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## **Foreign Direct Investment For Sale**

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# Foreign Direct Investment For Sale\*

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## Abstract

This study examines the choice of a multinational firm between two alternative entry modes, a greenfield investment and a joint venture, under incomplete information. The joint venture partner is selected by an auction, which distinguishes this study from other studies in the literature. A private values auction allows a multinational firm to increase its share of the joint venture profit so that a joint venture is always preferable to greenfield investment. The model also examines the nationally optimal entry mode and finds that greenfield investment is likely to reduce welfare. The anticipated welfare implications of a joint venture crucially depend on the expectation of the marginal cost of the joint venture. Relative to a greenfield investment, a joint venture is welfare-improving if the negative impact of a joint venture on a local rival's profit is small.

**Keywords:** Foreign Direct Investment; Joint Venture; Incomplete Information; Auction with Externality.

**JEL Classification:** F23; L24.

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# 1 Introduction

In foreign markets, multinational firms may face several challenges such as language barriers, cultural differences and institutional uncertainties. A *multinational firm* (MNF) may prefer to form a strategic alliance with an existing firm in such a market, and engage in joint production (e.g., joint use of a production site, distribution network, etc.) in order to eliminate such hurdles. However, it may be difficult for a multinational firm to select the prospective partner firm under uncertainty.

This study presents a general analysis of a firm's entry mode choice under incomplete information. I allow the firm intending to enter a pre-determined, single host country to select its entry mode from two options.<sup>1</sup> The first option is to set up its own subsidiary enabling the firm to have full control over its activities, which I refer to as a *greenfield investment*. If the firm decides not to make a greenfield investment, it can form a joint venture with a local firm in the host country, and engage in joint production, which I refer to as an international *joint venture*. In this case, both firms have partial control over the activities of the established joint venture. Joint venture entry requires another decision, that is, to select a partner from the available local firms. As discussed later, the type of information available to the selecting firm is crucial in the selection process.

From a theoretical perspective, a firm intending to be a multinational firm may prefer full control over its activities in a host country to avoid the costs of shared ownership (e.g., conflict in decision making, moral hazard, and free-riding) if institutional uncertainty is low. However, if a local firm can be helpful in overcoming country-specific hurdles, the MNF may prefer partial ownership. For example, non-state firms in China were not allowed to invest overseas before the 1980s. This restriction was eased during the liberalization era of the late 1980s and non-state firms were permitted to invest abroad provided they had sufficient capital, technical and operational know-how, and a suitable joint venture partner (UNCTAD 2005). Although government-dictated restrictions led Chinese firms to establish joint ventures, the concerns of the Chinese government in those years could easily be associated with the arguments discussed here.

Local experience and local knowledge (of the economic, policy and political environment) of local firms may make joint ventures more likely to be the first-

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<sup>1</sup>See Anderson and Gatignon (1986) for a classification of entry modes. Alternatively, see Buckley and Casson (1998).

time entry mode of a firm (Hennart 1991; Caves 1996; Das and Katayama 2003; Asiedu and Esfahani 2001). However, once the uncertainty is reduced and the MNF becomes familiar with the country-specific environment, through accumulating local knowledge and obtaining local experience, it may prefer to set up its own subsidiary. An MNF also tends to opt for a full-ownership mode if there is an inherent risk of expropriation by local partners, because the proximity of local firms to the MNF's intangible assets enables them to successfully establish rival firms after having used the MNF's key resources in a partnership (Gattai and Molteni 2007).

In the theoretical as well as the empirical literature, several studies have analyzed an MNF's strategic choice between a joint venture and a greenfield investment. For instance, Gomes-Casseres's 1989 study (cited in Nisbet *et al.* 2003: 249-250) examines the propensity of US multinationals to invest via joint venture or wholly-owned subsidiary. The results show that in countries where governments restrict inward investment the firm is likely to enter through a joint venture.<sup>2</sup>

Raff *et al.* (2006) find that if partner firms in a joint venture are too asymmetric in terms of their asset structures, then the best strategy for an MNF is to set up its own subsidiary instead of forming a joint venture. They also report that joint ventures are less likely relative to whole ownership in concentrated industries. Yu and Tang (1992) find that if there is a low cost difference between an MNF and local firms, a joint venture becomes preferable relative to a greenfield investment.

Several studies applying simple bargaining models have already addressed the selection of a local partner under complete information. However, relatively few studies have extensively formalized the process of negotiations between firms before the establishment of a joint venture.<sup>3</sup> Svejnar and Smith (1984) model the formation of international joint ventures through negotiations with a special emphasis on the bargaining power of firms, transfer pricing, stock ownership and profit shares. Al-Saadon and Das (1996) endogenously determine ownership shares as the outcome of some bargaining process. Asiedu and Esfahani (2001) examine ownership structures in foreign direct investment projects. They show how foreign investors, local entrepreneurs and government interact prior to the formation of a joint venture.

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<sup>2</sup>See Gomes-Casseres (1989, 1990) for an extensive analysis of factors affecting multinational firms' strategic choice between a joint venture and a greenfield investment.

<sup>3</sup>In such models, firms share the joint venture profit according to an exogenous share parameter. See Klimenko and Saggi (2007), Mattoo *et al.* (2001), Mukherjee and Sengupta (2001) and references therein.

In this study, I am in particular interested in providing an alternative analytical framework for an MNF negotiating with local firms over a joint venture contract, such that the MNF negotiates in the presence of one-sided asymmetric information. I explore the choice of an MNF between two alternative entry modes: a greenfield investment and a joint venture. The main focus of the analysis in this study is the selection of a joint venture partner. The MNF could pick one or both potential partner firms and make a take-it-or-leave-it offer, which is the most common approach in the international joint venture literature. If the MNF is able to observe how much local firms expect to benefit from the joint venture, it can make the offer to the firm that values the contract most. However, the MNF does not always know local firms' valuations.

There may be asymmetric information even between local firms. Local firms may not be publicly listed. Hence, the MNF may have limited information about these firms. It may also have limited knowledge of the host country's institutional environment if it has never invested in this country before. Moreover, local firms may also have intangible assets, such as access to a local informal network. This network may help to eliminate specific obstacles that may arise due to venturing with a foreign firm (e.g., bureaucratic delays and extra payments). By successfully eliminating obstacles, a firm may become relatively more efficient after forming a joint venture with a foreign firm than the other domestic firm. Therefore, local firms may know better than the MNF the scope for reducing marginal costs.

Hence, this study assumes that the productivity of the joint venture is private information of the local firms, which weakens the bargaining power of the MNF. If there is such an imperfection, the MNF's ability to extract surplus is limited (McAfee and McMillan 1987; Krishna 2002). Since local firms' valuations are not known, if the MNF picks one or both firms and makes a take-it-or-leave-it offer, not only will good offers be accepted by *good* types, but also by *bad* types.<sup>4</sup> Alternatively, the MNF can talk to all potential target firms simultaneously and invite offers. Multiple negotiations in this sense are strategically equivalent to an auction. As I will show later, holding an auction leads the MNF to avoid the *lemon's problem* such that it always picks a *good*-type firm, which is not necessarily the case for take-it-or-leave-it offers. Since the MNF's main concern is to form a joint venture with a *good*-type firm, it is likely that the MNF prefers multiple negotiations to negotiating with only

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<sup>4</sup>The joint venture's productivity is higher with a *good*-type firm than a *bad*-type firm.

one firm to which it makes a take-it-or-leave-it offer.<sup>5,6</sup> Therefore, an auction method is considered in this study as the means of selecting a joint venture partner.

In the existing foreign direct investment (FDI) literature, many studies have discussed and determined the equilibrium market structure under FDI. Among others, Gattai and Molteni (2007) provide a theoretical formalization of a joint venture contract as an alternative to greenfield investment. However, in their study, the share parameter determining the net return of a joint venture is imposed exogenously by a local government. Their theoretical model suggests that an MNF always prefers a joint venture when the share parameter is high enough.

Norbäck and Persson (2002) examine the interaction between cross-border acquisitions and greenfield investments in a multi-firm setting. The choice in their study is between an asset acquisition and a greenfield investment. They use a common values, first-price auction to determine the equilibrium acquisition price. The same authors also consider privatization as an entry mode, and use the same auction format. Selling a state enterprise is the focus in Norbäck and Persson (2004) where a greenfield investment is the outside option.<sup>7</sup> Jehiel and Moldovanu (2000) derive the equilibria of private values, second-price sealed-bid auctions of patents and takeover contests under different circumstances. Their study is not concerned with FDI, nor with determining the equilibrium market structure.

This study differs from existing studies in several respects. First, I concentrate on two alternative entry modes, a greenfield investment and a joint venture, in which I determine the net return from involvement in a joint venture to an MNF by an auction mechanism. Second, I assume that the entry of an MNF creates negative externalities on local firms.<sup>8</sup> Finally, this study includes incomplete information between firms. By using a private values model with negative externalities, I conclude that the auction allows the MNF to increase its share of the joint venture profit so that the joint venture is always preferable to greenfield investment. I also examine

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<sup>5</sup>For instance, in late 1993, two firms, Viacom and QVC, were interested in acquiring the US firm Paramount. Paramount agreed to sell itself to Viacom and excluded the other bidder. QVC argued that Paramount should have held multiple negotiations. According to QVC, an auction would have been the appropriate way to maximize shareholder value (Bulow and Klemperer 1996).

<sup>6</sup>See Bulow and Klemperer (1996). They compare an auction with a negotiation and show, under reasonable assumptions, that the auction may be preferable to the negotiation.

<sup>7</sup>Policy implications of Norbäck and Persson's (2004) study can be found in Norbäck and Persson (2005).

<sup>8</sup>In the negative externalities situation, when the multinational firm forms a joint venture with one local firm, the other local firm's profit decreases relative to greenfield investment.

the nationally optimal entry mode and find that greenfield investment is likely to reduce welfare. According to the model, the anticipated welfare implications of a joint venture crucially depend on the expectation of the marginal cost of the joint venture. Relative to a greenfield investment, the joint venture type of entry is welfare-improving if the negative impact of a joint venture on a local rival's profit is small.

The major contribution of this study is that it models the selection of a joint venture partner under incomplete information by an auction. The implications of applying a private values auction to the selection of a joint venture partner are, to my knowledge, not well developed in the FDI literature, where the most common approach is to assume a take-it-or-leave-it offer. Additionally, this study can also be seen as a contribution to the international business literature, as it provides an alternative analytical approach to capture the effects of institutional uncertainties that an MNF may face in the host country.

The remainder of the paper is structured as follows: the model is introduced and solved, for greenfield investment only, in *Section 2*. In *Section 3*, I solve the model for a joint venture type of entry, derive the equilibrium value of a joint venture contract, and determine the equilibrium market structure. *Section 4* investigates the nationally optimal entry mode, and *Section 5* concludes. For convenience, I have relegated most of the proofs to the *Appendix*.

## 2 The model

In the model, I have two countries: a source country and a host country. The host country has two local firms: firm  $i$  and firm  $j$ . The source country has only one MNF. In the host country, firms are assumed to compete in a homogeneous good market. The local firms have identical marginal costs denoted by  $c$  (i.e.,  $c_i = c_j = c$ ). The MNF is assumed to possess a relatively more efficient technology, which allows it to produce the homogeneous good with a lower marginal cost denoted by  $c^*$  (i.e.,  $c^* < c$ ). The marginal costs are assumed to take values on the open interval  $(0, 1)$  (i.e.,  $c^*, c \in (0, 1)$ ).

There is a linear market demand in the host country, such that the inverse demand function is expressed as  $P(Q) = (1 - Q)$ , where  $Q = q_m + q_i + q_j$ .  $Q$  represents the total amount of the homogeneous good produced in the host country, which comprises the MNF's output  $q_m$  and the local outputs  $q_i + q_j$ . The MNF can take advantage of possessing the efficient technology by investing in the host country.

There are two ways to enter the host country; the MNF can either make a greenfield investment or form a joint venture.<sup>9</sup> The MNF also has the option to stay out of the host country and not to invest at all. The interaction between firms takes place in four stages. In the first stage, the social planner of the host country decides whether to impose any restrictions on foreign entry. In the second stage, the MNF can form a joint venture partnership with a local firm, if it is not restricted by the social planner. In the third stage, the MNF has the option to set up its own subsidiary in the host country if it has not formed a joint venture and if it is permitted to do so. In the fourth stage, all active firms compete in the *Cournot* fashion. The game is solved backwards.

## 2.1 The host country in autarky

The MNF has the option to stay out. In this situation, there will be only two local firms in the host country. Let  $\pi_i^a$  and  $\pi_j^a$  denote the local firms' profits when there is no foreign entry. Note that superscript *a* refers to autarky. The profit levels of the local firms obtained by the Cournot duopoly game are given by equation (1):<sup>10</sup>

$$\pi_i^a = \pi_j^a = \frac{(1-c)^2}{9} > 0. \quad (1)$$

Let  $\pi_m^a$  denote the MNF's profit in the host country.  $\pi_m^a$  is equal to zero as the MNF will not be involved in production in the host country if it prefers not to invest in this country.

## 2.2 Greenfield investment

The MNF can enter the host country by setting up a wholly-owned subsidiary. Let  $f_g$  denote the fixed costs of making a greenfield investment.<sup>11</sup> In this case, there will be three firms in the host country. Let  $\pi_i^g$  and  $\pi_j^g$  be the local firms' profits, and  $\pi_m^g$  the MNF's profit, where superscript *g* refers to greenfield.

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<sup>9</sup>The model concentrates on horizontal FDI in which the main motivation is to serve consumers in a host country.

<sup>10</sup>The results given in this section as well as in the next section are standard, so the proofs are not included in the Appendix.

<sup>11</sup>See Horstmann and Markusen (1996) and Helpman *et al.* (2004) for discussions of the fixed costs of a greenfield investment.

The Cournot game between firms results in the profit levels given by equations (2) and (3):

$$\pi_i^g = \pi_j^g = \frac{(1 - 2c + c^*)^2}{16} > 0, \quad (2)$$

$$\pi_m^g = \frac{(1 - 3c^* + 2c)^2}{16} - f_g \begin{matrix} \geq \\ < \end{matrix} 0. \quad (3)$$

Note that the profitability of the greenfield type of entry depends directly on the extent of fixed costs (i.e.,  $\partial_{f_g} \pi_m^g < 0$ ).  $\pi_m^g$  given by equation (3) takes *non-negative* values for  $f_g \leq (1 - 3c^* + 2c)^2/16$  and *non-positive* values for  $f_g \geq (1 - 3c^* + 2c)^2/16$ . If the MNF undertakes greenfield investment, local competition will be tougher as the number of firms increases in the host country, and one firm, the MNF, is more efficient than the local firms.<sup>12</sup> Hence, there will be an increase in total production, which will reduce the local price. Local firms will be negatively affected by the entry of a more efficient firm.

### 3 Joint venture

The MNF has the option to form a joint venture with a local firm, if it does not want to undertake a greenfield investment. To form a joint venture, the MNF offers a contract to a local firm to share profits. The local joint venture partner is not required to make side payments to the MNF. This contract can be seen as a profit-sharing agreement. The MNF is presumed to have a lack of knowledge of the host country-specific business environment, as this investment is assumed to be its first-time entry to this country. According to the contract, the MNF will enable the joint venture partner to use its more efficient technology. In return, it will get access to its local partner's country-specific knowledge (e.g., customs, government regulations, market access and access to particular distribution channels); see, for example Chowdhury and Chowdhury (2002). Therefore, the cooperation between the MNF and a local firm creates synergies that enhance the efficiency of both parties. The local joint venture partner will be able to reduce its marginal cost after the joint venture, because both firms' assets can be combined in the joint venture.

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<sup>12</sup>Irrespective of the type of foreign entry, local firms are assumed to make *positive* profits. This restricts the extent of the MNF's cost advantage over the local firms; that is, the MNF and the local firms are not too different in terms of cost structure.

In this case, only two local firms are active in the market and the joint venture is more productive than the other local firm. Let  $\theta = (\theta_i, \theta_j)$  denote the marginal cost of a joint venture, where  $\theta \ll c$ . Equations (4) and (5) give the profit levels obtained by the Cournot duopoly game (see *Appendix A.1* for details):

$$\pi^v = \frac{(1 - 2\theta + c)^2}{9} > 0, \quad (4)$$

$$\pi^e = \frac{(1 - 2c + \theta)^2}{9} > 0. \quad (5)$$

Note that  $\pi^v$  represents the profit of the joint venture and  $\pi^e$  is the other firm's profit. Suppose that firm  $i$  has become the joint venture partner of the MNF. Equations (4) and (5) become  $\pi^v(\theta_i) = (1 - 2\theta_i + c)^2/9$  and  $\pi_j^e = (1 - 2c + \theta_i)^2/9$ , respectively. The comparison of  $\pi^v(\theta_i)$  and  $\pi_j^e$  with equation (1) posits that the joint venture's profit is higher than the joint profits of individual firms in autarky (i.e.,  $\pi^v(\theta_i) > \pi_i^a$ ). But the firm producing relatively less efficiently will be negatively affected (i.e.,  $\pi_j^e < \pi_j^a$ ). There will be an increase in aggregate production as the increase in total production of partner firms resulting from a joint venture will be high enough to compensate for the *negative* impact on the production of the other firm. Therefore, the price of the homogeneous good will decrease.

The net return to the MNF depends on the size of the technology improvement as it contributes to its local partner's profit. Let  $\pi_m^v$  denote the MNF's profit in the case that it forms a joint venture. It is mainly the remaining amount of the total joint venture profit given by equation (4) after the MNF's local partner has retained its profit. Therefore, the net return from involvement in a joint venture to the MNF's local partner will be  $\pi_i^v = [\pi^v(\theta_i) - \pi_m^v]$ . The MNF's problem is to maximize the net return to its investment project.

The MNF prefers a greenfield investment to staying out if the net return of a greenfield investment,  $\pi_m^g$  given by equation (3), is *non-negative*. If both  $\pi_m^g$  and  $\pi_m^v$  are *non-negative* profits, the MNF prefers a joint venture if its profit in the joint venture is higher than the profit a subsidiary of the MNF would make. Otherwise, it makes a greenfield investment. It is also possible that setting up a new plant in the host country requires high fixed costs, which may result in *negative* profits under greenfield investment. If this is the case, the MNF opts for a joint venture as long as  $\pi_m^v$  is *non-negative*. Therefore, the size of  $\pi_m^v$  becomes crucial for the MNF when selecting its ownership mode. The following section determines  $\pi_m^v$  by an auction.

### 3.1 Private values, second-price sealed-bid auction

As is usual in the literature, the amount of private information that each firm holds is defined by its *type*. Since the productivity of a joint venture is private information of the local firms, let the marginal cost of a joint venture represent the local firm's type (e.g.,  $\theta_i$  represents firm  $i$ 's type).<sup>13</sup> Each local firm knows the realization of the joint venture's marginal cost if it is the local joint venture partner, but this is not known by the rival local firm or by the MNF.<sup>14</sup> However, the distribution of  $\theta$  is common knowledge. To keep the model as simple as possible,  $\theta$  is assumed to be *uniformly distributed* over the interval  $(0, \bar{\theta})$  where  $\bar{\theta} \leq (2c + 3c^* - 1)/4$ . This restriction on  $\bar{\theta}$  guarantees *negative externalities* irrespective of  $\theta$ . To find a local joint venture partner, the MNF negotiates simultaneously with both firms and invites offers; this is strategically equivalent to an *auction*.

There are many formats by which this auction could be run. As the expected revenues coincide for all formats, I consider the simplest auction format, that is, a *second-price sealed-bid* auction. In this type of auction, each firm independently submits a single bid without seeing the other's bid. The local firms are assumed to be risk-neutral. The firm making the highest bid becomes the joint venture partner and pays the second-highest bid. Note that local firms' bids represent their willingness to pay to share the total joint venture profit with the MNF. Therefore,  $\pi_m^v$  will be the runner-up's willingness to pay. As discussed later, a local firm's willingness-to-pay depends on its own type and shows how much this firm values forming a joint venture with the MNF. Local firms' valuations are assumed to be symmetric, independently drawn from an identical, common and strictly increasing distribution. In a second-price sealed-bid auction with symmetric, independent and identically distributed private-values, it is optimal for a firm to bid its true value irrespective of what the other firm does.<sup>15</sup>

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<sup>13</sup>Firm  $i$  is a *good-type* (*bad-type*) firm relative to firm  $j$  if  $\theta_i < \theta_j$  ( $\theta_i > \theta_j$ ).

<sup>14</sup>The joint venture's marginal cost is the local firms' private information at the time of the auction, but will be revealed after the auction. The revelation assumption allows me to figure out the optimal entry mode of the MNF without assigning any probabilities to the realization of firms' true types. If the local firms' types were to remain private information even after the auction, we would have *Bayesian equilibria* without further insights such that the local firms would determine their equilibrium production levels according to their beliefs about their opponent's type, and hence the equilibrium profit levels given by equations (4) and (5) would change to include beliefs about opponents' types.

<sup>15</sup>Suppose that firm  $i$  bids *less* than its true value (i.e.,  $\forall \varepsilon > 0; b_i = v_i - \varepsilon$ ). If firm  $j$ 's bid,  $b_j$ , is lower than firm  $i$ 's bid (i.e.,  $v_i - \varepsilon > b_j$ ), firm  $i$  wins the auction and pays  $b_j$ , just as if it bids  $v_i$ . If  $b_j > v_i$ , firm  $i$  loses, just as if it bids  $v_i$ . But if  $v_i > b_j > v_i - \varepsilon$ , bidding  $v_i - \varepsilon$  causes firm  $i$

The benchmark case for the auction is determined by the *credibility* of alternative options. For instance, if greenfield investment is not a credible entry mode (i.e.,  $\pi_m^g \leq 0 = \pi_m^a$ ), the outside strategy will be the benchmark case, because the MNF will stay out of the host country if it prefers not to form a joint venture or if forming a joint venture fails for another reason. Similarly, if greenfield investment is a credible outside option (i.e.,  $\pi_m^g > \pi_m^a = 0$ ), the benchmark case will be greenfield investment, because the MNF will make a greenfield investment if it is not successful in forming a joint venture with one of the local firms. Hence, I have to distinguish these two cases.

**Case 1** *Greenfield investment is not profitable:*

In this case, fixed costs are sufficiently high (i.e.,  $f_g \geq (1 - 3c^* + 2c)^2/16$ ) resulting in a *non-positive*  $\pi_m^g$  given by equation (3). If this is the case, the MNF prefers to stay out unless it forms a joint venture. Let  $b_i$  and  $b_j$  denote firm  $i$ 's and firm  $j$ 's maximum willingness to pay, respectively. If firm  $i$  is willing to pay  $b_i$  to the MNF as the joint venture profit, its profit change will be  $[\pi^v(\theta_i) - b_i] - \pi_i^a$ . If firm  $j$  forms a joint venture with the MNF, firm  $i$ 's profit change will be  $[\pi_i^e - \pi_i^a]$ . Firm  $i$ 's maximum willingness to pay will be the amount that makes it indifferent between these two changes (i.e.,  $[\pi^v(\theta_i) - b_i] - \pi_i^a = [\pi_i^e - \pi_i^a]$ ). Solving this indifference condition for  $b_i$  gives firm  $i$ 's maximum willingness to pay such that  $b_i = [\pi^v(\theta_i) - \pi_i^e]$ . Similarly, firm  $j$ 's maximum willingness to pay will be  $b_j = [\pi^v(\theta_j) - \pi_j^e]$ .

**Case 2** *Greenfield investment is profitable:*

If fixed costs are sufficiently low (i.e.,  $f_g < (1 - 3c^* + 2c)^2/16$ ) such that  $\pi_m^g$  given by equation (3) is positive, staying out will not be credible. The MNF rather makes a greenfield investment as  $\pi_m^g > \pi_m^a$ . In this case, firm  $i$ 's profit change will be  $[\pi^v(\theta_i) - b_i] - \pi_i^g$  if it forms the joint venture by paying the MNF at its maximum willingness-level, and  $[\pi_i^e - \pi_i^g]$  if the MNF forms a joint venture with the other

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to lose the auction, whereas if it had bid  $v_i$ , it would have won the auction and paid  $b_j$  for a net surplus of  $v_i - b_j$ . So, firm  $i$  never gains, but might lose if it bids  $v_i - \varepsilon$ , which is less than its true value. Suppose that firm  $i$  bids *more* than its true value (i.e.,  $\forall \varepsilon > 0; b_i = v_i + \varepsilon$ ). If  $v_i + \varepsilon > b_j$ , firm  $i$  wins and pays  $b_j$ , just as if it bids  $v_i$ . If  $b_j > v_i + \varepsilon$ , it loses and pays nothing, just as if it bids  $v_i$ . But, if  $v_i + \varepsilon > b_j > v_i$ , bidding  $v_i + \varepsilon$  causes firm  $i$  to win the auction, but makes itself pay higher than its true value (i.e.,  $b_j > v_i$ ), which results in *negative surplus*. If it had bid its true value, it would have lost which would have resulted in zero surplus, which would have been better than a negative surplus. So, bidding  $v_i + \varepsilon$  may hurt firm  $i$  compared with bidding  $v_i$ , but it never helps (Krishna 2002; Klemperer 2004).

firm. Consequently, firm  $i$  will be indifferent for  $b_i = [\pi^v(\theta_i) - \pi_i^e]$ , and so will firm  $j$  for  $b_j = [\pi^v(\theta_j) - \pi_j^e]$ . Note that maximum willingness to pay does not depend on the profitability of credible options. This is because each firm's maximum willingness to pay represents how much that firm values forming a joint venture with the MNF. Each firm's value changes with its own type, because information about the added efficiency that each firm will gain by forming a joint venture is embedded in each firm's type  $\theta$ . This leads to *Proposition 1* where each firm's equilibrium bid is determined.

**Proposition 1** *Firm  $i$  and firm  $j$  bid  $b_i(\theta_i)$  and  $b_j(\theta_j)$  respectively, where  $b_i(\theta_i) = [\pi^v(\theta_i) - \pi_i^e(\theta_i)]$  and  $b_j(\theta_j) = [\pi^v(\theta_j) - \pi_j^e(\theta_j)]$ .*

**Proof.** Let firm  $i$  be the *good*-type firm relative to firm  $j$  (i.e.,  $\theta_i < \theta_j$ ). If both firms bid according to *Proposition 1*, firm  $i$  will win and pay the amount firm  $j$  has bid as  $b_i(\theta_i) > b_j(\theta_j)$  since  $\partial_{\theta_i} b_i(c, \theta_i) < 0$  and  $\partial_{\theta_j} b_j(c, \theta_j) < 0$ .

Now, let  $\hat{\theta}_j$  be firm  $i$ 's anticipation of firm  $j$ 's type such that  $\theta_i \leq \hat{\theta}_j < \bar{\theta}$ . And let firm  $i$  bid according to  $b_i(\theta_i, \hat{\theta}_j)$  in which  $\pi_i^e$  depends on  $\hat{\theta}_j$ . This is simply firm  $i$  bidding any amount *less* than that stated in *Proposition 1* (i.e.,  $b_i(\theta_i, \hat{\theta}_j) \leq b_i(\theta_i)$ ) as  $\theta_i \leq \hat{\theta}_j$  and  $\partial_{\hat{\theta}_j} b_i(\theta_i, \hat{\theta}_j) < 0$ . If  $b_j(\theta_j) < b_i(\theta_i, \hat{\theta}_j) \leq b_i(\theta_i)$ , firm  $i$  wins and pays  $b_j(\theta_j)$ , just as if it bids  $b_i(\theta_i)$ . But if  $b_i(\theta_i, \hat{\theta}_j) < b_j(\theta_j) < b_i(\theta_i)$ , bidding  $b_i(\theta_i, \hat{\theta}_j)$  causes firm  $i$  to lose the auction, whereas if it had bid  $b_i(\theta_i)$ , it would have won and paid  $b_j(\theta_j)$  for a net surplus. So, firm  $i$  never gains, but might lose if it bids less than  $b_i(\theta_i)$ . Note that there is no possibility that firm  $i$  bids more than  $b_i(\theta_i)$ , as  $b_i(\theta_i)$ , by definition, is the maximum amount that guarantees a *non-negative* net surplus.

■

Although both  $\pi^v$ , given by equation (4), and  $\pi^e$ , given by equation (5), depend on the *winner*'s type, each firm's equilibrium bid depends only on its *own* type. A firm would never gain by bidding less than its maximum willingness to pay, but might lose, as the amount it would pay if it won would not be the amount it had bid, but the amount its opponent had bid. Therefore, both firms prefer to bid as high as they can as long as their bid guarantees a *non-negative* surplus, which is for each firm to consider  $\pi^e$  given by equation (5) depending on its own type at the time of the auction and to bid according to *Proposition 1*.

By holding an auction, the MNF avoids the *lemon's problem* such that it always picks a relatively efficient firm. This is an implication of the fact that a firm's maximum willingness to pay is negatively related to its own type. The more

productive the joint venture, the higher the local firm's bid. Therefore, the MNF can pick a *good*-type firm via the *auction* because the winner will be the firm making the higher bid, that is, the firm making the joint venture most productive. Given that firms bid according to *Proposition 1*, the MNF has to compare the second-highest bid with the profit it can make with its alternative outside option; this leads the MNF to its preferred mode of entry, which is indicated in *Lemma 1*.

**Lemma 1** *Both firms submit positive bids such that  $b_i(\theta_i) = [\pi^v(\theta_i) - \pi_i^e(\theta_i)] > 0$  and  $b_j(\theta_j) = [\pi^v(\theta_j) - \pi_j^e(\theta_j)] > 0$ :*

*Let  $\min\{b_i, b_j\}$  represent the second-highest bid in the auction, which is the MNF's joint venture profit such that  $\pi_m^v = \min\{b_i, b_j\}$ ;*

*i) If  $f_g \geq (1 - 3c^* + 2c)^2/16$ , the MNF forms a joint venture as  $\pi_m^v > \pi_m^a = 0$ ,*

*ii) If  $f_g < (1 - 3c^* + 2c)^2/16$ , the MNF forms a joint venture as  $\forall \theta_n \in (0, \bar{\theta})$ ,  $\pi_m^v > \pi_m^g$ , where  $n = (i, j)$ .*

**Proof.** I want to show  $\forall \theta_n \in (0, \bar{\theta})$ ,  $\pi_m^v > \pi_m^g$ , where  $n = (i, j)$ . I know from equation (5) and equation (2) that  $\forall \theta_n \in (0, \bar{\theta})$ ,  $\pi_n^e < \pi_n^g$ . I also know that  $\forall \theta_n \in (0, \bar{\theta})$ ,  $\pi^v(\theta_n) \geq \pi_m^g + \pi_n^g$ . Rearranging the last expression will imply  $\pi^v(\theta_n) - \pi_n^g \geq \pi_m^g$ . Now I can show that  $\pi^v(\theta_n) - \pi_n^e > \pi^v(\theta_n) - \pi_n^g \geq \pi_m^g$  as  $\pi_n^e < \pi_n^g$ . By definition,  $b_n(\theta_n) = \pi^v(\theta_n) - \pi_n^e(\theta_n)$ , which allows me to write  $b_n(\theta_n) > \pi_m^g$ . This last expression tells me that any bid will be more than the MNF's greenfield profit. Therefore, I can write  $\max\{b_i, b_j\} \geq \min\{b_i, b_j\} = \pi_m^v > \pi_m^g$ . ■

*Lemma 1* posits that a joint venture dominates greenfield investment in both cases. Consequently, the MNF prefers *partial ownership* if there is asymmetric information, if the joint venture negatively affects the local rival competing against the joint venture, and if the MNF selects the joint venture partner by an auction. Although the result presented so far is derived from a second-price sealed-bid auction, any auction mechanism yields the same result, because the MNF's expected revenue (the net return from the auction) is on average the same. This is known as the *Revenue Equivalence Theorem*. According to this theorem, if the bidders are risk-neutral and if they have privately known values independently and identically drawn from a common and strictly increasing distribution, any symmetric equilibrium of any standard auction, in which the expected payment of the bidder with the lowest value is zero and the bidder with the highest value wins, yields the same expected revenue for the seller (Vickrey 1961; Milgrom and Weber 1982; McAfee and McMillan 1987;

Milgrom 1989; Krishna 2002; Klemperer 2004). Therefore, according to this model, if there is no restriction on entry type, the MNF opts for a joint venture instead of a greenfield investment as a result of any standard auction mechanism (e.g., a first-price sealed-bid, a second-price sealed-bid, or an ascending or a descending auction) by which the net return from involvement in the joint venture to the MNF is determined. However, the host country might want to put a restriction on the type of foreign entry. In the next section, I look at the issue from the host country's standpoint and examine the nationally optimal entry mode.

## 4 The nationally optimal entry mode

The analysis, up until this point, has not been concerned with the possibility of any restriction on any type of foreign entry. However, if the MNF's preference on its entry mode is expected to reduce initial welfare or to reduce welfare relative to an available alternative entry mode, the host country may prefer to put a restriction on the foreign firm's mode of entry to improve local welfare. Therefore, in this section, I first scrutinize the welfare implications of a greenfield investment and compare the results with welfare in autarky. Following that, I derive the expected welfare implications of a joint venture depending on  $\bar{\theta}$  and illustrate a specific case where the marginal cost of the joint venture is distributed over the interval in which the upper bound is maximized for a *negative externality*, that is,  $\bar{\theta} = (2c + 3c^* - 1) / 4$ .

Let there be a local social planner, who aims to maximize local welfare. Local welfare ( $W$ ) is defined as the sum of consumer surplus and total profits of domestic firms. Equation (6) gives the functional form of  $W$ :

$$W = \left[ \frac{1}{2} (q_m + q_i + q_j)^2 + \pi_i + \pi_j \right]. \quad (6)$$

Let  $W^a$  and  $W^g$  denote local welfare if the host country is in autarky and if the MNF makes a greenfield investment, respectively. There is no uncertainty when computing  $W^a$  and  $W^g$  as both depend on the parameters  $c$  and  $c^*$ , which are common knowledge. The functional forms of  $W^a(c)$  and  $W^g(c, c^*)$  computed according to equation (6) are given by equations (7) and (8) respectively (see *Appendix A.2* for details):

$$W^a = \left[ \frac{4}{9} (1 - c)^2 \right], \quad (7)$$

$$W^g = \left[ \frac{3}{8}(1-c)^2 + \frac{1}{32}(1-c^*)^2 + \frac{1}{8}(c-c^*)^2 - \frac{1}{8}(1-c)(c-c^*) \right]. \quad (8)$$

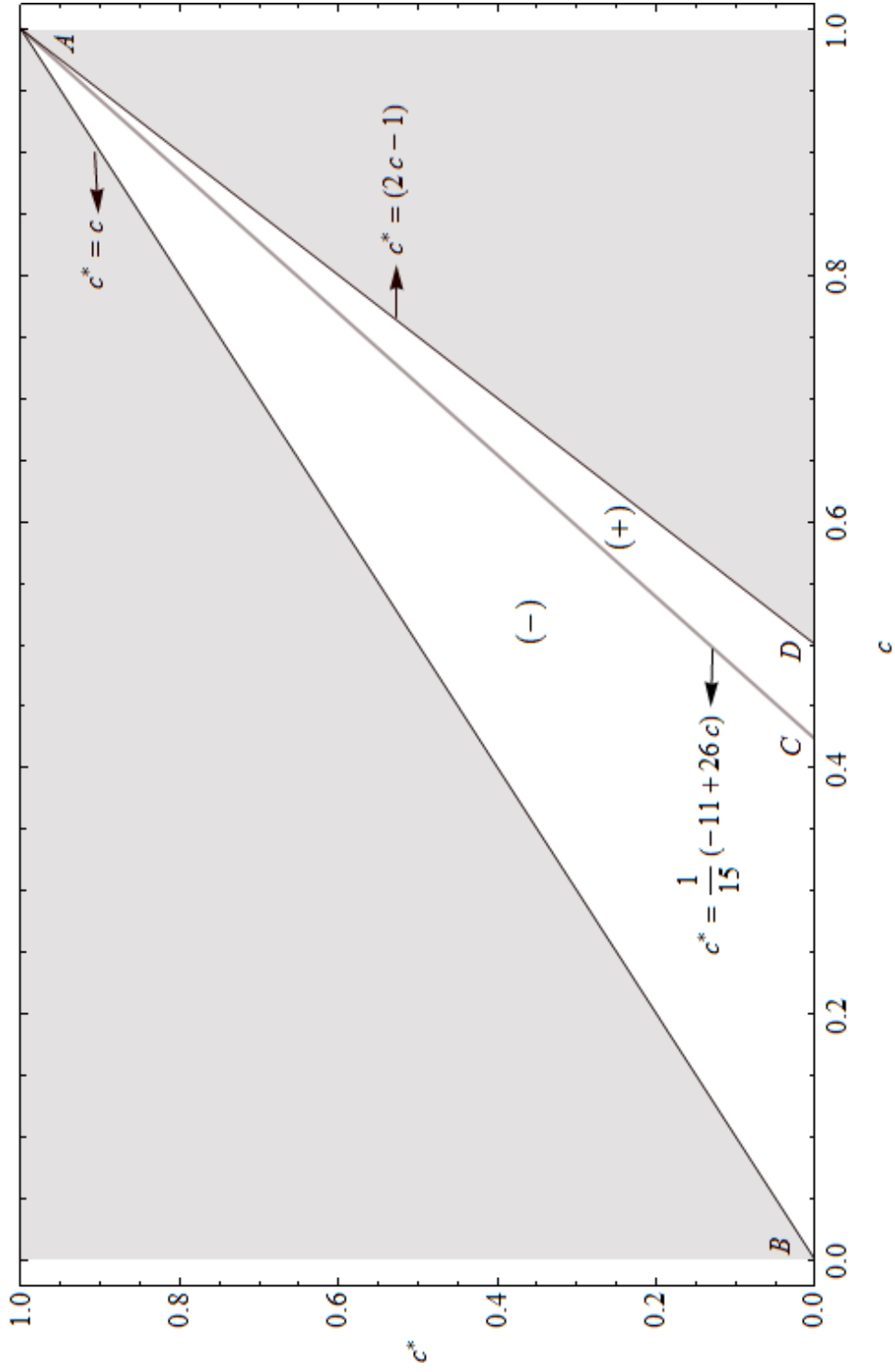
When is greenfield investment welfare-improving compared with autarky? To answer this question, I denote by  $W_a^g$  the welfare change relative to autarky when the MNF makes a greenfield investment. It is simply the difference between  $W^g$  given by equation (8) and  $W^a$  given by equation (7) and it depends on the parameters  $c$  and  $c^*$ . Then, I set  $W_a^g$  equal to zero and solve the function for  $c^*$  which gives another function  $c^*(c)$  representing the locus  $W_a^g(c, c^*) = 0$ . I simulate  $c^*(c)$  according to parameter values and illustrate this function in *Figure 1* along with the model's assumptions.

In *Figure 1*, the area to the left above the line  $AB$  is not available as the MNF has a cost advantage over the local firms (i.e.,  $c > c^*$ ). Additionally, the area to the right below the line  $AD$  is not available as greenfield entry does not lead to local firms exiting (i.e.,  $c^* > (2c - 1)$ ; see equation (2)). Therefore, I should consider the area given by triangle  $ABD$ . The simulated function  $c^*(c)$  is represented by the line  $AC$ .  $W^g$  is equal to  $W^a$  along this line. In the area given by triangle  $ABC$ , local welfare is decreasing due to greenfield investment as  $\partial_c W_a^g(c, c^*) > 0$ , as well as  $\partial_{c^*} W_a^g(c, c^*) < 0$  for  $c^* \leq (-11 + 26c)/15$ . Similarly, greenfield investment is welfare-improving in the area given by triangle  $ACD$ . It is clear from *Figure 1* that greenfield investment may increase local welfare if the local firms are less productive and if the MNF is more productive. However, greenfield investment is likely to reduce welfare if the MNF and the local firms are similar in their production costs.

#### 4.1 Welfare implications of a joint venture

Let  $W^v$  denote local welfare when the MNF enters the host country by forming a joint venture. The local social planner has to form an expectation over  $W^v$  as it depends on the marginal cost of a joint venture, which is private information. Let  $E[W^v]$  denote the expected value of  $W^v$ .  $E[W^v]$  can be expressed as a function of  $\bar{\theta}$ , as the expectation of  $\theta$  depends on  $\bar{\theta}$ , because it is uniformly distributed over the interval  $(0, \bar{\theta})$ , where  $\bar{\theta} \leq (2c + 3c^* - 1)/4$ . The functional form of  $E[W^v]$  computed according to equation (6) is given by equation (9) (see *Appendix A.2* for details):

$$E[W^v] = \left[ \frac{1}{108} (48 + 102c^2 + (32 - 7\bar{\theta})\bar{\theta} - 4c(30 + 7\bar{\theta})) \right]. \quad (9)$$



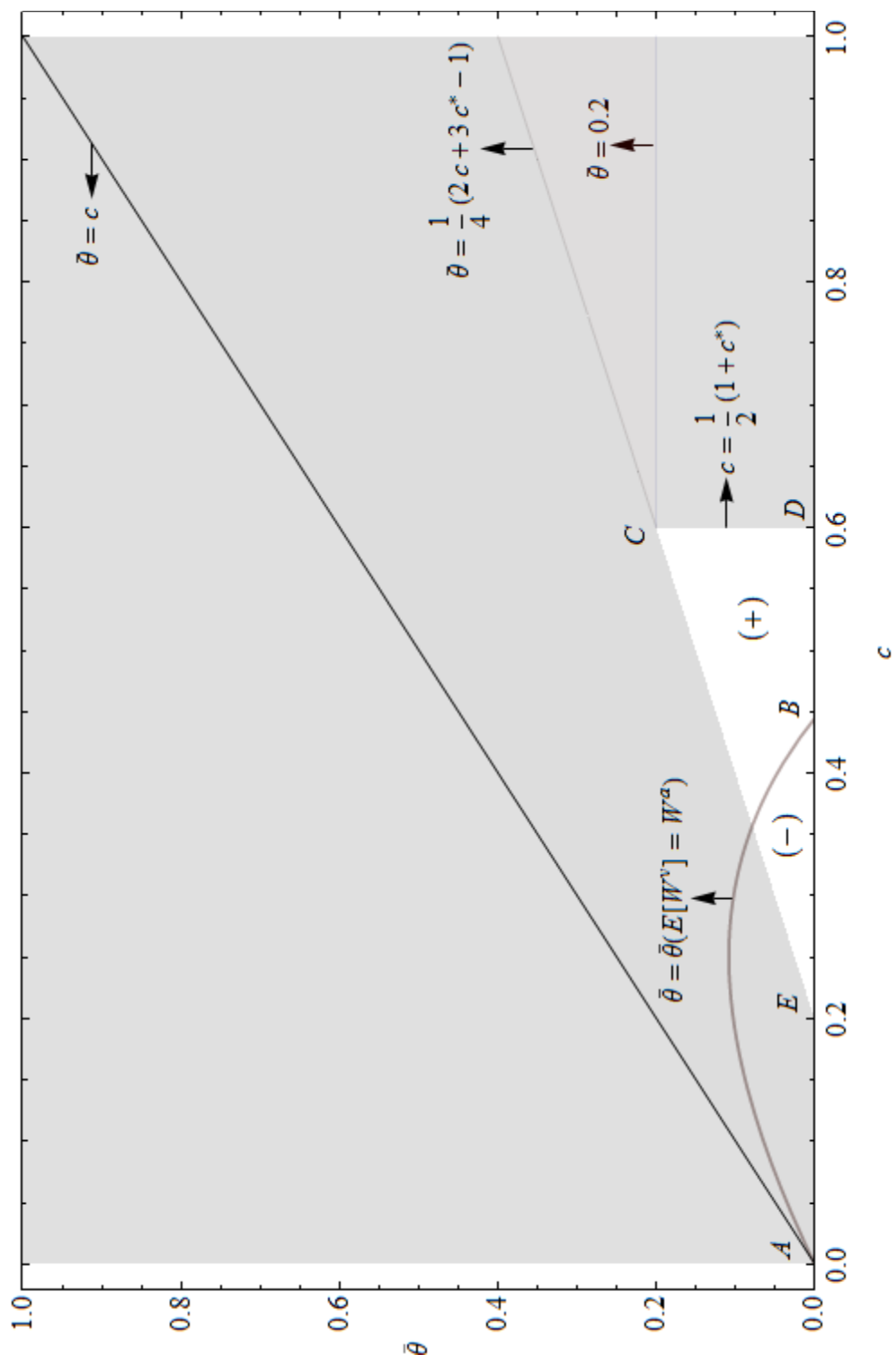
**Figure 1** Welfare Change (Greenfield Investment vs Autarky).

The change in equation (9) with  $\bar{\theta}$  is crucial as it affects  $E[W^v]$ . I find that  $\partial_{\bar{\theta}}E[W^v] > 0$ , that is, the higher is the upper limit of the interval over which  $\theta$  is distributed, the higher is local welfare if the MNF forms a joint venture. The intuition is as follows: if  $\theta$  is uniformly distributed on a wider interval, a joint venture is expected to be less productive as the expected value of  $\theta$  increases with an increase in  $\bar{\theta}$ . The expected consumer surplus strictly decreases with  $\bar{\theta}$ , whereas the local firms' expected total profits increase at a decreasing rate. The social planner expects the price to decrease less because the probability that a joint venture is relatively more efficient decreases with an increase in  $\bar{\theta}$ , which explains the decrease in the expected consumer surplus when  $\bar{\theta}$  increases. Similarly, the social planner expects the negative impact of a joint venture on the other firm's profit to be less severe as the joint venture is now less productive. So, the negatively affected firm's profit is expected to increase relatively. Although the joint venture profit is anticipated to decrease with an increase in  $\bar{\theta}$ , the net profit of the MNF's local partner is expected to increase as the bids are expected to decrease by more than the decrease in the expected joint venture profit.

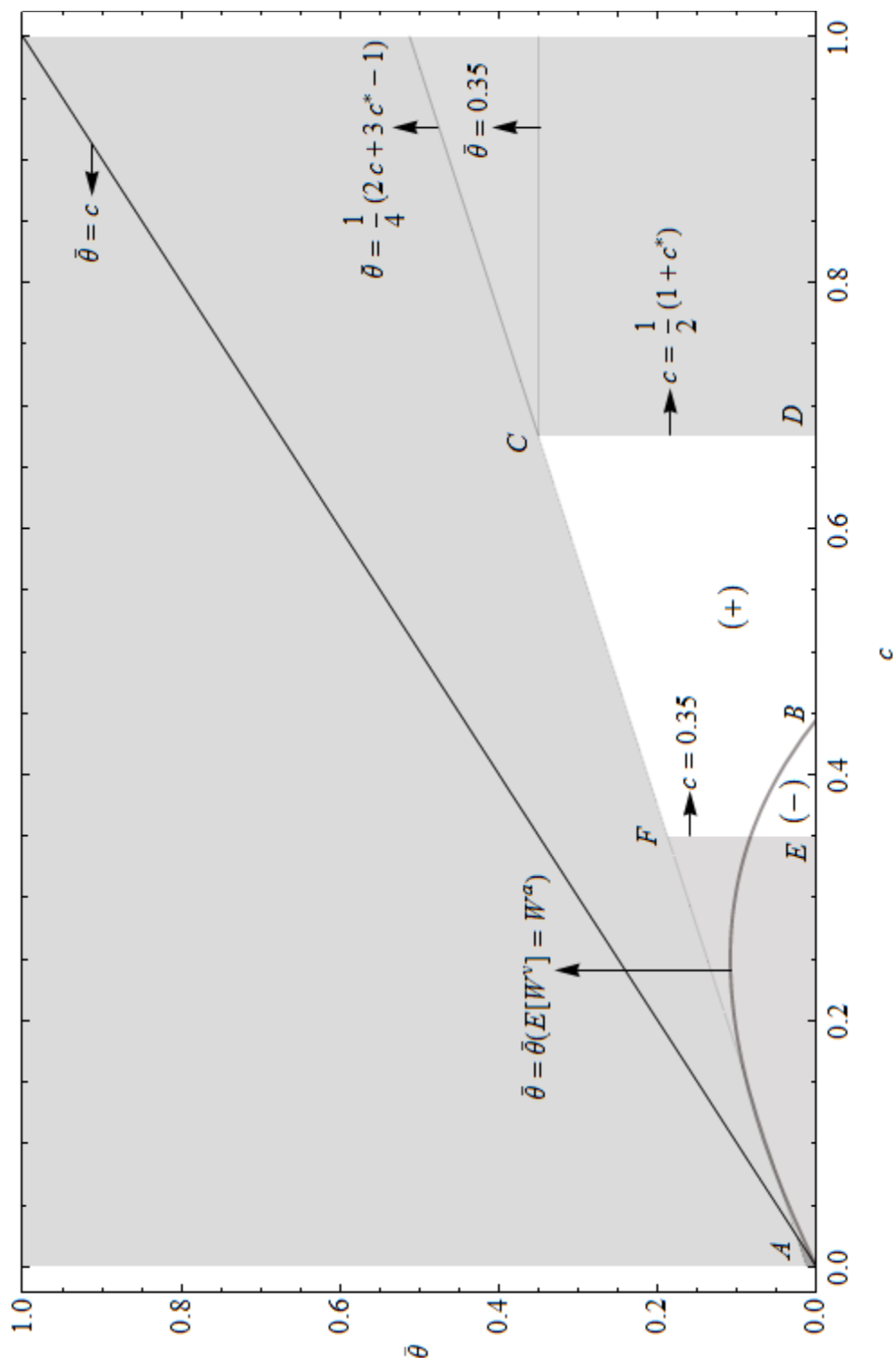
In order to compare  $E[W^v]$  with  $W^a$ , I take the difference between equations (9) and (7). I set the result equal to zero and solve for  $\bar{\theta}$ , which yields the function  $\bar{\theta}(c, c^*)$ . I simulate  $\bar{\theta}(c, c^*)$  according to parameter values and illustrate this function in *Figures 2* and *3* along with the model's assumptions. I fix  $c^*$  at 0.2 in *Figure 2* and at 0.35 in *Figure 3*.

In both figures, the simulated function  $\bar{\theta}(c, \cdot)$  is given by  $\widehat{AB}$ . Along  $\widehat{AB}$ ,  $E[W^v]$  is equal to  $W^a$ . The change in welfare is negative below  $\widehat{AB}$ , whereas it is positive above  $\widehat{AB}$ . However, the model puts a restriction on  $\bar{\theta}$  such that  $\bar{\theta} \leq (2c + 3c^* - 1)/4$ , which is represented by the area to the right below the line  $CE$  in *Figure 2* and  $AC$  in *Figure 3*. Note that  $\forall c, c^*, (2c + 3c^* - 1)/4 < c^*$  implying that  $\bar{\theta}$  is less than 0.2 in *Figure 2* and less than 0.35 in *Figure 3*. It also implies that there exists an upper limit of  $c$  such that  $c < (1 + c^*)/2$ . The upper limit is represented by point  $D$  in both figures. In *Figure 3*, the area to the right of the line  $EF$  represents the area in which the MNF has a cost advantage over the local firms such that  $c^* < c$ . Consequently, the area  $CDE$  in *Figure 2* and  $CDEF$  in *Figure 3* are under consideration. It is clear from both figures that a joint venture is welfare-reducing for some values of  $\bar{\theta}$  and welfare-improving for some other values.

In *Figure 3*, a joint venture is always welfare-improving if  $\bar{\theta} = (2c + 3c^* - 1)/4$ . This is the most optimistic scenario such that the MNF is not too strong and that the negative impact of a joint venture on a local rival's profit is minimized. In this



**Figure 2** Welfare Change (Joint Venture vs Autarky),  $c^* = 0.2$ .



**Figure 3** Welfare Change (Joint Venture vs Autarky),  $c^* = 0.35$ .

case,  $E[W^v]$  is maximized. This special case is generalized to any level of  $c$  and  $c^*$  and illustrated below.

***Illustration*** :  $\bar{\theta} = (2c + 3c^* - 1) / 4$

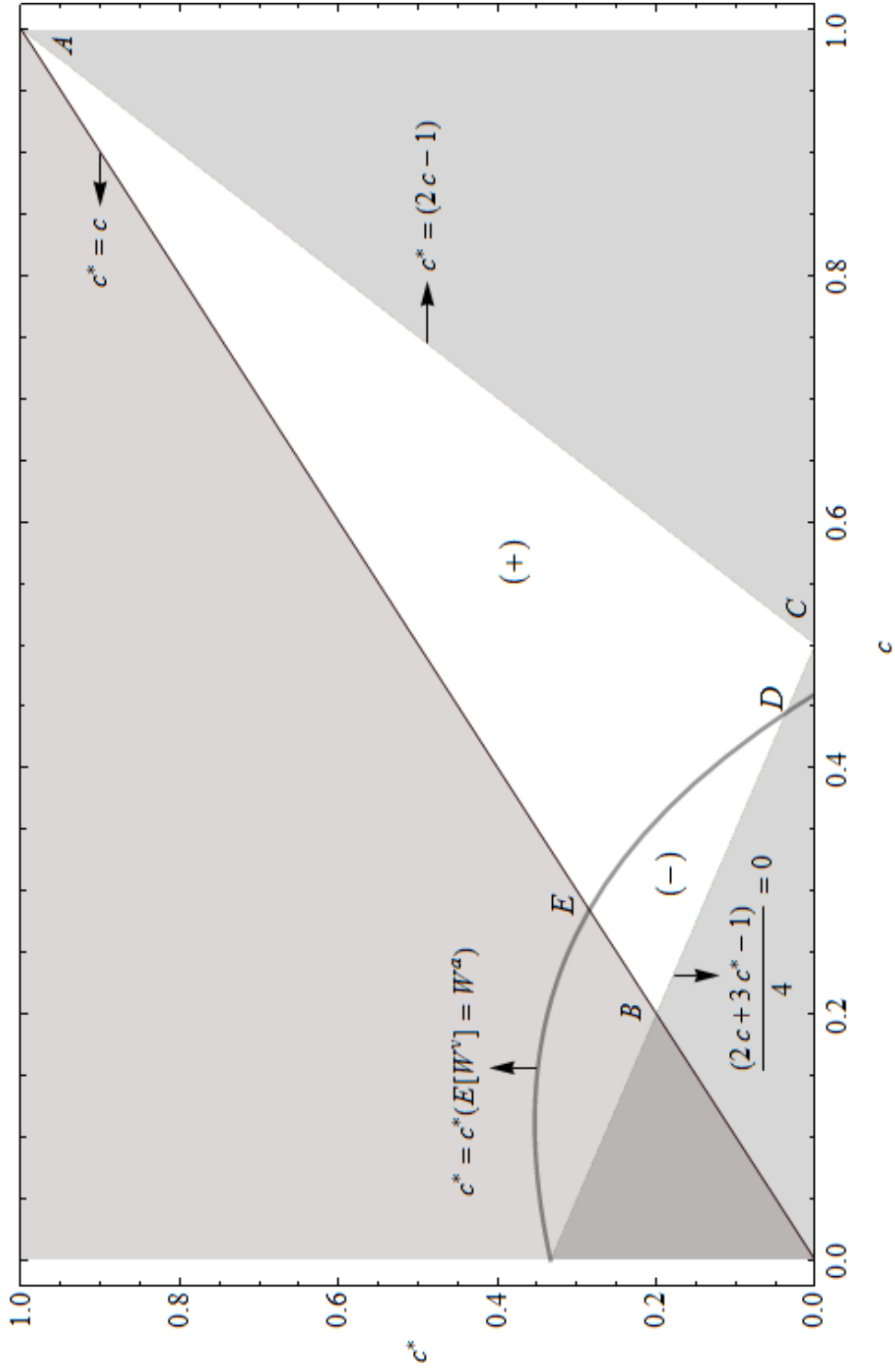
$E[W^v]$  can be characterized by  $c$  and  $c^*$  only in this case, as the expectation of  $\theta$  depends on  $c$  and  $c^*$ , because it is uniformly distributed over the interval  $(0, \bar{\theta})$  where  $\bar{\theta} = (2c + 3c^* - 1) / 4$ . The functional form of  $E[W^v]$  computed according to equation (6) is given by equation (10) (see *Appendix A.2* for details):

$$E[W^v] = \frac{1}{18} \left( (8 + 17c^2 - 20c) + \frac{(16 - 14c)(2c + 3c^* - 1)}{12} - \frac{7(2c + 3c^* - 1)^2}{96} \right). \quad (10)$$

Let  $E[W_a^v]$  denote the expected welfare change relative to autarky when the MNF forms a joint venture. It is the difference between  $E[W^v]$  given by equation (10) and  $W^a$  given by equation (7). The solution to  $E[W_a^v] = E[W^v] - W^a$  is given by equation (11):

$$E[W_a^v] = \frac{1}{18} \left( (9c^2 - 4c) + \frac{(16 - 14c)(2c + 3c^* - 1)}{12} - \frac{7(2c + 3c^* - 1)^2}{96} \right). \quad (11)$$

Compared with autarky, local competition increases as a result of a joint venture, which decreases the price and increases consumer surplus. Local competition increases not because the number of firms increases, but because one local firm becomes relatively efficient after it has formed a joint venture with the MNF. Hence, its profit increases, which increases local welfare. However, the other firm is negatively affected and its profit decreases relative to its autarky level, which reduces local welfare. The MNF also transfers a particular fraction of the joint venture profit to its *country-of-origin* which has a *negative* impact on local welfare. Consequently, the net effect of a joint venture type of entry on local welfare is ambiguous and depends on parameter values. In order to see how different parameter values change  $E[W_a^v]$ , equation (11) is set equal to zero and solved for  $c^*$ , which gives the function  $c^*(c)$  characterizing the locus  $E[W_a^v] = 0$ . The function  $c^*(c)$  is simulated according to parameter values between  $(0, 1)$  and illustrated in *Figure 4* along with the model's assumptions.



**Figure 4** Welfare Change (Joint Venture vs Autarky),  $\bar{\theta} = (2c + 3c^* - 1)/4$ .

There are three assumptions restricting the parameter values, and hence these are illustrated explicitly in *Figure 4*. The first assumption is  $c^* < c$ , so I am interested in the area to the right and below the 45°-line as this line shows the locus  $c = c^*$ . The second assumption is  $(2c + 3c^* - 1) / 4 > 0$ , so I am interested in the area above and to the right of the line given by  $(2c + 3c^* - 1) / 4 = 0$ . The last assumption is  $c^* > (2c - 1)$ , so I should consider the area above and to the left of the line given by  $c^* = (2c - 1)$ . Triangle *ABC* shows the region under consideration. Note that the thick-gray curve is the simulated function  $c^*(c)$ . Along this curve,  $E[W_a^v] = 0$ . Since the change in expected welfare increases by  $c$  (i.e.,  $\partial_c E[W_a^v(c, c^*)] > 0$ ), in the area *ACDE*,  $E[W_a^v] > 0$  and in the area *BDE*,  $E[W_a^v] < 0$ . Therefore, it is not always the case that a joint venture improves the host country's welfare relative to autarky. For small values of  $c$  and  $c^*$ , a joint venture may reduce welfare.

I next compare a joint venture with greenfield investment. Let  $E[W_g^v]$  denote the expected welfare change relative to greenfield investment when the MNF forms a joint venture.  $E[W_g^v]$  is the difference between  $E[W^v]$  given by equation (10) and  $W^g$  given by equation (8). The solution to  $E[W_g^v] = E[W^v] - W^g$  is given by equation (12):

$$E[W_g^v] = \frac{1}{576} [-23 - 4c + 100c^2 + 106c^* + 76cc^* - 111(c^*)^2]. \quad (12)$$

Both greenfield investment and a joint venture increase local competition relative to autarky. An increase in local competition is due to changing *market structure* in the former, whereas it is due to *increasing productivity* of a local firm in the latter. Market structure changes with a greenfield investment as the number of firms increases by the entry of a relatively efficient firm. Production increases, which decreases the price. If the MNF forms a joint venture, there will be no change in market structure as only local firms will be active just as if the host country is in autarky. However, one local firm will be more productive with a joint venture and even more productive than the MNF's subsidiary would be. Production increases more with a joint venture, and hence the price decrease is greater. Therefore, local consumer surplus increases relative to the greenfield case. In addition to these effects, there is a *profit-shifting* effect in both types of entry. The profit-shifting effect decreases local producer surplus more in the joint venture case, because the MNF's profit is higher with a joint venture. However, the negative effect is minimized at  $\bar{\theta} = (2c + 3c^* - 1) / 4$ , because the MNF's profit decreases with  $\bar{\theta}$ . Consequently,  $E[W_g^v]$  is positive if the net effect of profit-shifting is compensated by the increase in consumer surplus.



Similar to the previous case, in order to assess the net effect,  $E[W_g^v]$  given by equation (12) is set equal to zero and solved for  $c^*$ . This gives the function  $c^*(c)$ , which represents the locus  $E[W_g^v] = 0$ . *Figure 5* illustrates the simulation of  $c^*(c)$  along with the model's assumptions.

In *Figure 5*, triangle  $ABC$  is the only region under consideration. It is determined by the parameter constraints  $c > c^*$ ,  $c^* > (2c - 1)$  and  $(2c + 3c^* - 1)/4 > 0$ . Note that the gray line is the simulated function  $c^* = (1 - 2c)/3$ . Along this line,  $E[W_g^v] = 0$ . In the area to the right above this line,  $E[W_g^v] > 0$  as  $\partial_c E[W_g^v(c, c^*)] > 0$ . Since  $c^* = (1 - 2c)/3$  along the gray line,  $c^* > (1 - 2c)/3$  above this line. Rearranging this inequality yields  $(2c + 3c^* - 1) > 0$ . This has already been imposed by the constraint  $(2c + 3c^* - 1)/4 > 0$ , which is the upper bound assigned to local firms' types. Consequently,  $E[W_g^v]$  is always positive irrespective of parameter values. A joint venture is always welfare-improving relative to a greenfield investment. However, this result holds only when  $\bar{\theta} = (2c + 3c^* - 1)/4$ , which is the best scenario a local planner could expect from a joint venture imposing a negative externality.

According to this illustration, the host country will not force the MNF to make a greenfield investment, because its welfare will be higher if the MNF forms a joint venture. As the MNF prefers a joint venture rather than a greenfield investment, there is no need to restrict either type of entry just to attain the preferred equilibrium market structure. However, relative to autarky, local welfare may decrease if both local firms have high productivity and if the MNF forms a joint venture with one of the two local firms. Finally, if the contribution of a joint venture to a local firm's efficiency is sufficiently large, the host country may prefer the MNF forming a joint venture as it is likely to improve local welfare relative to autarky.

## 5 Concluding remarks

In this study, I have examined why foreign firms have difficulties in choosing a local partner to jointly produce in a foreign country's market, especially when there is asymmetric information on prospective efficiency gains, and how foreign firms can overcome this problem. The motivation of this study is the following. We often observe that incumbent firms have better information on particular aspects of their home markets than a multinational firm that has no business experience in those markets. Furthermore, it is often more costly, or even not possible, for an outsider firm to learn the details of foreign markets. Therefore, in this study, I have provided

an alternative analytical framework and have examined a multinational firm's entry mode choice under uncertainty.

In particular, this study has brought two important theories together: the theory of auctions and the theory of multinational firms. It has modelled the selection of a joint venture partner under incomplete information by an auction and has shown that, in any efficient auction mechanism, a multinational firm prefers a joint venture to greenfield investment as long as the joint venture negatively affects the local firm, which is competing against the joint venture.

An interesting extension of the analysis in this paper could be to scrutinize the policy implications of this study. Furthermore, this study has concentrated on one-sided asymmetric information between local firms and the multinational firm. However, it might be interesting to extend it to a two-sided asymmetric information situation, because multinational firms may have private information as well that might be crucial for prospective efficiency gains in a joint venture, but might be unknown to local firms.

# Appendix A

## A.1 The Cournot Competition and Firms' Profits

### Joint ventures

If the MNF enters the host country by forming a joint venture, there will be only two active firms. Suppose that firm  $i$  becomes the MNF's joint venture partner. Firm  $i$ 's problem can be expressed by  $\max_{q_i} \pi_i$ , where  $\pi_i = (1 - q_i - q_j - \theta_i)q_i$ . Similarly, firm  $j$ 's problem can be expressed by  $\max_{q_j} \pi_j$ , where  $\pi_j = (1 - q_i - q_j - c)q_j$ . The first-order conditions  $\partial_{q_i} \pi_i = 0$  and  $\partial_{q_j} \pi_j = 0$  yield the reaction curves  $q_i(q_j) = (1 - q_j^* - \theta_i) / 2$  and  $q_j(q_i) = (1 - q_i^* - c) / 2$ . If firm  $j$  were to form a joint venture with the MNF,  $q_i(q_j)$  would be equal to  $(1 - q_j^* - c) / 2$  and  $q_j(q_i)$  would be equal to  $(1 - q_i^* - \theta_j) / 2$ .

Solving simultaneously the two-equation system by considering  $q_i = q_i^*$  and  $q_j = q_j^*$  yields the equilibrium quantity levels  $q_i^* = (1 - 2\theta_i + c) / 3$  and  $q_j^* = (1 - 2c + \theta_j) / 3$ . If firm  $j$  were to form a joint venture with the MNF,  $q_i^*$  would be equal to  $(1 - 2c + \theta_j) / 3$  and  $q_j^*$  would be equal to  $(1 - 2\theta_j + c) / 3$ .

Substituting the quantity levels into firms' profit functions yields the equilibrium profit levels  $\pi_i^* = (1 - 2\theta_i + c)^2 / 9$  and  $\pi_j^* = (1 - 2c + \theta_j)^2 / 9$ . Note that, within the text,  $\pi_i^*$  and  $\pi_j^*$  are denoted by  $\pi^v(\theta_i)$  and  $\pi_j^e$ , respectively. If firm  $j$  were to form a joint venture with the MNF,  $\pi_j^*$  would be denoted by  $\pi^v(\theta_j)$  and would be equal to  $(1 - 2\theta_j + c)^2 / 9$ , whereas  $\pi_i^*$  would be denoted by  $\pi_i^e$  and would be equal to  $(1 - 2c + \theta_j)^2 / 9$ . ■

## A.2 Local Welfare

### The host country in autarky

If the host country is in autarky, local welfare will be given by equation (6), where local production is  $q_m^a = 0$ ,  $q_i^a = q_j^a = (1 - c) / 3$  and firms' profits are  $\pi_i^a = \pi_j^a = (1 - c)^2 / 9$ . By following the necessary calculations according to equation (6), local welfare is computed as equation (7). ■

### Greenfield investments

If the MNF makes a greenfield investment, local welfare will be given by equation (6), where local production is  $q_m^g = (1 - 3c^* + 2c) / 4$  and  $q_i^g = q_j^g = (1 - 2c + c^*) / 4$ , and firms' profits are  $\pi_i^g = \pi_j^g = (1 - 2c + c^*)^2 / 16$ . By following the necessary calculations according to equation (6), local welfare is computed as equation (8). ■

## Joint ventures

If the MNF forms a joint venture, local welfare will be given by equation (6). Both production levels and profits of firms depend on a random variable. The expected consumer surplus is given by the function  $E[(q_i + q_j)^2/2]$ . Substituting into this function the firms' total output gives  $E[((1 - 2 \min\{\theta_i, \theta_j\} + c)/3 + (1 - 2c + \min\{\theta_i, \theta_j\}/3))^2/2]$ , where  $\min\{\theta_i, \theta_j\}$  is the marginal cost of the local firm forming a joint venture with the MNF. The local firms' expected profits are  $E[(1 - 2 \min\{\theta_i, \theta_j\} + c)^2/9 - \min\{b_i, b_j\}] + E[(1 - 2c + \min\{\theta_i, \theta_j\})^2/9]$ , where  $\min\{b_i, b_j\}$  is the MNF's joint venture profit. The MNF transfers  $\min\{b_i, b_j\}$  to its country-of-origin.  $\min\{b_i, b_j\}$  is the second highest bid in the auction which can be expressed as  $(c - \max\{\theta_i, \theta_j\})(2 - \max\{\theta_i, \theta_j\} - c)/3$ . Expected values are computed as:

$$\begin{aligned} E[\min\{\theta_i, \theta_j\}] &= \int_0^{\bar{\theta}} \int_0^{\bar{\theta}} \min\{\theta_i, \theta_j\} f(\theta_i) d\theta_i f(\theta_j) d\theta_j \\ &= (2c + 3c^* - 1)/12 \text{ for } \bar{\theta} = (2c + 3c^* - 1)/4, \end{aligned}$$

$$\begin{aligned} E[\min\{\theta_i^2, \theta_j^2\}] &= \int_0^{\bar{\theta}^2} \int_0^{\bar{\theta}^2} \min\{\theta_i^2, \theta_j^2\} f(\theta_i^2) d\theta_i^2 f(\theta_j^2) d\theta_j^2 \\ &= (2c + 3c^* - 1)^2/96 \text{ for } \bar{\theta} = (2c + 3c^* - 1)/4, \end{aligned}$$

$$\begin{aligned} E[\max\{\theta_i, \theta_j\}] &= \int_0^{\bar{\theta}} \int_0^{\bar{\theta}} \max\{\theta_i, \theta_j\} f(\theta_i) d\theta_i f(\theta_j) d\theta_j \\ &= (2c + 3c^* - 1)/6 \text{ for } \bar{\theta} = (2c + 3c^* - 1)/4, \end{aligned}$$

$$\begin{aligned} E[\max\{\theta_i^2, \theta_j^2\}] &= \int_0^{\bar{\theta}^2} \int_0^{\bar{\theta}^2} \max\{\theta_i^2, \theta_j^2\} f(\theta_i^2) d\theta_i^2 f(\theta_j^2) d\theta_j^2 \\ &= (2c + 3c^* - 1)^2/32 \text{ for } \bar{\theta} = \frac{1}{4}(2c + 3c^* - 1)/4. \end{aligned}$$

Note that  $f(\theta_i) = f(\theta_j) = 1/\bar{\theta}$ ,  $f(\theta_i^2) = (\theta_i^2)^{-1/2}/2\bar{\theta}$ ,  $f(\theta_j^2) = (\theta_j^2)^{-1/2}/2\bar{\theta}$ . Substituting the expected values of the random variables appearing in the welfare function yields  $E[W^v]$  given by equation (9). ■

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