Chapter 2

International Joint Venture, Licensing and Buy-out under Asymmetric Information.
of entry with a subsidiary, may give some contract of buying out the host partner such that the host firm gets exactly what it expects to get by rejection and subsequent duopoly competition, if any. So the MNC has no reason to enter with a subsidiary anymore.

However, when the innovation outcome is not known to the host partner, but it is known to the MNC, this asymmetric information creates a problem in buying out shares from the host partner. To illustrate this point, let us suppose that the MNC wants to buy-out some shares. Now even if the MNC fails to innovate the new technology, it may pretend to have that in order to be liable to pay less to the host firm. Anticipating this, the host firm would not agree to sell out unless it gets some average price depending on its prior belief. As a result, if the MNC has the new technology it might find it better to enter by incurring the set up cost rather than paying the average price which involves some extra payment that may be greater than the set up cost under some values of prior belief. We will analyse the nature of this trade-off in the MNC’s decision problem in a principal-agent framework, where the MNC is the principal and the host firm is the agent.

In this framework, we provide a rationale for joint venture formation as opposed to licensing, which is very different from the existing literature. We show that under certain parameter configurations, the MNC may form a joint venture in order to avoid entry in the second period. This joint venture is unstable in the sense that the MNC will completely buy-out this venture in the second period. In our model, this instability is shown to be part of a perfect Bayesian equilibrium outcome. This implies that the instability is fully anticipated at the time of joint venture formation in the first period itself. For all other parameter values, the MNC would license out the technology in the first period, and in the second period the MNC might enter with a subsidiary or buy-out the existing business of the host partner. We also provide a justification for the transfer of an inferior technology by the MNC in the first period.

In the context of technology transfer, the possibility of imitation has been considered in the literature (see Katz and Shapiro (1985), Kabiraj and Marjit (1993), Rockett (1990) etc.). Gallini and Wright (1990) have considered the problem of technology transfer under asymmetric information in a static framework (with multistage game), when sharing of pre-contractual information about the economic value of innovation facilitates imitation at a fixed cost. They show that the licensor signals about the quality of its technology with an output based payment (royalty), but the imitation possibility restricts the size of that output based payment. This might lead to a situation where licensor leaves some of the rents with the licensee to avoid imitation in equilibrium. Contrary to their paper, in our model the imitation
of the first period technology can take place through a process of "learning by doing". However, we do not allow for royalty as an instrument for solving the asymmetric information problem in our model. Alternatively, we may assume that imitation is costless once the pre-contractual information about the technology is shared with the licensor. As a result, a contract on royalty payment cannot achieve the goal of solving the asymmetric information problem. An important difference with the paper by Gallini and Wright (1990) is that they have not allowed the licensor to enter and produce on its own, whereas we allow the licensor, having private information, to enter into the market at a fixed cost.

This chapter is somewhat related to a paper by Shleifer and Vishny (1986). They discuss the problem of value increasing takeover by a large shareholder of a firm, where the rest of the shares are 'diffusely' held. They demonstrate the role of a large shareholder in bringing about the value-increasing takeover in the context of free rider problem. In their model, the large shareholder needs to hold 50% of the firm's equity to change the incumbent management in order to realise the increase in value of the firm. The large shareholder can invest in research activity to get the technology, which is used to improve the value of the firm after takeover. They have shown that as the initial shareholding of the large shareholder increases, the possibility of takeover increases.

The main differences of Shleifer – Vishny model with our model are the following. First, we have considered the possibility of the two party shareholdings of a firm. So the problem of free rider does not arise. Secondly, we allow the possibility of setting up a business by the MNC (who can increase the profit of the firm with its new technology), that was not allowed in their paper. Thirdly, in our model the value improvement can be made by the incumbent management also, once the technology is transferred. So we do not have any restriction on the shareholding of the partner who brings about the value improvement. In Shleifer and Vishny (1986), the possibility of takeover is facilitated by the increase in initial shareholding of the large shareholder as it realises the value improvement in its own shareholding also. In our model, the whole increase in value is ultimately appropriated by the MNC. However, the joint venture serves a very different purpose in our model. In the presence of asymmetric information, the MNC forms a joint venture in the first period to avoid the entry in the second period as the entry involves a positive set up cost.

The rest of the chapter is organised as follows. In section 2, we describe the basic framework of our analysis and present the complete information version of the game. In section 3, we discuss the incomplete information game. In section 4, we discuss the possibility of an
inferior technology transfer by the MNC in the first period. The last section concludes our discussion.

2. The basic framework

The model comprises of two strategic agents: an MNC and a host firm; and a non-strategic agent: the government. We consider a two period model with no discounting.

We begin by describing the actions of the non-strategic agent, the government. The government is liberalising the economy stage-wise. Thus, in the first period, the MNC is allowed to hold equity up to a certain limit; and in the second period, the MNC is allowed to set up a wholly owned subsidiary. We also assume that the government restricts imports to the host country by imposing a prohibitive tariff. Under these conditions, the MNC can serve the domestic market in the first period either through licensing or by forming a joint venture with the host firm. In the first period joint venture, the government stipulates a minimum shareholding of the host partner (\( \alpha \)) greater than 50%, so that the control of the business rests with the host firm.

We now describe the technological setting of our model. In the first period, the MNC possesses a technology, which may be used to produce a particular product in the domestic market. This technology is "drastic" as compared to the domestically available technology of the host firm. This technology involves a particular constant marginal cost, which is a common knowledge to both the host firm and the MNC. We assume that the MNC can innovate a new technology in the first period without any cost. However, the outcome of this innovation is uncertain and not observable. The MNC may be successful in innovation with probability \( q \). So the probability of the MNC's failure to innovate this new technology is \( (1-q) \). \( q \) is common knowledge to both the firms. This new technology will be available for second period production only. The MNC knows the innovation outcome in the beginning of second period but the host firm can not observe that outcome. As a result in the second

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1 We have assumed that the host firm has full information about the first period technology, whereas it does not observe whether the MNC has the new technology in the second period. This is because the MNC has been operating with the first period technology in the international market. So the host firm knows about the effectiveness of the existing technology of the MNC. However, due to innovation the MNC may get a new technology, which the host firm can not observe. As a result the host firm would not be convinced as whether the new technology is the repackaged version of the existing technology or it is actually the new technology.
period the MNC has private information about its technological capability, whereas the host firm has a prior belief, which is the same probability distribution as the innovation outcome. Since the innovation outcome is not observable to the host firm, two parties cannot write a contract on the supply of new technology in the second period. We assume that this new technology is of the cost reducing type. This technological progress is drastic\(^2\) in nature. Let \(c_1\) denote the marginal cost of the first period technology. Suppose \(\Pi(c_1)\) is the one period monopoly profit that can be generated by utilising the first period technology of the MNC in the domestic market. We assume that the marginal cost associated with the new technology is \(c_2\) and this technology would yield monopoly profit \(\Pi(c_2)\) in the domestic market (obviously \(\Pi(c_2) > \Pi(c_1)\)).

The existing technology of the host firm is inferior as compared to that of the MNC in the beginning of first period. The host firm can continue with its existing technology to earn its reservation payoff. For simplicity, we take the host firm’s reservation payoff to be zero in both periods. We assume that the technology transfer facilitates imitation without any cost through a process of “learning by doing” during the first period production. Because of this imitation the host partner will have the necessary technical knowledge to carry out the production with the first period technology in the existing business without depending on the MNC in the second period.

Let us discuss the structure of the game.

**First period:** The MNC offers the technology by forming a joint venture with the host firm at an upfront fee \(T\). In this joint venture the MNC may choose to offer a share, \(\alpha\), to the host firm such that \(\alpha \geq \alpha^*\), keeping \((1-\alpha)\) share for itself. Note that we also allow for the fact that the MNC may choose to license out the technology by offering \(\alpha = 1\) in the first period. The first period profit is realised at the end of the period.

**Second period:** The MNC makes an offer of buying out some shares \(s\) at a price \(p\). The host firm can either accept or reject the offer. For simplicity, we assume that if the buy-out offer is accepted by the host firm, the MNC is contractually bound not to enter. However,

\(^2\) This is assumed for the sake of simplicity. Our analysis will go through even with non-drastic technological progress.
after rejection, the MNC decides on whether to enter with a subsidiary or not. The second period payoffs are realised at the end of the period.

The second period game is represented in Figure 2.1 below.

The option of not making an offer can be thought of as making an unacceptable offer, which gets rejected by the host firm and after that the MNC can decide whether to enter or not. We assume that (a) the MNC enters if it gets a payoff which is weakly greater than no entry option; and (b) the host firm accepts the buy-out offer when its payoff from acceptance is weakly greater than the payoff from rejection. We assume that the host firm’s setting up cost is prohibitive so that it does not set up a new unit after selling off its shares even if it knows the technology. In second period, if the MNC wants to set up a subsidiary it has to incur a set up cost $F(>0)$. Both the parties are assumed to be risk neutral.

We make a strong assumption that the MNC can not write a second period buy-out contract with the host firm in the first period itself. If they could write that contract then they could agree on a prior price ‘p’ at which an amount of share ‘s’ would be bought out by the MNC in the beginning of the second period irrespective of the innovation outcome. In that case the problem analysed in this chapter would not arise in the first place.

This game can be solved in standard backward fashion. First consider the case where both parties can observe the innovation outcome of the MNC. Thus, the above game is played under complete information.
The complete information scenario

Let us first analyse the second period outcome.

Second period

Suppose the MNC has offered the technology in the first period with a contract of a joint venture, where the host firm holds $\alpha$ share of the business and the MNC holds the rest, $1-\alpha$. To find out equilibrium of this game, we note that the entry of the MNC with a subsidiary involves not only the setup cost but also a competitive loss due to duopoly competition, if any. So, this entry reduces the total surplus in the relationship. As a result, the MNC would try to avoid the entry in order to maximise its profit.

To determine what would be the optimal acceptable buy-out offer in the second period, we have to know what happens in the following subgame after rejection of the offer. After rejection, the MNC may or may not enter to set up a subsidiary. In case of entry, the MNC with the new technology can monopolise the domestic market (since the new technology is drastic as compared to the existing first period technology). On the other hand, in case of entry with the first period technology, duopoly competition would take place between the subsidiary of the MNC and the joint venture unit as the host firm has the control over the existing joint venture unit. We denote duopoly profit under the first period technology by $\Pi^d(c_1)$ and assume that the total duopoly profits $(2\Pi^d(c_1))$ is less than the monopoly profit $(\Pi(c_1))$ under first period technology. We make the following assumption

$$(A1). \quad \Pi(c_2) \geq F > \Pi^d(c_1).$$

The implication of the above assumption is that the MNC’s entry threat with a subsidiary is not credible if the MNC is not successful in its innovation, but the entry threat is credible if the MNC is successful in innovating the new technology. We will analyse the game under the assumption $(A1)$. However, we would discuss at the end of Section 3 how the results change (if any), for other parameter configurations not permissible under assumption $(A1)$.

There are two cases to consider.

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3 We assume that the management of the subsidiary unit maximises the profit of its own unit under duopoly competition without taking into consideration the MNC’s shareholding in the joint venture unit.
(a) If the MNC is successful in innovation then the MNC has the new technology. Note that given any first period contract, the MNC's entry with a subsidiary is profitable as $\Pi(c_2) - F \geq 0$. So, the host firm would receive zero by rejecting the buy-out offer of the MNC, since the MNC would enter with a subsidiary consequent upon the rejection.

(b) If the MNC is not successful in innovation, it has the same first period technology. Now given any joint venture contract in the first period, the MNC's entry with a subsidiary is not profitable as $(1-\alpha) \frac{\Pi(c_1)}{\Pi(c_1)} + F < (1-\alpha) \Pi(c_1)$ under assumption (A1). So the MNC would not enter even after rejection of the buy-out offer. As a result, the host firm can receive the payoff $\alpha \Pi(c_1)$ even by rejecting the buy-out offer.

Thus, the host firm would accept any buy-out offer which would allow it to achieve the above mentioned payoffs depending on the MNC's technological capability, since by rejection the host firm does not get more either because of the entry of the MNC or otherwise. The MNC can make a buy-out offer such that the host firm gets exactly those payoffs. This buy-out offer can be complete or partial along with some lumpsum transfer payments between the parties. For example, the MNC having the new technology can buy out the host firm completely by paying zero price or it can offer any share $\alpha$ to the host firm and ask for a payment $\alpha \Pi(c_2)$. In any case, the MNC obtains the payoff $\Pi(c_2)$ in the second period. On the other hand, when the MNC does not have the new technology, then also it can make an offer of complete buy-out by paying price $\alpha \Pi(c_1)$ to the host firm to obtain $(1-\alpha) \Pi(c_1)$. The MNC can get the same payoff even with any partial buy-out offer along with a lumpsum payment such that the host firm gets $\alpha \Pi(c_1)$. The interesting point to note is that under complete information the MNC would give a buy-out (complete or partial) contract and never enter with a subsidiary.

Given the above characterisation of the second period outcome let us consider the full game.

**Full game**

In the first period, the MNC offers the first period technology with a contract of a joint venture such that the host firm gets its reservation payoff in two periods. Suppose the MNC charges an upfront payment $T$ and offers a share $\alpha$ to the host firm. By accepting this contract, the host firm obtains the total payoff in two periods $\alpha \Pi(c_1) + q \cdot 0 + (1-q) \alpha \Pi(c_1) - T$.

And the MNC obtains from this contract

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1 This means that the MNC may sell out the technology also.
\[(1-\alpha)\Pi(c_1) + q\Pi(c_2) + (1-q)(1-\alpha)\Pi(c_1) + T\]

The MNC chooses \(\alpha\) and \(T\), subject to the constraint that the host firm gets its reservation payoff in two periods, which is assumed to be zero. Thus, the MNC gets the total payoff in two periods \(\Pi(c_1) + q\Pi(c_2) + (1-q)\Pi(c_1)\). Interestingly, this payoff is independent of the initial offer of share \(\alpha\) to the host firm. Hence, under complete information the MNC may optimally choose to either license out the technology or to form a joint venture with the host firm\(^5\). Thus, we have the following proposition on the subgame perfect equilibrium outcome under complete information.

**Proposition 1.** The MNC makes an offer of the technology in the first period either in joint venture or in licensing contract. In the second period the MNC makes an offer of buy-out (complete or partial) to the host firm such that the host firm obtains either zero or \(\alpha\Pi(c_1)\) depending on whether the MNC has been successful in developing the new technology or not. However, the entry never occurs in equilibrium. In two periods, the MNC's total payoff is \(\Pi(c_1) + q\Pi(c_2) + (1-q)\Pi(c_1)\) and the host firm obtains zero.

Without any loss of generality, we assume that whenever the MNC is indifferent between a licensing contract and joint venture formation, it would offer licensing contract. We will maintain this assumption to explicitly account for the rationale for joint venture formation, as opposed to licensing contract (see the next section).

### 3. Incomplete information scenario

Suppose that the outcome of the innovation is not observable to the host firm. As a result, the second period game starts with asymmetric information, where the MNC has private information about its technological capability and the host firm has a prior belief that the MNC has got the new technology with probability \(q\).

To find out the equilibrium of the full game, we proceed in standard backward fashion. First, consider the second period outcome.

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\(^5\) Here the licensing contract in the first period can be viewed as a sale of the technology by the MNC.
would reject that offer in order to get the payoff \(\alpha \Pi(c_1)\), since the low type would not enter after the rejection. Hence, the low type would mimic to be high type and make the same complete buy-out offer, which gets accepted by the host firm. Also, the low type MNC would be better off by making that complete buy-out offer rather than making an unacceptable offer and then continuing with the joint venture, since \(\bar{R}(\alpha) < \alpha \Pi(c_1)\). Now, given the pooling (complete) buy-out offer of \(\bar{R}(\alpha)\), the MNC’s true identity (as to whether it is high type or low type) will not be revealed to the host firm. Consequently, the host firm’s prior belief about the MNC’s type will not change. So the host firm would accept that offer as by rejection the host firm will get \(qG + (1-q) \alpha \Pi(c_1)\), which is equal to \(\bar{R}(\alpha)\). Thus, we have a pooling equilibrium outcome with the MNC making a complete buy-out offer with the payment \(\bar{R}(\alpha)\) irrespective of its technological capability, and the host firm accepting that offer.

(b) It is obvious from the above discussion that any buy-out offer made by the high type, such that the host firm gets a payoff less than \(\bar{R}(\alpha)\), would also be mimicked by the low type MNC. The host firm, by rejecting such pooling offer, would get the expected payoff \(\bar{R}(\alpha)\), since the high type MNC would enter with a subsidiary and the low type MNC would continue the joint venture. Therefore, any buy-out offer such that the host firm gets less than \(\bar{R}(\alpha)\), would be rejected by the host firm. As a result, if \(\bar{R}(\alpha) > F\), then the high type MNC differentiates itself by entering with a subsidiary (without making any buy-out offer) to get \(\Pi(c_2) - F > \Pi(c_2) - \bar{R}(\alpha)\). Now if the buy-out offer is made, it reveals the information to the host firm that the MNC is low type. So the low type MNC has to make the offer by giving a payoff to the host firm \(\alpha \Pi(c_1)\). Thus, the low type MNC obtains \((1-\alpha) \Pi(c_1)\). The low type MNC may simply continue the joint venture without making any offer to get the same payoff. So the host firm’s expected payoff under separating equilibrium is also \(\bar{R}(\alpha)\). Thus if \(\bar{R}(\alpha) > F\), then the separating equilibrium outcome involves that no offer is made (or some arbitrary unacceptable offer is made by the MNC) and the high type MNC enters with a subsidiary and the low type MNC continues the existing joint venture business. This is the only separating equilibrium under given parameter restriction.

Thus, the above proposition establishes one possible equilibrium configuration given the parameter values. Let us try to find out whether there can be any other pooling equilibrium of the second period game given the parameter restriction \(\bar{R}(\alpha) \leq F\). Suppose the host firm’s strategy is to accept any buy-out offer \((s, p)\) such that \((\alpha-s) \Pi(c_1) + p \geq R\) for any given \(q \in (0,
1) and otherwise, to reject the buy-out offer with the belief that the offer has come from low type MNC (i.e., $q = 0$). The high type MNC would not make any complete buy-out offer such that the host firm gets $R > F$. This is because, by not making that offer (or making some unacceptable offer) and directly entering, the high type MNC gets $\Pi(c_i) - F$, which is a greater payoff than the payoff from making the offer of buying out the host firm by paying $R$. Similarly, the low type MNC would not make any offer involving $R$ such that $R > \alpha \Pi(c_i)$.

As a result, the potential pooling offers that can be made by the MNC are limited to $R \leq \min[F, \alpha \Pi(c_i)]$. On the other hand, any pooling offer $R < \bar{R}(\alpha)$ will not be accepted by the host firm. This is because by rejection, the host firm expects that with probability $(1-q)$ the MNC is low type and therefore, the joint venture would be continued leading to the payoff $(1-q) \alpha \Pi(c_i) = \bar{R}(\alpha)$. Hence, the potential for pooling equilibrium exists for $Re[\bar{R}(\alpha), \min(F, \alpha \Pi(c_i))]$. Now for any $R$ belonging to the above range and the corresponding strategy of the host firm, both types of the MNC would make the complete buy-out offer by paying that $R$.

On the other hand, the strategy of the host firm is also optimal given the belief and the strategy of the MNC. Thus, we have a continuum of pooling equilibrium involving the payoff, $R$, to the host firm such that $Re[\bar{R}(\alpha), \min(F, \alpha \Pi(c_i))]$.

On the other hand, there exists a class of separating equilibria, if $F > \alpha \Pi(c_i)$. Consider the same strategy of the host firm such that $R \in (\alpha \Pi(c_i), F)$. It is easy to see that given the strategy of the host firm, only the high type MNC offers $R$ (under complete buy-out), the low type MNC does not make any offer. Given the belief and the strategy of the MNC, the host firm's strategy is also optimal. These strategies and beliefs would describe a separating equilibrium. Note that in this equilibrium, the host firm holds the off-the-equilibrium belief that if the offer does not involve at least $R$, it is made by low type. However, none of these equilibria satisfy the "intuitive criterion" (see Cho and Kreps, 1987), since any small deviation below $R$ (but above $\alpha \Pi(c_i)$) would still mean that the offer has come from high type and as a result, the new offer would be accepted; thereby, the initial equilibrium gets upset. We also note that for $F < \alpha \Pi(c_i)$, no equilibrium exists involving the host firm's strategy with $R$ belonging to the range $(F, \alpha \Pi(c_i))$ such that it receives the payoff $R$ in the equilibrium. This is so because the high type would never make such an offer as it is better off by entering directly with a subsidiary. On the other hand, if the low type makes that offer, the host firm would not accept it, since the host firm understands from that offer that it is made by the low type only; so it does better by rejecting it and receiving the payoff from the existing business.
Out of all these equilibria, we note that the equilibrium described in Proposition 2 is the best equilibrium from the MNC's point of view. This is so because under pooling equilibrium the MNC buys out the host firm by paying $R(\alpha)$, which is the lowest possible price to buy-out the host firm and under separating equilibrium the high type MNC enters in case the set up cost $F$ is less than the lowest buy-out price $R(\alpha)$. The rest of the analysis is carried out with respect to this best equilibrium in the second period subgame.

Given the above characterisation of the second period outcome, we now proceed to find out the equilibrium of the full game.

**Full game**

In the first period the MNC offers the first period technology with a contract of a joint venture such that the host firm receives its reservation payoff. Suppose the MNC charges an upfront payment $T$ and offers a share $\alpha$ to the host firm. By accepting this contract, the host firm obtains in two periods a total payoff $\alpha \Pi(c_1) + R(\alpha) - T$

And the MNC obtains from this contract

$$(1-\alpha)\Pi(c_1) + q \Pi(c_2) + (1-q)\Pi(c_1) - R(\alpha) + T$$ if $R(\alpha) \leq F$

$$(1-\alpha)\Pi(c_1) + q [\Pi(c_2) - F] + (1-q)\Pi(c_1) - R(\alpha) + T$$ if $R(\alpha) > F$

The MNC chooses $\alpha$ and $T$, subject to the constraint that the host firm gets its reservation payoff (in two periods), which is assumed to be zero. Thus, the MNC gets the total payoff in two periods

$$\begin{align*}
\Pi(c_1) + q \Pi(c_2) + (1-q)\Pi(c_1) & \quad \text{if } R(\alpha) \leq F \\
\Pi(c_1) + q [\Pi(c_2) - F] + (1-q)\Pi(c_1) & \quad \text{if } R(\alpha) > F
\end{align*}$$

Hence, the MNC obtains a greater payoff as long as the condition $R(\alpha) \leq F$ is satisfied (under pooling equilibrium). Therefore, the MNC would choose $\alpha \geq \bar{\alpha}$ such that $(1-q)\alpha \Pi(c_1) \leq F$ (putting the value of $R(\alpha)$ from (2)) as long as feasible. Note that given any parameter configuration, the likelihood of this condition to be satisfied increases as $\alpha$ decreases to $\bar{\alpha}$. So without loss of generality we assume that whenever the MNC chooses to offer a joint venture contract it would choose to offer $\bar{\alpha}$ share to the host firm. However, if $R(\alpha) \leq F$ is satisfied even with the choice of $\alpha = 1$, then the MNC’s maximum payoff is attainable even
with the choice of licensing contract. That means if \((1-q)\Pi(c_1) \leq F\), then the MNC will choose licensing contract. So the joint venture is formed only when \((1-q)\bar{\alpha} \Pi(c_1) \leq F< (1-q)\Pi(c_1)\). On the other hand, if \(\bar{R}(\alpha) \leq F\) is not possible to satisfy with any choice of \(\alpha \geq \bar{\alpha}\) (i.e., if \(\bar{R}(\alpha) > F\)) then the MNC would choose to license out the technology in the first period as it is indifferent between the licensing and a joint venture contract.

Hence we get the following proposition on the choice of contract in the first period.

**Proposition 3.** *When \((1-q)\bar{\alpha} \Pi(c_1) \leq F< (1-q)\Pi(c_1)\), the MNC would choose to offer a joint venture contract by offering a share of \(\bar{\alpha}\) to the host firm in the first period. Otherwise, the MNC chooses to offer a licensing contract to transfer the technology in the first period.*

Note that the MNC can obtain the total surplus that is available in the relationship. If \(\bar{R}(\alpha) > F\), then the high type MNC would enter in the second period rather than buying out the host firm. The setup cost that is incurred due to this entry, is a pure wastage of total surplus. Since the entry of the MNC involves a pure wastage of surplus in terms of setup cost \(F\), the MNC does better by avoiding this entry as far as possible. Under certain parameter configurations given by \((1-q)\bar{\alpha} \Pi(c_1) \leq F< (1-q)\Pi(c_1)\), the formation of a joint venture exclusively helps to avoid this wastage by making the entry of the high type relatively an inferior option as compared to the buy-out of the host firm in the second period. Although the high type MNC pays some extra payoff to the host firm under pooling equilibrium (as \(\bar{R}(\alpha) > 0\)), that is always recouped from the host firm in the first period through a lumpsum payment \(\ell\) charged by the MNC.

Thus, we obtain the joint venture formation under certain parameter configurations. Note that this joint venture business will be completely bought out in the second period as \(\bar{R}(\alpha) \leq F\) (by Proposition 2(a)). Hence, in this model we find both the joint venture formation and its subsequent instability in terms of complete buy-out of the joint venture unit by one partner.

Let us characterise the MNC’s choice of licensing or joint venture with respect to the permissible set of parameter values of \(F\) and \(q\) in terms of Figure 2.2 below. The MNC offers the licensing contract for all parameter values except the range \((1-q)\bar{\alpha} \Pi(c_1) \leq F< (1-q)\Pi(c_1)\). However, from Proposition 2, we find that in case of licensing contract for \(F \geq (1-q)\Pi(c_1)\)
(since $\bar{R}(\alpha) \leq F$), both types of the MNC buy-out the host partner completely in the second period (we denote this case by Licensing (b)). On the other hand, for $\bar{R}(\alpha) > F$, the licensing contract involves that in the second period the high type MNC will enter with a subsidiary but the low type MNC will not enter with a subsidiary (we denote this case by Licensing (s)). In the diagram below the horizontal axis measures $F$ and the vertical axis measures $q$. (Note that we rule out $0, 1$ values of $q$ as these are trivial cases analysed under complete information scenario).

![Diagram](image)

Figure 2.2

It is clear from the above analysis that given any $F$, the nature of equilibrium (whether pooling or separating) crucially depends on the second period expected payoff of the host firm, which is denoted by $\bar{R}(\alpha)$. The MNC’s total two period payoff is greater under pooling equilibrium, as the entry of the MNC does not take place. Under some parameter configurations, the first period contract of joint venture exclusively help to enforce that pooling equilibrium in the second period.
Chapter 2

Recall that in the above analysis we have assumed that the MNC cannot write a second period buy-out contract with the host firm in the first period itself. Let us now relax this assumption and see what happens. If they could write that contract then they could agree on a prior price ‘$p’ at which an amount of share ‘$s’ to be bought out in the beginning of the second period irrespective of the innovation outcome of the MNC. In that case, one simple way to solve this problem is to offer the first period technology under licensing contract in the first period with the upfront payment $\Pi(c_i)$ and write a contract that the business is to be handed over to the MNC in the second period at zero price. Then, the MNC does not need to either form a joint venture or set up a subsidiary. We have assumed away that kind of buy-out contract from our analysis.

Let us now discuss the outcome of the game when we allow for other parameter configurations (not permissible under assumption (A1)). This discussion will follow with respect to the best pooling equilibrium for the MNC and the unique separating equilibrium in the second period described in Proposition 2. For low values of $F \leq (1-\bar{\alpha}) \Pi^l(c_i) + \Pi^d(c_i) - (1-\bar{\alpha}) \Pi(c_i) = F^*$(say), we find that the entry threat of the low type MNC with a subsidiary is credible in the second period. Now given any contract of joint venture, the expected payoff of the host partner in the second period is $\bar{R}(\alpha) = (1-q) \alpha \Pi^d(c_i)$. This is because in case of rejection of the MNC’s buy-out offer, the low type MNC would also enter and subsequently duopoly competition would take place. Note that as long as $\bar{R}(\alpha) \leq F$, we observe the pooling equilibrium in the second period, as both types of the MNC would make a complete buy-out offer to the host firm by paying a price $\bar{R}(\alpha)$. When $F \geq (1-q) \Pi^d(c_i)$, then $\bar{R}(\alpha) \leq F$ is satisfied even with licensing contract offered in the first period. This licensing contract involves the complete buy-out of the host firm’s business in the second period (Licensing (b)). However, only for the range of parameter values for which the joint venture would exclusively help to achieve this pooling equilibrium is $(1-q) \bar{\alpha} \Pi^d(c_i) \leq F < (1-q) \Pi^l(c_i)$. When $F < (1-q) \bar{\alpha} \Pi^d(c_i)$, even the joint venture formation in the first period does not help to achieve the pooling equilibrium in the second period. So the MNC would offer a licensing contract in the first period. In the second period, the high type MNC would enter with a subsidiary (without making any offer) in order to differentiate itself from the low type and the low type MNC would make an offer to the host firm such that the host firm obtains $\Pi^d(c_i)$. This offer can be made as either complete or partial buy-out along with a lumpsum payment. The low type MNC does better by making this offer as opposed to entry even though the entry is feasible. As a result, under this separating equilibrium, the high type MNC enters with a
subsidiary and the low type MNC buys out (either completely or partially) the host firm in the second period without entry (Licensing (s)). Thus, in this case, the characterisation of the first period choice of licensing or joint venture contract can be represented by the following diagram.

Consider another situation such that $\Pi^d(c_i) \geq F > F^*$. Here, the entry threat of the MNC remains credible in the second period even when the MNC is not successful in innovation provided $\alpha \geq \alpha^*$, where $\alpha^*$ is defined as

$$\alpha^* = \alpha^* \text{ such that } (1-\alpha^*) \Pi^d(c_i) + \Pi^q(c_i) - (1-\alpha^*) \Pi(c_i) = F,$$

and $\alpha < \alpha^* \leq 1$.

Note that as $F$ increases to $\Pi^d(c_i)$, $\alpha^*$ increases to 1.

For any given $F$, the purpose of the MNC is to minimise the expected payoff of the host firm in the second period as it improves the payoff of the MNC by increasing the possibility of pooling equilibrium. Note that the expected payoff of the host firm in the second period associated with $\alpha < \alpha^*$ is always less than that associated with the other range ($\alpha \leq \alpha < \alpha^*$).

This is because for $\alpha \geq \alpha^*$, the entry threat of the low type MNC remains credible leading to the situation that the host firm's expected payoff is $(1-q) \alpha \Pi^d(c_i)$. On the other hand, for $\alpha > \alpha^*$, the entry threat of the low type MNC is not credible in the second period leading to the situation that the host firm's expected payoff is $(1-q)\alpha \Pi(c_i)$. Since $\alpha > 1/2$, $(1-q)\alpha \Pi^d(c_i)$ for $\alpha^* \leq \alpha < 1$ is always less than $(1-q)\alpha \Pi(c_i)$ for $\alpha \leq \alpha^*$. Therefore the pooling equilibrium will occur for $(1-q)\alpha^* \Pi^d(c_i) \leq F$ and the separating equilibrium will occur for $F < (1-q)\alpha^* \Pi^d(c_i)$ in this case. However, only for $(1-q)\alpha^* \Pi^d(c_i) \leq F < (1-q)\Pi^d(c_i)$, the joint venture
exclusively helps to achieve the pooling equilibrium in the second period. In case of pooling equilibrium, the MNC will completely buy-out the host firm in the second period and under separating equilibrium the high type MNC will enter with a subsidiary (without making any offer) and the low type MNC will buy out the host firm either partially or completely such that the host firm obtains $\Pi^*(c_1)$. Given the relation between $F$ and $a^*$ from (3), we are able to characterise the first period choice of licensing or joint venture contract in Figure 2.4 below.

![Figure 2.4](image)

Now we are left with the last possibility, $F > \Pi(c_2)$, to consider. In this case the entry of the MNC is not profitable in the second period, irrespective of the technological capability of the MNC. Note that this case is comparable to a certain extent with the paper by Shleifer and Vishny (1986).

Given the first period offer of joint venture, the host firm will get $a\Pi(c_1)$ by rejecting the offer of the MNC in the second period. So the minimum acceptable offer to the host firm is $\bar{R}(\alpha) = a\Pi(c_1)$. (4)

Now we claim that the high type MNC would make the complete buy-out offer. Suppose the high type MNC makes an offer to buy-out the host partner such that the host firm gets $\bar{R}(\alpha)$. Then $(\alpha - s) \Pi(c_2) + p = \bar{R}(\alpha)$. Note that any partial buy-out offer of giving $\bar{R}(\alpha)$ to the host firm made by the high type MNC would be replicated by the low type MNC. This is because by replicating that partial buy-out offer the low type MNC would effectively pay $(\alpha - s) \Pi(c_1) + p < \bar{R}(\alpha)$ (as $\Pi(c_2) > \Pi(c_1)$). As a result, the host firm would not accept any such buy-out offer since it would get an expected payoff which is less than $\bar{R}(\alpha)$. However, in
case of complete buy-out offer both types of MNC offer $\bar{R}(\alpha)$. Therefore, this pooling buy-out offer involves complete buy-out by paying $\bar{R}(\alpha)$ to the host firm. Then the host firm will accept this offer. The low type MNC may replicate the above buy-out offer if it so desires. Otherwise also, the low type MNC can offer a range of buy-out contract such that the host firm gets $\bar{R}(\alpha)$ or simply continue the existing business without entering. Thus, in the second period the high type MNC can get $\Pi(c_2) - \alpha\Pi(c_1)$ and the low type MNC would get $(1-\alpha)\Pi(c_1)$.

From the above characterisation of the second period outcome, it is easy to see that the first period joint venture formation has no role to play as the entry never occurs in the second period equilibrium. Therefore, the MNC would offer a licensing contract in the first period by charging an upfront payment such that the host firm obtains zero in two periods. Thus, the MNC obtains the total payoff in two periods $\Pi(c_1) + q\Pi(c_2) + (1-q)\Pi(c_1)$ and the host firm would receive zero by accepting the offer of licensing contract. Thus, we have the following proposition on the equilibrium outcome in this case.

**Proposition 4.** The MNC makes an offer of the technology in the first period in licensing contract. In the second period the high type MNC makes a complete buy-out offer to the host firm such that the host firm obtains $\Pi(c_2)$ and the low type MNC is indifferent between a range of buy-out offer including the complete buy-out one. However, entry never occurs in equilibrium in the second period. The MNC’s total payoff in two periods is $\Pi(c_1) + q\Pi(c_2) + (1-q)\Pi(c_1)$ and the host firm obtains its reservation payoff, which is zero.

Let us highlight some of the differences between the paper by Shleifer and Vishny (1986) and the above case. Here the MNC can not enter, still the full value increase of the firm is realised. Although there is no restriction on the equity holding of the of the MNC to bring about the value increase, the asymmetric information forces the equilibrium involving the complete buy-out of the host firm by the high type MNC (with new technology) in the second period. Note that the MNC is an outsider (having no initial stake in the business), who is taking over the firm completely (owning 100%).

4. **The possibility of inferior technology transfer.**

Let us check whether there is any incentive for the MNC to transfer an inferior technology in the present setup. Suppose, in the first period, the MNC has two technologies instead of one
the superior technology. Thus, we find the possibility of the inferior technology transfer by
the MNC in the first period under certain parameter configurations. Note that this inferior
technology may be transferred either in licensing or to a joint venture unit. This transfer of
inferior technology increases the possibility of buy-out (pooling equilibrium) in the second
period by reducing the host firm's expected payoff in the second period. The similar results of
inferior technology transfer would hold when we consider the other parameter configurations
not permissible under assumption (A1) except in the situation described in Proposition 4. In
that situation, the MNC will always transfer the superior technology in the first period under
licensing, as there is no equilibrium in the second period involving entry of the MNC.

This justification of transferring an inferior technology is very different from what is offered
in the existing literature. In the competitive context, Rockett (1990) discussed the possibility
of licensing an inferior technology when both the licensor and the licensee compete in the
same market. On the other hand, Kabiraj and Marjit (1993) have analysed the possibility of an
inferior technology transfer by a foreign firm to a domestic firm when there is a potential
threat of entry by the licensee to the existing market of the licensor. However, in our model
the inferior technology may be transferred even in a joint venture and for an altogether
different purpose.

5. Conclusion

This chapter has provided a rationale for international joint venture formation as opposed to
licensing, and also its subsequent instability, where instability is interpreted as complete buy-
out of the joint venture unit by a foreign firm (MNC). Here we have dealt with an important
aspect of international joint ventures where the partners are asymmetrically informed about
the technology supplied by one of the parties in the course of the relationship. The joint
venture is formed in response to government restriction on foreign equity holding in the first
period. However, the joint venture becomes unstable in the second period when the
government removes the foreign equity restriction. Here we show that under certain
parameter configuration the possibility of buy-out in the second period encourages the
formation of joint venture as opposed to licensing in the first period. In this framework, we
find the possibility of the transfer of an inferior technology in the first period either under
licensing or to a joint venture business under certain parameter configurations.