_H^0 \qquad \text{(A10)}$$

which is the status quo payoffs plus type H's share of the gains associated with $\widehat{d}_H = \underline{d}$. A necessary condition for type H to play the pooling strategy is that the right-hand-side of (A9) is no less than the separating payoffs in (A10),

$$E[G] \geq G^H(\underline{d}) + (1-\mu^0)\frac{(1+\Delta)}{(1-\alpha)}\pi_H^0 \qquad \text{(A11)}$$

[8] To avoid any confusion, note carefully how this determination of the buy-out price follows from the ex ante bargaining. We consider pooling equilibria, and it follows that the investor remains confused about the identity of the domestic firm at the bargaining stage, i.e. $\mu(\widehat{d}, -) = \mu^0$. The domestic firm, of course, knows its own type, but "accepts" bargaining predicated on the prior. Hence, the investor expects gains as given in (A8), and when his bargaining strength is α, the price is determined in such a way that the investor appropriates a share α of the surplus in ex ante expected terms. The realized share of surplus to the investor, and, hence, the domestic firm, varies with the actual type of the domestic firm.

Rearranging and isolating μ^0, we conclude that for both types of the domestic firm to prefer a pooling equilibrium with immediate buy-out requires

$$\mu^0 \geq \underline{\mu}_1 \equiv 1 - \frac{\gamma_H \underline{d}}{\gamma_H \overline{d} - (\pi_L^1 - (1+k)) + \frac{(1+\Delta)}{(1-\alpha)} \pi_H^0}. \tag{A12}$$

Unless $\alpha = 0$ *and* $\underline{d} = \overline{d}$, this is stronger than (A7), that is $\underline{\mu}_1 > \underline{\mu}$, but the qualitative result remains that, if the prior of the investor is sufficiently optimistic, then undominated pooling equilibria with immediate buy-out exist. The associated price is *uniquely* given in (A9). If (A12) does not hold, no undominated pooling equilibrium with immediate buy-out exists. We summarize.

Lemma 2. *Suppose $\underline{d} \leq \overline{d}$. If $\mu^0 \geq \underline{\mu}_1 (\geq \underline{\mu})$, then undominated pooling equilibria with immediate buy-out exist. The unique outcome is as given in Lemma 1. If $\mu^0 < \underline{\mu}_1$, no undominated pooling equilibria exist.*

Temporary partnership with a buy-out option

In a temporary partnership with a buy-out option, the offer is of the form $(\widehat{d}, \widehat{p}) \in \Re_+ \times \Re$. By the arguments given in Section 4, it is immediate that the candidate option price must satisfy $\widehat{p} \leq \pi_H^1 - (1+k)$, to be individually rational for the investor *ex post* and renegotiation-proof, see (3.1). The payoffs of type H conditioned on this should weakly dominate the status quo, that is,

$$\pi_H^1 - (1+\gamma_H)\widehat{d} + \Delta \widehat{p} \geq (1+\Delta)\pi_H^0 \tag{A13}$$

which is identical to (A1) implying that Assumption 5 ensures non-negativity of the exercise price. Thus, the payoffs of type L must satisfy

$$\pi_L^1 - (1+\gamma_L)\widehat{d} \geq 0 \tag{A14}$$

It follows that the first period investment share of the domestic firm in a (pooling) partnership must be such that (4.1) is reversed,

$$\widehat{d} \leq \frac{\pi_L^1}{1+\gamma_L} \equiv \underline{d} \tag{A15}$$

Finally, the investor's *ex ante* expected payoffs are

$$-(1+k) + \widehat{d} + \mu^0 \Delta (\pi_H^1 - (1+k) - \widehat{p}) \tag{A16}$$

given that $\widehat{p} \in [0, \pi_H^1 - (1+k)]$.[9] The first two terms in (A16) represent the investor's first-period investment outlay, and the third term is the total discounted net profit if the domestic firm proves to be of type H, which is the case with

[9] Thus, the option associated with the "pooled" partnership is exercised if and only if the domestic firm turns out to be of type H.

probability μ^0. Total *ex ante* expected gains may now be written as $E[G(\widehat{d})] = \mu^0\{(1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) - \gamma_H\widehat{d}\} + (1-\mu^0)(\pi_L^1 - (1+k) - \gamma_L\widehat{d})$, or

$$E[G(\widehat{d})] = E[G] - (\mu^0\gamma_H + (1-\mu^0)\gamma_L)\widehat{d} \tag{A17}$$

where $E[G]$ is defined in (A8), and the last term captures the intrinsic (expected) "waste" of resources associated with the investments of the domestic firm during the partnership period. For a given $\widehat{d}$, the exercise price is defined by $-(1+k) + \widehat{d} + \mu^0\Delta(\pi_H^1 - (1+k) - \widehat{p}) = \alpha E[G(\widehat{d})]$, which implies

$$\Delta\widehat{p} = \Delta(\pi_H^1 - (1+k)) - \frac{(1+k) - \widehat{d}}{\mu^0} - \frac{\alpha}{\mu^0}E[G(\widehat{d})] \tag{A18}$$

Substituting this into (A13) we obtain the necessary condition for type H to participate in the pool as $\pi_H^1 - (1+\gamma_H)\widehat{d} + \Delta(\pi_H^1 - (1+k)) - \frac{(1+k)-\widehat{d}}{\mu^0} - \frac{\alpha}{\mu^0}E[G(\widehat{d})] \geq (1+\Delta)\pi_H^0$, which, after tedious manipulation, can be written as

$$\mu^0 \geq \underline{\underline{\mu}}(\widehat{d}) \equiv 1 - \frac{\gamma_H(\overline{d} - \widehat{d})}{\gamma_H(\overline{d} - \widehat{d}) - (\pi_L^1 - (1+k)) + \gamma_L\widehat{d} + \frac{1+\gamma_L}{1-\alpha}(\underline{d} - \widehat{d})} \tag{A19}$$

From (A19) it follows that $\widehat{d} < \overline{d}$ in any pooling equilibrium with a buy-out option, and from (A15) we have $\widehat{d} \,\square\, \underline{d}$. Hence, $\underline{\underline{\mu}}(\widehat{d}) \in (0,1)$, and we conclude that there exist (systems of) prior beliefs according to which the investor is sufficiently optimistic to allow sequential pooling equilibria with a temporary partnership. In other words; if the investor is sufficiently optimistic a priori, there is a *range* of positive pooling equilibrium levels of the first period investment by the domestic firm, $\widehat{d}$, and with each $\widehat{d}$ is associated an exercise price given by (A18). We can complete the equilibrium by postulating admissible, posterior beliefs as in the previous case. If (A19) is not satisfied, no pooling equilibrium with a temporary partnership exists. To summarize, note that $\underline{\underline{\mu}}(\widehat{d})$ is strictly increasing in $\widehat{d}$ and define $\underline{\underline{\mu}} \equiv \underline{\underline{\mu}}(0)$. Hence, $\underline{\underline{\mu}} < \underline{\underline{\mu}}(\widehat{d})$, $\forall \widehat{d} > 0$, and we have.

Lemma 3. *If $\mu^0 \geq \underline{\underline{\mu}}$, then sequential pooling equilibria with a temporary partnership and a buy-out option exist. With each $\mu^0 \geq \underline{\underline{\mu}}$ is associated a range, $[0, d(\mu^0)]$, of equilibrium investment levels for the domestic firm, where $d(\mu^0)$ is increasing in μ^0 and $d(\mu^0) < \min\{\underline{d}, \overline{d}\}$. With each $\widehat{d} \in [0, d(\mu^0)]$ is associated a unique exercise price given in (A18). If $\mu^0 < \underline{\underline{\mu}}$, no sequential pooling equilibrium with a partnership and a buy-out option exists.*

As in the previous subsection on pooling equilibria with immediate buy-out, we consider in more detail the case where Assumption 6 is satisfied. If Assumption 6 holds, separating equilibria exist, and all outcomes but those associated with $\widehat{d}_H = \underline{d}$ are ruled out by the dominance refinement. Thus, in any candidate for pooling equilibrium with an initial partnership and a buy-out option, both types of the domestic firm must do at least as well as in the separating equilibrium. For type L this is implied by (A15) and what remains is to consider type H. The pooling equilibrium payoffs of type H are captured by the left hand side of (A13), and substituting for $\Delta\widehat{p}$ using (A18), these payoffs are $\pi_H^1 - (1+\gamma_H)\widehat{d} + \Delta(\pi_H^1 - (1+k)) - \frac{(1+k)-\widehat{d}}{\mu^0} - \frac{\alpha}{\mu^0}E[G(\widehat{d})]$. We can rewrite this as

$$\frac{1-\alpha}{\mu^0}E[G(\widehat{d})] - \frac{1-\mu^0}{\mu^0}(1+\gamma_L)(\underline{d}-\widehat{d}) + (1+\Delta)\pi_H^0 \tag{A20}$$

The separating payoffs are given in (A10), and we require $\frac{1-\alpha}{\mu^0}E[G(\widehat{d})] - \frac{1-\mu^0}{\mu^0}(1+\gamma_L)(\underline{d}-\widehat{d}) + (1+\Delta)\pi_H^0 \geq (1-\alpha)G^H(\underline{d}) + (1+\Delta)\pi_H^0$. Solving for μ^0, we get

$$\mu^0 \geq \underline{\underline{\mu}}_1(\widehat{d}) \equiv 1 - \frac{\gamma_H(\underline{d}-\widehat{d})}{\gamma_H(\underline{d}-\widehat{d}) - (\pi_L^1 - (1+k)) + \gamma_L\widehat{d} + \frac{1+\gamma_L}{1-\alpha}(\underline{d}-\widehat{d})} \tag{A21}$$

As in the case with immediate buy-out, we notice that the dominance argument embedded in (A21) implies that, unless $\alpha = 0$ and $\underline{d} = \overline{d}$, the requirement is stronger than (A19), that is, $\underline{\underline{\mu}}_1(\widehat{d}) > \underline{\underline{\mu}}(\widehat{d})$. We also note that $\underline{\underline{\mu}}_1(\widehat{d})$ is strictly increasing in $\widehat{d}$, and we define $\underline{\underline{\mu}}_1 \equiv \underline{\underline{\mu}}_1(0)$. We can then state.

Lemma 4. *Suppose $\underline{d} \square \overline{d}$. If $\mu^0 \geq \underline{\underline{\mu}}_1 (\geq \underline{\underline{\mu}})$, then undominated pooling equilibria with a partnership and a buy-out option exist. With each $\mu^0 \geq \underline{\underline{\mu}}_1$ is associated a range, $[0, d_1(\mu^0)]$, of equilibrium investment levels for the domestic firm, where $d_1(\mu^0) \square d(\mu^0) < \underline{d}$. With each $\widehat{d} \in [0, d_1(\mu^0)]$ is associated a unique exercise price given in (A18). If $\mu^0 < \underline{\underline{\mu}}_1$, no undominated pooling equilibrium with a partnership and a buy-out option exists.*

Combining Lemma 1 through Lemma 4 completes the proof of Proposition 2.

Proof of Proposition 3

To ease the exposition, we use (A18) to define a (generic) exercise price as a function of d, given the beliefs of the investor, μ, as follows

$$\Delta\widehat{p}(d;\mu) = \Delta(\pi_H^1 - (1+k)) - \frac{(1+k)-d}{\mu} - \frac{\alpha}{\mu}E_\mu[G(d)] \tag{A22}$$

Here the subscript in $E_\mu[\cdot]$ captures that expectations are with respect μ.

When testing a pooling equilibrium associated with some admissible $\widehat{d}$, we ask whether there is an alternative level d^0, which could only conceivably have been sent by type H, in the sense that this type would gain from choosing d^0 *if* beliefs are updated to $\mu(d^0) = 1$ whereas type L would lose *even if* $\mu(d^0) = 1$. If the answer is yes, the out-of-equilibrium beliefs "supporting" $\widehat{d}$ should satisfy

$\mu(d^0) = 1$, which in turn renders $\widehat{d}$ unstable. If the answer is no, $\widehat{d}$ is said to survive refinement. We consider the two types of pooling equilibria.

Immediate buy-out

Pooling with immediate buy-out implies $\widehat{d} = 0$ and $(1+\Delta)\widehat{p} = (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0$, where the latter coincides with the equilibrium payoffs of both types of domestic firm. Only undominated equilibria are considered, and we have

$$(1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 \geq (1-\alpha)G^H(\underline{d}) + (1+\Delta)\pi_H^0 \qquad \text{(A23)}$$

where the right-hand-side is just the separating equilibrium payoffs of type H. To test the putative pooling profile we ask whether there exists an alternative signal $d^0 > 0$ and associated buy-out price $\Delta\widehat{p}(d^0; 1)$ □ $\Delta(\pi_H^1 - (1+k))$ such that

$$\pi_H^1 - (1+\gamma_H)d^0 + \Delta\widehat{p}(d^0; 1) > (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 \qquad \text{(A24)}$$

and

$$\pi_L^1 - (1+\gamma_L)d^0 + \min\{\Delta\widehat{p}(d^0; 1), 0\} < (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 \qquad \text{(A25)}$$

If the answer is affirmative, the pooling equilibriumis destabilized. Combining (A23) and (A24) implies that $\Delta\widehat{p}(d^0; 1) > 0$, and it follows that (A25) reduces to

$$\pi_L^1 - (1+\gamma_L)d^0 < (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 \qquad \text{(A26)}$$

and, using (A23) again, we have

$$\begin{aligned} (1-\alpha)E[G] + \mu^0(1+\Delta)\pi_H^0 &\geq (1-\alpha)G^H(\underline{d}) + (1+\Delta)\pi_H^0 \\ &\geq (1+\Delta)\pi_H^0 \geq \pi_H^1 > \pi_L^1 \\ &> \pi_L^1 - (1+\gamma_L)d^0 \end{aligned}$$

where the second inequality follows from the non-negativity of gains in separating equilibrium, the third from Assumption 5, the fourth from Assumption 3 and 4, and the last follows the requirement that $d^0 > 0$. Hence, (A26) is satisfied for any $d^0 > 0$. What remains is to check whether any such d^0 is consistent with (A24). We first note that the buy-out price can be written as

$$\Delta\widehat{p}(d^0; 1) = \Delta(\pi_H^1 - (1+k)) - (1+k) + d^0 - \alpha E_1[G(d^0)]$$

$$= \Delta(\pi_H^1 - (1+k)) - (1+k) + d^0 - \alpha((1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) - \gamma_H d^0)$$

Using this and the definition of $E[G]$, we can write the requirement in (A24) as

$$\pi_H^1 - (1+\gamma_H)d^0 + \Delta(\pi_H^1 - (1+k)) - (1+k) + d^0 - \alpha((1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) - \gamma_H d^0)$$

$$> \mu^0(1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) + (1-\mu^0)(\pi_L^1 - (1+k)) + \mu^0(1+\Delta)\pi_H^0$$

After some manipulation, this can be rewritten as

$$(1-\mu^0)\left(\frac{(1+\Delta)}{(1-\alpha)}\pi_H^0 + (1+\Delta)(\pi_H^1 - (1+k) - \pi_H^0) + ((1+k) - \pi_L^1)\right) > \gamma_H d^0$$

Since all three terms in the large bracket are strictly positive, it follows that the left hand side is strictly positive, and we conclude that (A24) is satisfied provided that d^0 is chosen small enough. Hence, we can state.

Lemma 5. *If Assumption 6 is satisfied, all pooling equilibria with immediate buy-out are destabilized.*

Temporary partnership with a buy-out option

In an undominated pooling equilibrium with a temporary partnership we have $\widehat{d} \in [0, \underline{d})$, and the exercise price is $\Delta\widehat{p}(\widehat{d}; \mu^0) \in (0, \Delta(\pi_H^1 - (1+k)))$. The equilibrium payoffs of type H and type L are given by $\pi_H^1 - (1+\gamma_H)\widehat{d} + \Delta\widehat{p}(\widehat{d}; \mu^0)$ and $\pi_L^1 - (1+\gamma_L)\widehat{d}$, respectively. We ask whether there exists an alternative signal d^0 and associated exercise price $\Delta\widehat{p}(d^0; 1) \Box \Delta(\pi_H^1 - (1+k))$ such that

$$\pi_H^1 - (1+\gamma_H)d^0 + \Delta\widehat{p}(d^0; 1) > \pi_H^1 - (1+\gamma_H)\widehat{d} + \Delta\widehat{p}(\widehat{d}; \mu^0) \qquad \text{(A27)}$$

and

$$\pi_L^1 - (1+\gamma_L)d^0 + \min\{\Delta\widehat{p}(d^0; 1), 0\} < \pi_L^1 - (1+\gamma_L)\widehat{d} \qquad \text{(A28)}$$

If the answer is affirmative, the equilibrium is destabilized; if not, the equilibrium survives. A quick look at (A28) reveals that any $d^0 > \widehat{d}$ is sure to make type L strictly worse off. So, what remains is to check whether there exists a $d^0 > \widehat{d}$ such that (A27) is satisfied. A direct argument should suffice to show that this is, indeed, the case. Note first that $\Delta\widehat{p}(d; \mu)$ is strictly increasing in d and that $\Delta\widehat{p}(d; 1) - \Delta\widehat{p}(d; \mu)$ is strictly positive for all $\mu < 1$. (A27) can be rewritten as $\Delta\widehat{p}(d^0; 1) - \Delta\widehat{p}(\widehat{d}; \mu^0) > (1+\gamma_H)(d^0 - \widehat{d})$, or, alternatively, as

$$\Delta\widehat{p}(d^0; 1) - \Delta\widehat{p}(d^0; \mu^0) > (1+\gamma_H)(d^0 - \widehat{d}) - (\Delta\widehat{p}(d^0; \mu^0) - \Delta\widehat{p}(\widehat{d}; \mu^0)) \qquad \text{(A29)}$$

The right hand side of (A29) vanishes as $d^0 \to \widehat{d}$, whereas the left hand side does not. Thus, there exists a d^0 larger than but sufficiently close to $\widehat{d}$ such that (A27) holds. It follows that the pooling equilibrium associated with $\widehat{d}$ is destabilized..

Lemma 6. *If Assumption 6 is satisfied, all pooling equilibria with a temporary partnership are destabilized.*

Combining Lemma 5 and Lemma 6 completes the proof of Proposition 3.