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Foreign direct investment with host country market structures, with empirical application to Japan☆

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ABSTRACT

In this paper, we consider models that describe foreign firms' and host countries' decisions on foreign direct investment (FDI) when host country product markets are characterized by certain types of market structures. We show that, under certain conditions, the host country and foreign parent firm (FP) are both better off in equilibrium if FP chooses to form a joint venture (JV) with a domestic partner in the host country, with some form of technology transfer, rather than have FP's exclusive reliance on exporting to the host country. These results provide justification, for example, to China's and some other host countries' FDI policies in recent years. Our results also justify host countries with small open economies to resort to the introduction of new foreign competitors when they face their domestic markets suffering from monopolists' abuse of market power. Canada, for example, is known to use inward FDI with limited foreign ownership as government policy tools for dealing with abusive domestic monopolists. Our welfare implications may be useful for evaluating such FDI-driven competition and other public policy issues. We also present an empirical example using data from Japan to test some of our empirical implications.

1. Introduction

One of the main decisions facing a business firm considering foreign direct investment (FDI) is that of the ownership structure for its foreign subsidiary: should it be a fully-owned subsidiary, or should it be a joint venture (JV) with a partner firm in the host country?[1] In case of a joint venture, how much ownership should the foreign parent firm have in the joint venture?[2]

The ownership structure of a foreign subsidiary is particularly important for technology-based manufacturing firms whose competitive edge comes primarily from their intangible assets such as engineering and scientific knowledge, production skills and know-how, and brand names. These intangible assets may also reflect product quality, marketing, and other management techniques. The integrity of the ownership of technology-based firms' intellectual property rights is often difficult to secure even under legal contracts. It is difficult for a foreign parent firm (FP) to write a legal contract with a local JV partner firm (JP) which specifies precisely the way in which FP's particular intangible asset is to be used in the JV. For example, a licensing agreement which allows a JV to use its FP's technology may not protect the licensor's property rights very well since the licensee might use the licensed technology for products other than the ones specified in the agreement. JP may also obtain essential information related to the licensed technology from the JV. Furthermore, the essential information and skills may be obtained by other firms (other than JP) in the host country.[3]

Such a problem of skill spillover will likely be reduced if the provider of the intangible skills owns substantial equity in the operations utilizing such skills. As pointed out by Grossman and Hart (1986), the ownership of an asset includes not only the entitlement to the return

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[1] In this paper we use joint venture (JV) and international joint venture (IJV) interchangeably. In practice most prominent JVs are indeed IJVs.

[2] Our approach to this topic given below has not been extensively explored in the literature to the best of our knowledge. However, there is also a large management literature on related topics (see, for example, Chiao et al., 2010 and Puck et al., 2009 for further references).

[3] The importance of protecting intellectual property rights in FDI projects is discussed, for example, in Dai and Lahiri (2011), Lee (2014), Lee and Mansfield (1996), Mansfield (1994, 1995), Nakamura et al. (1996) and Smarzynka (2002).

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stream resulting from the use of the asset, but also the residual rights of control over all aspects of the use of the asset except those rights which are explicitly contracted away. In this sense, equity participation in a direct investment plays an essential role in technology-based firms' expansions into foreign markets where potential competitors also do business.

Two types of direct investment, fully-owned and jointly-owned subsidiaries, have different implications for the diffusion of a foreign parent firm's technology. While a fully-owned subsidiary can keep FP's loss due to unauthorized use of its intangible assets to a minimum, a FP might not be able to reap fully the return that its intangible assets could potentially earn. This may occur, for example, if a FP or its 100% subsidiary is not familiar with local production inputs and distribution and marketing practices. The geographical distance between a FP and its fully-owned subsidiary in a host country also increases FP's cost of agency (monitoring).[4] A JP in a host country may be able to provide management skills which, combined with FP's technology, could fully utilize the potential of the technology. On the other hand, JP may take advantage of the JV with FP as a learning experience for developing its own future technology.[5]

While its FDI ownership structure is of potential concern to a FP for the reasons discussed above, it is also of policy concern to the host country. For example, FPs' behavior in their FDI's product markets in the host country may significantly affect host country's welfare. As we show below, FP's ownership structures can have important implications for host country's welfare in different ways. It is also well known that powerful FPs can affect the nature of host country's product markets significantly using their FDI operations with or without local JV partners. (JV partners are often FP's potential competitors also.) There has been, however, relatively little research in the literature that relates firms' product market structures of the kinds discussed above to models of FDI, which explicitly take into account the ownership structures of FDI projects. This paper addresses this issue.

In Section 2 we present our basic bargaining models for firms' JV decisions and discuss their basic properties. Application of the basic models to markets with certain structures is presented in Section 3. Specifically, we consider a single product market in a host country, and assume that FP's bargaining parameter α is a given constant. FP (a foreign parent firm) and its host country JV partner determine their respective ownership shares in the JV, β and 1-β based on Nash bargaining game. As Table 1 shows, FP can be just an exporter (Model (1)), or owns a JV with a host country firm (Model (2)). We abstract from the complications that might arise if FP exports and also owns a JV, and we assume that FP is either an exporter or a JV owner, but not both. We also treat FP's fully owned subsidiary (100%), (also known as wholly owned subsidiary), as an extension of a joint venture (as β approached one) and hence do not treat it separately in the theoretical framework. (Empirically we will treat FPs with 100% subsidiaries using probit and tobit regression models.) We consider the following scenario for the host country (HC): HC has a market which has N competitor firms and one local firm outside the same industry (i.e. third-party HC firm). We assume that FP makes a JV only with third-party HC firm. So in Model (2) in Table 1, FP forms a JV with the third party HC firm, and the JV competes with N local firms. For the HC government, it determines policies by deciding if the JV should be permitted, as well as determining values of policy variables, t (trade barriers) and R (intellectual property protection). (Additional FDI models with market structures and related welfare analyses are presented in Nakamura and Zhang (2017).)

Our main results from Section 3 are summarized as follows. We first find that, under certain plausible conditions, the host country and FP are both better off if FP chooses to form a JV with a local partner (third-party local firm), with a technology transfer contract (the duopoly case of JV and the local competitor), rather than have FP's exclusive reliance on exporting to the host country (Lemma 1). Another implication of our analysis is that as the number of host country competitors (N) to FP increases, FP's optimal ownership share in a JV with a local third-party firm falls (Proposition 1).[6]

We present an empirical example in which we test the above analytical prediction regarding the relationship between FP's ownership in JV and the market structure in the HC product market, using Japanese data in Section 4. Our estimation results are consistent with our theoretical implications. Section 5 concludes.

2. Basic model with nonzero threat points

In our theoretical analysis, we use the Nash bargaining solution for joint venture (JV) and the Cournot-Nash equilibrium for quantity competition between JV and other firms in the host country. The product market rivalry will be considered in Section 3; this section presents the bargaining model. This is a basic prototype model for a case in which the transfer of intangible assets is verifiable, but it is difficult to write a contract that prohibits potential competitors (including JV partners) from taking advantage of the transferred assets.[7] This case happens, for example, when transferred assets are an observable brand name, a patent, or a complete set of technology which is not divisible. The control power that comes with ownership of foreign operations can reduce the potential spillover cost accrued to the owner.[8] By controlling the way their assets are to be used, the owner can reduce or eliminate any inappropriate use of the assets.

Consider that FP has an opportunity for a foreign operation with the expected income Y, where Y is assumed to be constant.[9] This operation requires intangible assets as inputs from both FP and JP, FP's potential JV partner in the host country. (Both FP and JP are assumed to be risk-

[4] See Brickley and Dark (1989) for empirical evidence that franchising is associated with the distance, a source of agency (monitoring) cost, between the owner of an intangible asset (e.g. brand name, reputation) and the site of business operation using the intangible asset. Many previous studies have identified various forms of intangible assets as the driving force of firms' international expansion (e.g. Balakrishnan and Koza, 1993; Hymer, 1960; Teece, 1977; Von Hippel, 1994). A more recent study of the Commission of the European Communities (Zambon, 2003) stresses the shift of corporate decision-making emphasis from tangible to intangible assets and focuses on the measurement issues of intangible assets.

[5] Nakamura and Yeung (1994) present a principal-agent model for the determination of a FP's ownership share in a JV in which FP, the dominant provider of intangible skills to JV, chooses its ownership share in the JV by balancing the marginal benefit (intrinsic profit) it receives from the JV against the marginal cost of control (agency cost and technology spillover). In the model the JP plays no role in the determination of its ownership share in JV. While there is some anecdotal evidence that ownership shares in some joint ventures are indeed determined in the manner assumed in Nakamura and Yeung (1994), their model does not consider the potential bargaining processes that may take place between a FP and JP.

[6] As discussed in the text later, this could happen because, while additional competitor (from N increasing to N+1) lowers both FP's expected exports and profit (and hence the threat point – the lowest acceptable level of ownership) and the profit of its JV with a local third-party partner firm, the reduction in the former is greater than that in the latter, which. in turn allows FP to accept lower ownership share than the case with N local competitors.

[7] We follow and extend the framework used by Nakamura and Xie (1998) to the present model. Further empirical evidence for this and related models are found, for example, in Dimelis and Louri (2002), Ishikawa, Sugita and Zhao (2009), Kasuga (2003, 2008), Louri et al. (2002), Mayer et al. (2003), Mok et al. (2002), Nakamura (2005) and Windsperger (2009). Related theoretical results are also found, for example, in Che and Facchini (2009), Lee (2004), Mugele and Schnitzer (2008), Raff, Ryan and Stahler (2009), and Stahler (2014). Other empirical results for various countries are also found in Barbosa and Louri (2002), Cai and Stiegertb (2012), Görgab et al. (2010), Merino (2013) and Li and Zhong (2003).

[8] In case contracts are enforceable as in developed countries, it is possible to write contracts that give JV partners more control rights than their shares of ownership warrant. This is not the case in developing countries. These contracts are typically driven by many firm-specific idiosyncratic factors. In this paper we assume that ownership generally determines the basic control rights of JV partners.

[9] Our income variable (with expected value Y) does not include the costs and benefits of spillover of intangible assets such as technology. Our model thus focuses on analysis of such costs and benefits. Further discussion on this is found below.

Table 1
Nomenclature (exporting and market models).

	(1) Case 1 FP as an exporter (benchmark case)	(2) Case 2 FP forms JV with a third party HC firm
host country (HC) market structure	N (>1) HC competitors (i = 1, 2, ..,N)	JV competes with N HC competitors (i = 1, 2, ..,N)
FP's share of JV ownership (β)	$\beta = 0$	$0 < \beta < 1$
number of HC firms involved	N	$N + 1$
marginal cost of production at FP and HC competitors: c_{FP}, c_{HC}	$c_{FP} \leq c_{HC}$ c_{HC}: marginal cost for all HC competitors (i = 1, 2, ..,N)	$c_{JV} < c_{HC-JV} \leq c_{HC}$ c_{HC-JV}: post-JV marginal cost for all HC competitors (i = 1, 2, ..,N)
output of FP and HC competitors: x_{FP}, x_{HC}	x^e_{FP}, x^e_{HCi} (i = 1, 2, ..,N)	x^N_{JV}, x^N_{HCi-JV} (i = 1, 2, ..,N)
profit of FP and HC competitors: π_{FP}, π_{HC}	π^e_{FP}, π^e_{HCi} (i = 1, 2, ..,N)	π^N_{JV}, π^N_{HCi-JV} (i = 1, 2, ..,N)
market output (X)	X^e	X^N_{JV}
market price (P)	P^e	P^N_{JV}
HC welfare (W)	W^e	W^N_{JV}
HC consumer surplus (CS)	CS^e	CS^N_{JV}

Notes: In our game models the host country's decision variables are: t ($t \geq 0$), nontariff barrier that faces imports; and R($R \geq 0$), host country's level (strength) of the enforcement of its IPR laws. FP's decision variable is β, FP's ownership share of JV: $\beta = 0$ for Case 1; and ($0 < \beta < 1$) for Case 2. FP's ownership share is determined endogenously by the Nash bargaining process given in Section 2 of the text.

neutral firms in the following.) By licensing intangible assets required for the operation, either FP or JP alone, or a third party, could potentially run this operation under some (incomplete) contract. We assume that transfer of the intangible assets required for the operation is itself verifiable but the output resulting from the use of the transferred assets is not verifiable. Suppose that, without any ownership in the operation, FP and JP incur the maximum costs of technology spillover, C_F and C_J, respectively. These costs of spillover are assumed to decrease as the owners of intangible assets increase their ownership shares in the operation.[10]

In this paper ownership in an international operation is considered as a primary decision variable.[11] Denote by β FP's ownership share in the operation, where $0 \leq \beta \leq 1$. Then JP's share is 1-β. The net expected benefits from the operation for FP and JP are given by:

$$\text{FP: } U_F = \beta Y + \beta g_F C_J - (1-\beta)C_F = \beta\cdot(Y + g_F C_J + C_F) - C_F \tag{1a}$$

$$\text{JP: } U_J = (1-\beta)Y + (1-\beta)g_J C_F - \beta C_J = (1-\beta)(Y + g_J C_F + C_J) - C_J \tag{1b}$$

In (1a-b), $\beta\, g_F\, C_J$ and $(1-\beta)g_J C_F$, respectively, denote the portions of their respective partner's technology spillover that FP and JP receive, where $0 \leq g_F \leq 1$ and $0 \leq g_J \leq 1$. When $g_F = 1$ ($g_J = 1$), then JP's (FP's) spillover all goes to FP (JP); otherwise, part of the spillover costs go to other parties.[12]

Our model assumes that JV's future income is a random variable but its expected value (Y) is constant. This implies that the partner firms' costs and benefits of spillover enter as separate terms in the firms' net benefit functions (1a-b). Note also that JV's income can be either a static random variable or a stochastic process with constant expected value Y.[13] In order to focus on the factors of immediate interest to us, our model given above implicitly assumes the following: (i) the economic fundamentals underlying a proposed JV which generate its future expected income (Y) are assumed to be known to both parent firms at the outset of their negotiations; and (ii) all predictable time-varying factors (e.g. seasonality) have been removed from our JV income. These assumptions are reasonable and realistic. For example, it is not likely that one JV partner could hide knowledge of some fundamentals that might contribute to the true income potentials of the proposed JV from the other negotiating partner, given that both partners involved are assumed to be highly sophisticated players in international business. Both parties can also protect themselves from such potential deceptions by contract. The second assumption allows us to remove the sources of known time-varying factors from our expected income considerations. Our model assumptions still allow for occurrences of unexpected surprises or shocks.

Suppose that H_F (≥ 0) and H_J (≥ 0) are, respectively, the threat points of FP and JP, representing the two firms' current profit positions without a proposed joint venture. Then, in order that FP and JP choose to have a JV, we must have

$$U_F \geq H_F \tag{2a}$$

$$U_J \geq H_J \tag{2b}$$

Using (1a) and (1b), we can rewrite rationality conditions (2a) and (2b) as,

$$\beta \geq \underline{\beta}, \quad \text{where} \quad \underline{\beta} = \frac{C_F + HF}{Y + g_F C_J + C_F} \tag{3a}$$

$$\beta \leq \overline{\beta}, \quad \text{where} \quad \overline{\beta} = \frac{(Y + g_J C_F) - HJ}{Y + g_J C_F + C_J} \tag{3b}$$

Note that $\underline{\beta}$ (≥ 0) is the minimum acceptable ownership share for FP, while $1 - \overline{\beta} = (C_J + H_J)/(Y + g_J C_F + C_J)$ (≥ 0) is the minimum acceptable ownership share for JP. The feasible region for β, ($\underline{\beta}$, $\overline{\beta}$), exists

[10] Here, the role of equity shares differs from the one in Marjit and Mukherjee (1998) who consider the contractual arrangements with equity participation when the success rate of the technology in developing countries is uncertain and the technology providing and receiving firms have different perceptions of this rate. There, equity participation conveys commitment values and is a better arrangement than some other technology collaboration agreements.

[11] We also assume for simplicity that side payments are not allowed between a FP and JP. (The introduction of such side payments, however, would not change our results to follow.) This assumption is justified on the practical ground that side payments in the context of international operations correspond to the contractible aspects of the use of intangible assets such as technology and name brand. It is customary to contract away contractible aspects of transactions involving technical licensing or brand use in the form of lump-sum payments or royalty payments on product sales. We are interested, however, in non-contractible aspects of the use of intangible assets for which meaningful side payments cannot be determined. In addition, different from other related studies (e.g. Lee, 2004; Ishikawa, Sugita and Zhao, 2009) that assume the host government places restrictions on the extent of an IJV's foreign ownership, the present paper places no such restrictions.

[12] We assume that spillover costs C_F and C_J represent measurable profit losses. For example, industry analysts often estimate the loss to FP of host country competitors' illegal use of FP's technologies and brand names.

[13] One stochastic process we have in mind for the JV income is a random walk process. (Since we don't need this assumption, it is not explicitly assumed in the paper.) Substantial amounts of empirical evidence exist in the literature suggesting that the income processes of firms, including joint venture firms, follow a random walk (e.g. Albrecht et al., 1977; Dechow et al., 1998; Watts and Leftwich, 1977). Conditional on the current income which is viewed as constant, expected value of a random walk process is also constant representing the past income.

only if

$$(Y + g_F C_J)(Y + g_J C_F) - (H_F + H_J)Y \geq C_F C_J + (g_J C_F + C_J)H_F + (g_F C_J + C_F)H_J \quad (4)$$

That is, the expected income including the benefits from the JV partner's technology spillover is large relative to the costs of the total spillover after adjusting for the current pre-JV incomes of both FP and JP. If inequality (4) does not hold, the FP would have no foreign operation. In the following we assume that (4) holds.

When both FP and JP have no current interest in the proposed JV's lines of business, their threat points are likely equal to zero (i.e. $H_F = H_J = 0$) and inequality (4) reduces to $(Y + g_F C_J)(Y + g_J C_F) \geq C_F C_J$. If there are no spillover costs (i.e. $C_F = C_J = 0$) then (4) reduces to $Y \geq H_F + H_J$, as expected. Also we note that: $\underline{\beta} = 0$ if and only if $C_F = H_F = 0$; and $\overline{\beta} = 1$ if and only if $C_J = H_J = 0$.

The "first best" solution for the JV partners occurs when both FP and JP cooperate fully in maximizing the joint (expected) benefit in determining their ownership shares. This solution is not likely to be implemented in practice given that neither the use of intangible assets nor the production output which makes use of the intangible assets as inputs are verifiable or contractible (see Nakamura and Zhang, 2017). Under such conditions both FP and JP will attempt to maximize their ownership shares in the IJV to protect their own interests. Given that the first-best solution is not achievable, FP and JP begin negotiation.

A behavioral model that is suitable to describe the negotiation process between FP and JP in determining their ownership shares in the operation is the Nash bargaining solution (Nash, 1950). We denote the relative bargaining power of FP and JP, respectively, by α and $(1 - \alpha)$, where $0 \leq \alpha \leq 1$. Following the literature (e.g. Farge and Wells, 1982) we assume α is an exogenously given parameter. Then the Nash bargaining solution, β^{NB}, is given by:

$$\underset{\beta}{Max} \quad (U_F - H_F)^{\alpha} \cdot (U_J - H_J)^{1-\alpha} \quad (5)$$

where U_F and U_J are given by (1a-b). It is shown that β^{NB} is given by[14]

$$\beta^{NB} = \alpha\overline{\beta} + (1 - \alpha)\underline{\beta} = \underline{\beta} + \alpha \cdot (\overline{\beta} - \underline{\beta}) \quad (6)$$

where $\underline{\beta}$ and $\overline{\beta}$ are given by (3a) and (3b), respectively. Note that, for $0 \leq \alpha \leq 1$, we have $\underline{\beta} \leq \beta^{NB} \leq \overline{\beta}$.[15]

In extreme cases where either FP or JP has all the bargaining power, we have:

$$\beta^{NB} = \overline{\beta}, \quad \text{if } \alpha = 1 \quad (7a)$$

$$\beta^{NB} = \underline{\beta}, \quad \text{if } \alpha = 0 \quad (7b)$$

As a managerial implication, suppose that only FP suffers from spillovers due to the host country's weak intellectual property (IP) protection, i.e. $C_F > 0$ and $C_J = 0$ in (1a-b), where we also assume $H_F = H_J = 0$ for simplicity. Then $\underline{\beta} = C_F/(Y + C_F)$ and $\overline{\beta} = 1$ by (3a-b). By (6) FP's optimal negotiated ownership share in the JV is $\beta^{NB} = \alpha + (1 - \alpha)\underline{\beta} > \alpha$, i.e. FP must demand for a larger share than the share, α, which corresponds to the amount of FP's intrinsic contribution to the JV. If the host country strengthens IP protection and hence eliminates FP's spillover, then we have $C_F = \underline{\beta} = 0$ and $\beta^{NB} = \alpha$. FP now must consider only the fundamentals that it can contribute to the JV in negotiating for its ownership share in the JV.

An important empirical issue is how Nash bargaining solution β^{NB} depends on FP's bargaining power, α. From (6) we see that $d\beta^{NB}/d\alpha = \overline{\beta} - \underline{\beta} > 0$: i.e. β^{NB} increases linearly as FP's bargaining power relative to JP's increases. Thus, the greater the parent firm's bargaining power is, the larger its ownership share in the IJV operation becomes. This also implies that with a higher bargaining power FP will be able to receive a larger share of IJV's profits $\beta Y + \beta g_F C_J$, while minimizing its spillover cost (see (1a)).[16]

3. Product market structure and rivalry

In Section 2 we have presented a basic model of JV ownership with technology spillovers, (1a-b) and (2a-b), in which the expected payoff of a proposed JV, Y, is assumed to be constant. No assumption was made about the nature of JV's product market. An important modification of our basic model is to introduce production activities by FP, JP, JV, and other firms in the host country. More specifically, this section extends the model and considers the situation in which FP's direct exporting to the host country (HC) is taken as the firms' current profit position without a proposed JV, and in which FP seeks a JV partner in a host-country industry with certain product market structures. The market structure is proxied by $N(\geq 1)$, the number of HC firms. These firms are identical in the sense that they have the same cost, and so a larger N represents a more competitive market structure. FP and these N firms are in the same product market. (See Table 1.)

Our main objective in this section is to derive the implications of HC's product market structure for JV ownership structure. Before deriving the ownership implications, however, we need to check under what conditions a JV between FP and a third-party local firm is permitted by the HC. If such conditions do not exist, FP must enter the HC market by direct exporting (if it indeed decides to enter the market) where it competes with those N local firms.[17]

Whether a JV is permitted by HC requires a domestic-welfare comparison between the JV and exporting cases (Cases 1 and 2 in Table 1). We concentrate on the case of linear (inverse) demand $P = a - X$, where X is total (market) output and P is market price.[18] Consider first the FP-exporting case: Suppose that FP's primary competitiveness is its lower marginal cost of production which we assume comes from the technological advantage it has over its HC competitors:

$$c_{FP} \leq c_{HC} \quad (8)$$

[14] Nakamura and Xie (1998).

[15] Our model is not a two-person zero-sum game for various combinations of values for the model parameters C_F, C_J, g_F, g_J and β. For this reason, Von Neumann and Morgenstern's (1944, 1947, 1953) theory of zero-sum two-person games cannot be used for analyzing the present problem. It is for this type of the problem that the original Nash bargaining solution (Nash, 1950) was proposed (e.g. Crawford, 2000). A number of variations of the original Nash model were also developed (e.g. Rubinstein, 1982). In general, all bargaining situations including ours have two things in common that distinguish them from two-person zero-sum game situations: (i) the total payoff to the negotiating parties should be greater than the sum of what they would get in the absence of agreement; and (ii) it is not a zero-sum game. The Nash bargaining solution is an essential component of the theories that explain, for example, the behavior of the firm (Grossman and Hart, 1986) and the strategic implications of trade wars and trade agreements in international business (Grossman and Helpman, 1995).

[16] The present model can be extended to more complex models with different types of inputs of intangible assets the JV requires from its parent firms. In all cases contractibility of output is not satisfied, and potential parent firms are likely to demand positive ownership shares in the JV. Also it is shown that the FP's ownership share in its JV increases with its relative bargaining power in all of these cases (Nakamura and Xie, 1998).

[17] Here we have assumed that the JV is formed between FP and a third-party local firm and, thus, excluded the possibility that the JV is formed between FP and one of the N competitors. The latter possibility is examined in Nakamura and Zhang (2017) who find that while FP likely prefers such an option, the JV with a third-party local firm is preferred from the HC's domestic consumer welfare perspective. They further show that, for some parameter space, the gain in consumer surplus outweighs the profit loss. In such cases, the HC will not permit the JV between FP and a direct domestic competitor (since the JV with a third-party local firm yields higher total surplus for the HC). (The analysis is not presented in the text to save space.) Our focus on the JV with a third-party local firm also fits our empirical setting (Section 4).

[18] We assume in this paper that firm outputs (products) are not differentiated, and so the difference in technology is captured in the difference in costs. Product differentiation can be justified on the grounds that JV uses superior foreign technology, which potentially leads to products that meet customer demands better than local ones. A parameter may be introduced to the demand functions to indicate the degree of substitutability between JV's output and those of the local firms (e.g. Ishikawa, Sugita and Zhao, 2009). Our basic insights would remain the same in the case of differentiated products, however. We further note that the case of general demand functions is also explored in Nakamura and Zhang (2017) and the results might still hold in the general case.

where c_{FP} and c_{HC} are the marginal costs of FP and HC firms, respectively.[19] Note that c_{FP} may also include the transport cost (if any) of moving output from the foreign to host country. In addition, FP may encounter trade barriers, which are made equivalent to an added cost, valued at t (≥ 0), for each unit of its exports to the host country.[20] Ignoring any fixed production costs, their profit functions can be written as:

$$\pi^{HC} = P(X)x_{HC} - c_{HC}x_{HC}, \qquad \pi^{FP} = P(X)x_{FP} - (c_{FP} + t)x_{FP}$$

where the first expression is for one of the N HC firms. The Cournot equilibrium quantities with these $(N + 1)$ firms are (superscript e for FP "exporting") :[21]

$$x^e_{HCi} = (a - 2c_{HC} + c_{FP} + t)/(N + 2), \text{ for every } i \tag{9}$$

$$x^e_{FP} = [a - (N + 1)(c_{FP} + t) + Nc_{HC}]/(N + 2) \tag{10}$$

with $i = 1, 2, ...,N$, and the corresponding profits are:

$$\pi^e_{HCi} = [(a - 2c_{HC} + c_{FP} + t)/(N + 2)]^2, \quad \text{for every } i \tag{11}$$

$$\pi^e_{FP} = [(a - (N + 1)(c_{FP} + t) + Nc_{HC})/(N + 2)]^2 \tag{12}$$

The HC's (equilibrium) welfare is the sum of domestic consumer surplus CS^e and domestic profit $\sum_{i=1}^{N} \pi^e_{HCi}$:

$$W^e = [(N + 1)a - Nc_{HC} - (c_{FP} + t)]^2/2(N + 2)^2 + N\cdot[(a - 2c_{HC} + c_{FP} + t)/(N + 2)]^2 \tag{13}$$

where the first term on the RHS of (13) is CS^e, and the second term is the domestic profit.[22]

As for the JV case, it is natural to assume that the JV has a cost advantage over the pre-JV FP:

$$c_{JV} < c_{FP} \leq c_{HC} \tag{14}$$

where c_{JV} denotes JV's marginal cost and the second inequality follows from (8). This assumption arises owing, for example, to the integration of FP's superb technology with JP's advantages in local-market knowledge, which may be referred to as the "synergy effect" of the JV.[23] Following the set-up in Section 2, we further allow that, once the JV is formed, there may be technology spillover from the JV to the HC firms (which are JV's direct competitors in the HC market). Such spillover lowers these firms' post-JV marginal cost so that

$$c_{HC-JV} \leq c_{HC} \tag{15}$$

Finally, to ensure that with N HC firms, the host country may still find it more desirable to have a JV than to have FP enter the home market via exporting, we assume:

$$(2N + 1)c_{JV} < 3Nc_{HC-JV} - (N - 1)a \tag{16}$$

Note that when $N = 1$, condition (16) reduces to $c_{JV} < c_{HC-JV}$, i.e. JV has a lower marginal cost than its HC competitor (a non-JV partner) despite the potential leakage of its technology. This is expected in our set-up, because the parent firms' ownership prevents 100% leakage of their technology and knowhow to non-JV partners. Such a cost advantage by a JV is assumed to continue to hold for the case of $N > 1$ (adjusting for N and market size a as specified in (16)).

The Cournot equilibrium for the JV case is given by (superscript N for "N firms"),

$$x^N_{HCi-JV} = (a - 2c_{HC-JV} + c_{JV})/(N + 2), \text{ for every } i \tag{17}$$

$$x^N_{JV} = [a - (N + 1)c_{JV} + Nc_{HC-JV})/(N + 2) \tag{18}$$

and the equilibrium profits are,

$$\pi^N_{HCi-JV} = [(a - 2c_{HC-JV} + c_{JV})/(N + 2)]^2, \text{ for every } i \tag{19}$$

$$\pi^N_{JV} = [(a - (N + 1)c_{JV} + Nc_{HC-JV})/(N + 2)]^2 \tag{20}$$

The corresponding HC's welfare is:

$$W^N_{JV} = CS^{JV} + \sum_{i=1}^{N} \pi^N_{HCi-JV} + (1 - \beta)\pi^N_{JV} = [(N + 1)a - Nc_{HC-JV} - c_{JV}]^2/2(N + 2)^2 + N[(a - 2c_{HC-JV} + c_{JV})/(N + 2)]^2 + (1 - \beta)\pi^N_{JV} \tag{21}$$

where FP's ownership share of JV is β.

Regarding the question of whether a JV between FP and a third-party local firm is permitted by the HC, we obtain the following results:

Lemma 1. *While a JV between FP and a third-party local firm is preferable to FP's direct exporting from the perspective of domestic consumer welfare and JP profit, the N domestic competitors may suffer from the JV formation. Nevertheless, both the host country and FP can be better off with the JV formation than under FP's direct exporting, owing either to the host country's choice of optimal trade barriers or to its choice of intellectual-property protection levels.*

The proof of Lemma 1 is given in the Appendix. In Lemma 1, the host country's choice of optimal trade barriers refers to the HC welfare-maximizing value of t, whereas the HC's choice of intellectual-property (IP) protection levels refers to the situation where the HC uses IP protection so that FP prefers a JV to direct exporting. Recall that the difference of $c_{HC} - c_{HC-JV}$ underlies the HC firms' benefit from JV's technology spillover (the "spillover effect"). Suppose now that the extent of such spillover depends on variable R, defined as the strength of the IP protection in the host country. Specifically, we let

$$\text{Unit spillover benefit} = c_{HC} - c_{HC-JV} = l_1 - l_2R \tag{22}$$

with l_1 and l_2 being positive parameters. Parameter l_2 indicates that (for example) the stronger the enforcement of intellectual property right laws, the smaller the spillover; whereas l_1 denotes the maximum amount of spillover which takes place when $R = 0$. Thus, Lemma 1 shows that there are feasible ranges of t (trade barriers) and R (IP protection) such that both the host country and FP prefer JV to FP's direct exporting. In our following discussion on ownership implications, we shall assume that t and R are in the feasible ranges.

To examine the effect of HC's product market on JV's ownership structure, we first examine the rationality conditions for forming this JV. To focus on the impacts of technology spillover on the costs of production, we here consider that all spillover costs are captured in

[19] See also Lee (2004) who made a similar assumption.

[20] Trade barriers include both tariffs and nontariff barriers such as import quotas. As indicated below, we treat the two types as equivalent. This treatment is for simplicity and analytical convenience. As is well known in the literature, whether tariff rates and (say) quotas are equivalent – in the sense that the domestic prices of the good are identical when a given level of imports is generated by means of a tariff or alternatively by a quota – depends on several factors including the market structure and nature of firm rivalry (e.g. Takacs, 1978; Hwang and Mai, 1988; Mai and Hwang, 1989). For example, Hwang and Mai (1988) show, in the duopoly rivalry between a foreign firm and a home firm, that the equivalence holds only when they engage in Cournot competition, a rivalry mode assumed in this paper.

[21] We consider Cournot (quantity) rather than Bertrand (price) competition mainly for analytical convenience (in addition to the equivalence result indicated in footnote 20). In general, which model of competition is applicable to a particular industry depends in large part on its production technology. In Cournot competition, firms commit to quantities, and prices then adjust to clear the market implying the industry is flexible in price adjustments, even in the short run. On the other hand, in Bertrand competition, capacity is unlimited or easily adjusted in the short run. As pointed out by an anonymous referee, when we assume Bertrand competition between JV and other firms, the analytical results may be very different. We see the Bertrand analysis as a natural and useful extension of the present analysis.

[22] Although tariff rates have been reduced substantially through various rounds of multilateral trade negotiations – to the extent that these rates become negligible among, for example, industrialized countries – nontariff barriers still exist. These latter barriers may be present in the form of quotas, voluntary export restraints, domestic laws and regulations, and unnecessarily complicated and cumbersome administrative procedures ("red tapes") (e.g. Deardorff, 1987; Ching et al., 2004). For simplicity, we consider that t represents only nontariff barriers; as a consequence, the HC's welfare is the sum of domestic consumer surplus and domestic profit.

[23] This follows Yu and Tang (1992). The specification differs from Lee (2004) who assumed that the JV will have a lower unit cost only if FP holds a larger equity share because of its superior technology.

terms of their impacts on the reductions in the firms' marginal costs of production benefitting from the spillover, i.e. $C_J = C_F = 0$. Then following the discussion in Section II and since the alternative to JV is FP's direct exporting (i.e. FP's no-JV threat point), FP's rationality condition is $\beta\pi^N_{JV} \geq \pi^e_{FP}$, or equivalently by (12) and (20),

$$\beta \geq (\pi^e_{FP}/\pi^N_{JV}) = [(a - (N+1)(c_{FP} + t) + Nc_{HC})/(a - (N+1)c_{JV} + Nc_{HC-JV})]^2 \equiv \underline{\beta} \quad (23)$$

For simplicity, we assume that the JV's local partner cannot enter the domestic market by itself. So this firm, JP, is always willing to form the JV, as long as its payoff is nonnegative (i.e. $H_J = 0$ in the terminology of Section 2). With the zero threat point, the minimum share that JP is willing to accept is thus zero: i.e. its rationality condition is

$$\beta \leq 1 \equiv \overline{\beta} \quad (24)$$

Using (6) and (24) we obtain the Nash bargaining solution:

$$\beta^{NB} = \alpha + (1 - \alpha)\underline{\beta} \quad (25)$$

where α $(0 < \alpha < 1)$ is the parameter representing FP's inherent bargaining power, and $\underline{\beta}$ (≥ 0) is the minimum acceptable ownership share for FP.

Proposition 1. *At the Nash bargaining solution with a JP's zero threat point and linear demand, FP's ownership share of JV, β^{NB}, is given by (25) and (23). From β^{NB} we obtain the following comparative-static results: (i) an increase in α will increase β^{NB}; (ii) an increase in t will lower β^{NB}; (iii) an increase in R will lower β^{NB}; (iv) a decrease in c_{JV} will lower β^{NB}; and (v) an increase in N will reduce β^{NB} when the technology leakage (spillover) to the non-JV competitors is sufficiently small* (i.e. *c_{HC-JV} is sufficiently close to c_{HC}), which will be the case if the host country enforces its intellectual-property protection sufficiently strong; the result (an increase in N reduces β^{NB}) also arises when the host country chooses its trade barriers optimally.*

Comparative-static results (ii)–(iv) presented in Proposition 1 are consistent with our intuition.[24] Specifically, part (ii) states that as the HC's trade barriers increase, FP's willingness for accepting a JV with a lower ownership share in it increases. Higher trade barriers reduce the payoff from direct exporting, thereby making the no-JV threat point a less attractive alternative for FP (relative to JV). Part (iii) states that a high level of IP protection in the host country allows FP to accept a lower ownership share in JV. Also, high levels of IP protection mean that HC receives less benefit from JV in terms of its technology spillover to local competing firms, but the host country also gets compensated (in part) through higher ownership share in JV by JP.[25] Part (iv) states that JV's lower marginal cost (as a result of the higher synergy effect between FP and JP) allows FP to accept a lower ownership share in JV, which is also consistent with the HC government's welfare considerations. While part (ii) affects (negatively) FP's payoff at the threat point, parts (iii) and (iv) affect (positively) its payoff through the JV option. These implications of (i)-(iv) can be tested empirically.

As mentioned earlier, our main interest in this subsection concerns the effect of N on JV's ownership structure, i.e. result (v). Unlike the effects in parts (ii)-(iv), an increase in N reduces FP's payoffs at both the threat point (direct exporting) and the JV option. Note that $d\beta^{NB}/dN$ has the same sign of $d\underline{\beta}/dN$, which in turn will be same as the impact of N on π^e_{FP}/π^N_{JV}, the ratio of the two profits. While an increase in N reduces both the numerator and denominator of this ratio, it reduces the former (π^e_{FP}) more than the latter (π^N_{JV}) if c_{JV} is sufficiently small as compared to its competitors' unit cost c_{HC-JV}.[26] This condition makes JV a lower cost competitor (vs. its HC firms) than when FP is a pure exporter, and is ensured by either the condition that c_{HC-JV} is sufficiently close to c_{HC}, which will be the case with the strong IP protection, or condition (16) in the case of optimal trade barriers. As a result, the profit ratio becomes smaller as N increases, leading to result (v). In other words, as N increases, the negative impact on the threat point is more severe (relative to the JV case) and consequently, FP becomes more willing to accept lower ownership share in a JV. This result will be tested empirically in Section 4 below.

4. An empirical example

One empirically testable implication of Proposition 1 is that as the number (N) of host country competitors to FP increases, FP's optimal ownership share in a JV with a local third-party firm decreases (Proposition 1(v)). We examine this empirical implication using Japanese data.[27,28] It was pointed out that most international JVs in Japanese manufacturing industries are formed by foreign parent firms (FPs) with new products and/or technology which they want to exploit in Japan. Their typical joint-venture partners (JPs) are local firms which can contribute to facilitating FPs' business and which are not involved in lines of business that compete directly with FPs'.[29]

4.1. Data

Table 2 has descriptive statistics for our data.[30] %FP denotes our dependent variable, FP's ownership share in percent (= 100 × β) in joint ventures in Japan. For fully owned subsidiaries, we have %FP = 100.[31] We also define a dummy dependent variable, b_%FP, such that b_%FP = 1 if %FP > 0; b_%FP = 0 otherwise. %FP is dependent variable for OLS and Tobit regressions, while b%FP is dependent variable for probit regressions.

The primary explanatory variables in our regressions are as follows. The number of competitors (N) for a joint venture, the variable of our primary interest, is the number of listed firms (denoted as S) in the relevant industry in which the joint venture operates.[32]

As control variables we include FP's intra-firm-trade variables, %EXtoFP and %IMfrFP. Previous studies in the literature suggest that FPs' bargaining power is increased by their ability to import their intermediate goods and services from their global affiliates elsewhere outside Japan (denoted by %IMfrFP).[33] Generally such intermediate goods imported from FPs' own facilities are unavailable in the marketplace and embody FPs' technology and other characteristics which are the source of their competitiveness. Similarly, their bargaining power is increased by their ability to export their intermediate and/or final products to their overseas subsidiaries and other affiliates (denoted by

[24] Interpretation of result (i) is the same as in our basic model. The proof of the proposition is given in the Appendix.

[25] While the impact on HC is discussed here, we note that the equity share of a JV is negotiated between FP and JP, not between FP and HC's government.

[26] In Cournot rivalry, the negative profit impact of an increase in N on one firm's profit depends on the firm's unit cost level, with the impact being less severe as the cost becomes smaller.

(footnote continued)

[27] Japan enforces IPR protection reasonably strictly. This is consistent with one of the two conditions required for Proposition 4(v). On the other hand, it is not clear that to what degree the other condition (optimal trade policy condition) is satisfied. For example, Japan seems to have effective trade policies for manufacturing industries but their trade policies for their agricultural industries have been always controversial.

[28] Given limitations on the availability of relevant data at this time, our empirical example here is intended to be illustrative rather than a full test of our theory.

[29] FPs and their competitor firms in Japan generally do not form JVs. Exceptions to this include FPs' takeover of failing Japanese competitors. JVs that were formed between FPs and third-party Japanese firms along the lines described above include: Caterpillar-Mitsubishi, Mitsubishi Motor, Fuji Xerox, Yokogawa-Hewlett-Packard, and Sumitomo 3M.

[30] We included in our sample foreign firms' jointly owned and fully owned manufacturing subsidiaries located in Japan in year 2000 for which relevant data exist.

[31] There are a small number of joint ventures which have multiple Japanese partner firms. In such cases we assume that Japanese parent firm with the largest ownership share is the Japanese partner firm.

[32] We also assume that the number of listed firms is exogenously given.

[33] For example, see Nakamura (1991), Nakamura and Xie (1998) and Nakamura (2005).

Table 2
Descriptive statistics.

variable	obs	mean	std. dev.	min	max	Variable definition
%FP	395	80.53	25.06	0	100	FP's ownership share in foreign subsidiary (JV) in per cent.
b_%FP	395	.5671	.4961	0	1	dummy variable set equal to one if %FP > 0; zero otherwise.
%EXtoFP	395	2.821	3.786	0	11.9	per cent of JV's exports that go to FP.
%IMfrFP	395	12.77	16.31	0	74.7	per cent of JV's imports that come from FP.
%RD_jp	395	4.442	1.990	.25	8.49	per cent of JP's R&D spending over its sales revenue.
%RD_CR_jp	395	3.554	2.534	0	10.2	per cent of 10-firm concentration ratio in R&D spending by industry
%RET_TA_jp	395	5.453	2.057	0	10.9	per cent of return to total assets over total assets for JP
S	395	75.06	38.70	7	129	number of JVs in the sample (as a proxy for level of domestic competition)
RD_HI_jp	395	3703.	2699.	0	4361.	HH index for R&D spending for JP
%RD_fp	395	4.408	7.227	0	24.6	per cent of FP's R&D spending over its sales revenues

Data source: most corporate and industry variables on FPs' operations in Japan including joint ventures and fully owned subsidiaries were calculated using data from Toyo Keizai a (data on inward FDI, various years), Toyo Keizai b (data on CSR, various years)and Toyo Keizai c (Japanese company data book, various years); Japanese government data (METI, various years); and R&D related variables were calculated using data from Horiuchi (2005) and Mitsui (2009).

%EXtoFP). The presence of these intra-firm activities also facilitates FPs' global profit maximization by allowing them to manipulate their transfer prices.

Other control variables that affect FPs' relative bargaining power include their R&D environment related variables. We include R&D-sales ratios for FP (%RD_fp) and their JV partner (%RD_jp).[34] In addition, since some Japanese manufacturing industries have concentrated patterns of R&D investment,[35] which may adversely affect FPs' relative bargaining power, we include %RD_CR_jp (10-firm R&D concentration ratio (%) for each industry) and RD_HI_jp (Herfindahl-Hirschman Index (HHI) calculated for R&D expenditures for firms in each industry).[36] We also include Japanese partner firms' return to toal assets (%RT_TA_jp) high values of which would weaken FP's bargaining power.

Finally we include home country dummies for controlling FPs' home country effects.[37] Our regressions results are presented for the cases with and without industry dummies included.[38]

4.2. Empirical results

We are interested in empirically exploring the implications of the level of domestic competition for FPs' propensity to set up fully-owned subsidiaries rather than joint ventures. We use the number of listed firms in the relevant industry (S) as a proxy measuring the level of domestic competition. Our theoretical discussions in the previous section suggest that as domestic competition intensifies (i.e. as N increases), FP's ownership share in a joint venture decreases. We present our regression results in Tables 3, 4, and 5. We are interested in the determinants of a FP's decision to set up a fully-owned subsidiary rather than a joint venture. Probit regressions provide estimates for the binary event that a FP sets up a fully-owned subsidiary (Table 4). Tobit regressions provide estimates for a limited dependent variable model where the dependent variable is censored from above (Table 5). OLS regressions (Table 3) provides benchmark estimation results for comparative purposes. We primarily discuss Tobit results (Table 5) since our data is appropriately analyzed by Tobit analysis.

In Table 5, N has a negative coefficient and is statistically significant at a 10% level in Tobit analysis for both with and without industry dummies. It is also significant in both OLS and Probit cases (Tables 3 and 4). This is consistent with our hypothesis that the higher the domestic competition, the less bargaining power a FP has in choosing its ownership share in a joint venture. Note that this is also consistent with our intuition.

Other variables RD_HI_jp and RD_CR_jp measure the level of domestic concentration in R&D investments. Tobit and Probit analyses show RD_HI_jp is significant and negative for cases without industry dummies (Tables 4 and 5). It is also significant and negative for both with and without industry dummies in Table 3. This is consistent with an interpretation that concentrated (monopolistic) R&D investment patterns depress FP's bargaining power. This is also consistent with our anecdotal evidence that even if FP has high R&D capacity of its own, domestic firms' concentrated R&D investments (e.g. joint R&D investments by domestic competitors' collaborative research projects) might provide tough competition to a FP. On the other hand, RD_CR_jp is not significant.

Parent firms' strengths in R&D are potentially important factors for determining their bargaining power. In Table 5, %RD_fp is significant and positive, suggesting that a high level of FP's R&D activity enhances its bargaining power. An interesting observation is that %RD_jp is also significant and positive in Table 5, suggesting that FPs' bargaining power is increased by their ability to locate a JP with strong R&D capacity. This is consistent with the notion that FPs are interested in taking advantage of potential Japanese partner firms' R&D capabilities in their operations in Japan.

JP's return to total assets (%RET_TA_jp) has statistically significant and negative coefficients in Tables 3 and 5 for the cases with industry dummies. In Probit regressions it is statistically significant and negative for both cases with and without industry dummies. This suggests that FPs' bargaining power is depressed when their partner firm's financial conditions represented by $RET_TA_jp are strong.

Finally, FPs' capability to export their output to their affiliates outside Japan is statistically significant and positive only for cases without industry dummies in Tables 3 and 5. FPs' capability to procure from their affiliates (%IMPfrFP) is not generally statistically significant. These results suggest that FPs' operations in Japan are not necessarily strongly integrated in FPs' global supply chains. Rather they are more focused on R&D – intensive operations for which FPs' commodity inputs are not essential and for which export outlets are not very relevant.

5. Concluding remarks

In this paper, we have applied bargaining models of foreign direct investment (FDI) to some economic circumstances where product markets in the host country are characterized by certain types of market structures. We have obtained analytically optimal ownership structures for these cases and discussed their properties. We have also shown that, under certain plausible conditions, the host country and FP are both

[34] Values for the RD_jp variable are missing when a FP has fully-owned subsidiaries. In these cases, RD_jp contains relevant industry values.

[35] See, for example, Horiuchi (2005) and Mitsui (2009).

[36] Estimates for Herfindahl-Hirschman Index based on firms' sales revenues or equivalent for manufacturing industries for various years relevant for our sample are not available and hence they were not included in this study. (Such estimates, if available, might function as an alternative variable for N.)

[37] We include home country dummies for the U.S.A., the U.K., Germany, Switzerland, Holland, and France (id_us, id_uk, id_germ, id_swiss, id_holland and id_fra). Many FPs in Japan come from these countries.

[38] We do not show coefficients for these dummies to save space. We also ran regressions with time (year) dummies but they were insignificant and hence were not included.

Table 3
Foreign parents' ownership shares in their foreign operations and the number of competitors (N): OLS regression results[1,2].

dep.var.: %FP	Coef.	Std. Err.	t	P > t	Coef.	Std. Err.	t	P > t
	with industry dummies				*without industry dummies*			
%EXtoFP	0.0310	0.9458	0.03	0.974	1.1470	0.6808	1.68*	0.093
%IMfrFP	0.0509	0.1448	0.35	0.725	−0.0260	0.1207	−0.22	0.830
%RD_jp	6.3072	3.1028	2.03**	0.043	6.5494	2.3675	2.77***	0.006
%RD_CR_jp	1.6038	1.8471	0.87	0.386	−1.2446	1.5479	−0.80	0.422
%RET_TA_jp	−5.3387	3.0744	−1.74*	0.083	−1.3299	1.6098	−0.83	0.409
S	−0.1796	0.0995	−1.81*	0.072	−0.1798	0.0876	−2.05**	0.041
RD_HI_jp	−0.0019	0.0011	−1.67*	0.096	−0.0027	0.0011	−2.50**	0.013
%RD_fp	0.2578	0.1841	1.40	0.162	0.2674	0.1851	1.44	0.149
Cons	102.54	14.054	7.30***	0	90.329	9.3130	9.70***	0

[1] Regressions were run with industry dummies (left-side panel) and without (right-side panel).
FPs' home country dummies were also included in these regressions.
[2] *, **, ***: statistically significant at 10%, 5% and 1%, respectively.

Table 4
Foreign parents' ownership shares in their foreign operations and the number of competitors (N): Probit regression results (b_%FP = 1 if fully owned; =0 0therwise)[1,2].

dep.var.:b_%FP	Coef.	Std. Err.	z	P > z	Coef.	Std. Err.	z	P > z
	with industry dummies				*without industry dummies*			
%EXtoFP	−0.0004	0.0516	−0.01	0.993	0.0557	0.0362	1.54	0.124
%IMfrFP	0.0037	0.0075	0.49	0.623	−0.0010	0.0062	−0.17	0.867
%RD_jp	0.2117	0.1696	1.25	0.212	0.2631	0.1294	2.03**	0.042
%RD_CR_jp	0.1870	0.1036	1.80*	0.071	0.0396	0.0851	0.47	0.641
%RET_TA_jp	−0.3197	0.1706	−1.87*	0.061	−0.1575	0.0862	−1.83*	0.068
S	−0.0092	0.0054	−1.71*	0.087	−0.0105	0.0048	−2.19**	0.029
RD_HI_jp	−7.1E-05	6.18E-05	−1.15	0.251	−0.0001	5.93E-05	−2.02	0.044
%RD_fp	0.0194	0.0148	1.31	0.190	0.0207	0.0147	1.41	0.159
Cons	1.5495	0.7751	2.00**	0.046	1.1716	0.5059	2.32**	0.021

[1] Regressions were run with industry dummies (left-side panel) and without (right-side panel).
FPs' home country dummies were also included in these regressions.
[2] *, **, ***: statistically significant at 10%, 5% and 1%, respectively.

Table 5
Foreign parents' ownership shares in their foreign operations and the number of competitors (N): Tobit regression results[1,2].

dep. var.:%FP	Coef.	Std. Err.	t	P > t	Coef.	Std. Err.	t	P > t
	with industry dummies				*without industry dummies*			
%EXtoFP	0.3224	2.0788	0.16	0.877	2.6489	1.4853	1.78*	0.075
%IMfrFP	0.0675	0.3047	0.22	0.825	−0.0649	0.2568	−0.25	0.801
%RD_jp	11.917	6.8340	1.74*	0.082	12.400	5.1657	2.40**	0.017
%RD_CR_jp	5.2802	4.2779	1.23	0.218	−0.8936	3.5552	−0.25	0.802
%RET_TA_jp	−12.621	6.9124	−1.83*	0.069	−4.1452	3.4143	−1.21	0.225
S	−0.4155	0.2103	−1.98**	0.049	−0.4056	0.1845	−2.2**	0.028
RD_HI_jp	−0.0036	0.0023	−1.57	0.118	−0.0051	0.0022	−2.36**	0.019
%RD_fp	1.1215	0.6369	1.76*	0.079	1.1460	0.6380	1.80*	0.073
Cons	158.17	31.194	5.07***	0	132.59	20.033	6.62***	0
/sigma	45.433	2.8280			46.186	2.8785		

[1] Regressions were run with industry dummies (left-side panel) and without (right-side panel).
FPs' home country dummies were also included in these regressions.
[2] *, **, ***: statistically significant at 10%, 5% and 1%, respectively.

better off if FP chooses to form a joint venture (JV) with a domestic partner (JP) in a host country, with a technology transfer contract, rather than FP's exclusive reliance on exporting to the host country.[39] This seems consistent with the type of industrial policies towards inward FDI that China has successfully implemented over the last few decades (e.g. Hu and Jefferson, 2002; Cheung and Lin, 2004; Ishikawa, Sugita and Zhao, 2009; Chu and Wang, 2015). In China all FDI projects are approved in principle only if they are jointly owned by a FP and domestic enterprises (often state owned) and the JV contract includes a clause on forced transfer of FP's technologies.[40]

Another main objective of our paper is to link characteristics of the product market to a JV's ownership structure. In particular, we found that as the number of host-country competitors to FP increases, FP's optimal ownership share in a JV with a local third-party firm falls. We have further presented an empirical example using Japanese data on inward FDI. In this example, we estimated the impacts of the level of

[39] Our welfare results are broadly consistent with the results reported in the literature.

[40] Empirical evidence by, e.g., Zhang, Zhang and Zhao (2003), shows that in China the state sector had significantly lower R&D and productive efficiency than the non-state sector, and that within the non-state sector, foreign firms had higher R&D and productive efficiency than domestic collective owned enterprises and joint stock companies. At the same time, Chinese state-owned enterprises had few successes in closing the R&D and technology gaps through direct technology transfers. Taken together, these developments motivated the Chinese government to use the JV mechanism to achieve the goals of learning/transferring superior foreign technology and developing its industries and overall economy.

domestic competition on FPs' ownership shares in their joint ventures with Japanese partner firms. The estimation results are consistent with our theoretical prediction that the presence of domestic competition depresses FPs' bargaining power and hence their ownership shares in the joint ventures.

It is possible to extend our method of analysis for evaluating various public policy alternatives regarding FDI projects. For example, both developed and developing countries with relatively small domestic markets sometimes resort to the introduction of new foreign competitors when their domestic markets suffer from domestic monopolists' abuse of market power. Canada, for example, is known to use inward FDI as a government policy tool for dealing with abusive domestic monopolists. Some of our welfare implications may be useful for evaluating such FDI-driven competition policies. Another application is to analyze the impacts on host country's welfare of the laws restricting FP's ownership shares. Restricting foreign ownership shares in inward FDI is being practiced in both developing and developed countries, especially in various service sectors (e.g. the airline industry). Finally, the model of this paper has relied on static framework. Technology spillover, which is one of the key concepts in the model, has dynamic features that may not be captured in static framework. A possible extension to dynamic cases includes the threat of future competition that FP may face. The local firms (JP or other HC firms) may take advantage of technology spillover, as well as the joint venture with FP as a learning experience, for developing their own future technology and in a few years later become FP's real competitors in the host-country market. The strengthened local firms may further emerge as viable competitors in FP's other (international) markets (e.g. Kabiraj and Marjit, 1993; Clougherty and Zhang, 2005, 2009; Feess, Hoeck, and Lorz, 2009; Chu and Wang, 2015; Ohashi and Toyama, 2015). These possibilities seem to be widely recognized among decision-makers of the technology-sending firms (e.g. Bennett et al., 2001) and thus these firms would design JV ownership structures accordingly and strategically. Investigating the implications of such dynamic, multimarket competition in the product market for JV ownership structures would be a fruitful area of future research.

Appendix

1. Proof of Lemma 1. We first compare HC's welfare between a FP being a pure exporter and a FP being a JV partner:

$$W_{JV}^N - W^e = (CS_{JV}^N - CS^e) + \left(\sum_{i=1}^{N} \pi_{HCi-JV}^N - \sum_{i=1}^{N} \pi_{HCi}^N\right] + (1+\beta)\pi_{JV}^N \tag{A1}$$

According to (13) and (21), to have $W_{JV}^N > W^e$ we need:

$$[2(N+1)a - N(c_{HC-JV} + c_{HC}) - (c_{FP} + t + c_{JV})][N(c_{HC} - c_{HC-JV}) + (c_{FP} + t - c_{JV})]$$
$$- 2N[2a - 2(c_{HC-JV} + c_{HC}) + (c_{JV} + c_{FP} + t)][2(c_{HC-JV} - c_{HC}) + (c_{FP} + t - c_{JV})] + (1-\beta)\pi_{JV}^N > 0 \tag{A2}$$

The first term on the left-hand side of A2) captures the difference in *CS*, which can be easily seen to be positive. The *CS* gain comes from two sources: (i) JV presence may reduce the HC firms' cost (i.e. $c_{HC-JV} \le c_{HC}$ by ((15)), owing to the technology spillover; and (ii) JV (strictly) lowers FP's cost (i.e. $c_{JV} < c_{FP} + t$ by (14) and $t \ge 0$). The second source is due to JV's leveraging on JP's local knowledge, or its bypassing trade barriers, or both. The second term in (A2) captures the change in domestic profit. On the other hand, the JV formation affects the profit of N HC firms both positively and negatively. The positive effect is obvious, in that $c_{HC-JV} \le c_{HC}$ as indicated above; whilst the negative effect arises because these domestic firms now face a tougher opponent than the FP exporting, in that $c_{JV} < c_{FP} + t$. Finally, the last term in (A2) captures the domestic share of JV profit, which is nonnegative.

Without knowing about both the extent of spillover and JP's share in JV, consider the most conservative (yet possible) case of $c_{HC-JV} = c_{HC}$ and $\beta = 1$ ("conservative" for the purpose of our comparison). In this case, $W_{JV}^N > W^e$ reduces to:

$$2(N+1)a - N\cdot(c_{HC-JV} + c_{HC}) - (c_{FP} + t + c_{JV}) > 2N\cdot[2a - 2(c_{HC-JV} + c_{HC}) + (c_{JV} + c_{FP} + t)] \tag{A3}$$

Further, define $W^e(t^*) = \max W^e(t)$: that is, the host government chooses t to maximize domestic welfare (13), which consists of domestic consumer surplus CS^e and domestic profit $\sum_{i=1}^{N} \pi_{HCi}^e$. Maximizing component $\sum_{i=1}^{N} \pi_{HCi}^e$ requires t being as large as possible, whilst maximizing CS^e requires t to be as small as possible. And optimal t^* will balance these two opposing requirements:

$$t^* = [3Nc_{HC} - (N-1)a - (2N+1)c_{FP}]/(2N+1). \tag{A4}$$

Given t^* of (A4), (A3) then becomes

$$(N-1)a + (2N+1)c_{JV} - 3Nc_{HC-JV} < 0 \tag{A5}$$

which, after rearranging the terms, is exactly condition (16). This condition ensures $W_{JV}^N > W^e$.

Next we show that the condition, (16) or (A5), also ensures that JV formation is in FP's best interest. This will happen if FP's profit from the JV is greater than its profit from direct exporting, i.e. $\beta\pi_{JV}^N > \pi_{FP}^e$. A necessary condition for this is that $\pi_{JV}^N > \pi_{FP}^e$ or equivalently,

$$N(c_{HC} - c_{HC-JV}) < (N+1)(c_{FP} + t - c_{JV}) \tag{A6}$$

Note that condition A6) implies $c_{FP} + t > c_{JV}$ since we have $c_{HC-JV} \le c_{HC}$ by ((15). At $t = t^*$, we have

$$c_{FP} + t^* - c_{JV} = -[(N-1)a + (2N+1)c_{JV} - 3Nc_{HC}]/(2N+1) \tag{A7}$$

which is positive under condition (A5). Furthermore, using (A7) we can show that condition (A6) holds under (A5).

Finally, we can extend our comparison between FP's exporting versus JV setup in HC to the situations where the HC government's choice of trade barrier t is not optimal but HC can choose the level of IP protection, R. Thus, there are feasible ranges of a, t, R and β such that both the host country and the FP prefer the JV to FP's direct exporting. □

2. Proof of Proposition 1. These five comparative-static results are obtained by differentiating β^{NB} with respect to each parameter concerned, of which the first four results can be easily shown (note, in particular, that part (iii) is obtained by replacing the corresponding expression in (23) with (22)). To show part (v), we differentiate β^{NB} with respect to N:

$$d\beta^{NB}/dN = (1-\alpha)(d\underline{\beta}/dN) \tag{A8}$$

Given $\alpha < 1$, we want to show $(d\underline{\beta}/dN) < 0$. Using (23) it can be calculated that $d\underline{\beta}/dN$ has the same sign of the following expression:

$$[a - (N+1)c_{JV} + Nc_{HC-JV}](c_{HC} - c_{FP} - t) - [a - (N+1)(c_{FP} + t) + Nc_{HC}](c_{HC-JV} - c_{JV}) \tag{A9}$$

Notice that the second term in A9) is always negative by ((15) and (10) (to ensure $x^e_{FP} > 0$), while the first term will, by 18) (to ensure $x^N_{JV} > 0$), be non-positive if and only $t \geq c_{HC} - c_{FP}$. In the extreme case of $c_{HC-JV} = c_{HC}$ (zero leakage from JV to HC competitors, which are non-JV partners), (A9) becomes, after manipulating the terms, that:

$$(a - c_{HC})(c_{JV} - c_{FP} - t) \tag{A10}$$

which, by (14) and $t \geq 0$, is negative. Thus, $(d\underline{\beta}/dN) < 0$ as long as c_{HC-JV} is sufficiently close to c_{HC}. The latter condition can also be ensured if the enforcement of IP protection is sufficiently strong, noting that the HC government can choose R in (22) such that $c_{HC-JV} = c_{HC}$.

Now no particular conditions are imposed on the difference between c_{HC-JV} and c_{HC} (except, of course, the maintained assumption $c_{HC-JV} \leq c_{HC}$). At $t = t^*$ we have, by (A4), that $t^* - (c_{HC} - c_{FP}) = -(N-1)(a - c_{HC})/(2N+1) \leq 0$, and so (A9) is negative when $N = 1$ but it consists of a positive first term and a negative second term for $N > 1$. Further manipulation of (A9) however reduces the expression to

$$(a - c_{HC})[(N-1)a + (2N+1)c_{JV} - 3Nc_{HC-JV}]/(2N+1) \tag{A11}$$

which, by A5) or ((16), negative. The analysis above thus proves part (v). □

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