Discussion Paper No. 691

EXPORT, FOREIGN DIRECT INVESTMENT, AND JOINT VENTURES: LEARNING THE RIVAL'S COSTS THROUGH PROPINQUITY

Anthony Creane
and
Kaz Miyagiwa

June 2007

The Institute of Social and Economic Research
Osaka University
6-1 Mihogaoka, Ibaraki, Osaka 567-0047, Japan

Export, foreign direct investment, and joint ventures:

learning the rival's costs through propinquity

Anthony Creane[†] and Kaz Miyagiwa[‡,§]

We examine the role of cost uncertainty in a firm's choice between exporting and foreign investment in oligopolistic industry. We consider both foreign direct investment and an international joint venture, and allow country-specific and firm-specific cost uncertainty. Unlike exporting, either form of foreign investment exposes home and foreign firms to common country-specific cost shocks, implying a better knowledge of each other's country-specific shocks. Further, a joint venture allows the firms to learn each other's firm-specific cost. A firm's plant location decision depends on the interaction of these two effects, which depend on the type of competition and the substitutability of the firm's products.

JEL: D83, F12
Key words: Country-specific cost uncertainty, learning, Foreign investment, FDI, Joint ventures

[†]Michigan State University
[‡]ISER, Osaka University, and Emory University

[§]We thank Jim Anderson, Carl Davidson, Steve Matusz and participants at the Hitotsubashi Trade Conference (2006), IIOC Conference (2006) and at seminars at Kobe University and George Washington University for their comments on preliminary work. We would also like to thank the Department of Economics at Boston College (Creane) and at Hitotsubashi University (Miyagiwa) for their hospitality while working on this paper.

1. Introduction

Over the last quarter-century multinational activity (measured by production and sales of foreign affiliates) has grown at much faster paces than GDP and trade (Markusen, 2002). The impressive rise in multinational activity has prompted international trade economists to seek reasons why some firms choose foreign investment over exporting. The seminal works of Helpman (1984), Markusen (1984) and Ethier (1986) on the emergence of multinational enterprises, and others that have followed them, have established that market access mode decisions are influenced by technology characteristics such as firm-level and plant-level scale economies as well as country characteristics such as market sizes, differences in marginal costs, and trade costs.[1]

In this paper we focus instead on the role of cost uncertainty in a firm's choice between exporting and foreign investment. There is a well-developed literature on a firm's location choice under exchange-rate uncertainty in non-strategic settings; see, e.g., Goldberg and Kolstad (1995), Viaene and Zilcha (1998), Sung and Lapan (2000).[2] The present paper differs from these in that it focuses on the effect of cost uncertainty in a setting where a firm's location choice has strategic implications.

Our model has two features that are novel in the literature. First, we distinguish two types of cost uncertainty. One is country-specific, that is, it depends on where production takes place and may reflect fluctuations in locally procured input prices or supplies.[3] The other is firm-specific or idiosyncratic cost uncertainty, which reflects fluctuations in product-specific input prices or firm-specific production processes and is independent of plant location.[4] Second, while the literature

---

[1] See Caves (1991) and Markusen (1995, 2003) for reviews of this literature.
[2] Kotseva and Vetts (2005) study the case of demand uncertainty in which a firm learns a demand parameter over time.
[3] Country-specific cost or production uncertainty has been widely studied in the international macroeconomics literature, but not in the study of international oligopoly.
[4] There, of course, can additional idiosyncratic uncertainties that the rival could never learn, but adding these to the model would not change the results.

usually considers a firm's choice between exporting and FDI, this paper further distinguishes between two types of foreign investment, namely, FDI, which is a stand-alone operation, and a joint venture or a merger.

Unlike exporting, either form of foreign investment exposes foreign and home firms to the common country-specific cost shocks as they come to produce in the same country. For example, facing a high wage implies that the rival is also facing a high labor cost. Other actions the firms take, e.g., using common suppliers, enhance this effect. The exposure to common country-specific cost shocks allows the firms to learn the country-specific component of the rival's cost by observing its own. As a result, the exposure to common cost shocks introduces a correlation of strategies, the phenomenon hitherto unexamined in the literature. We call the effect from this the common-shock effect.[5] The common-shock effect occurs uniquely in an environment where a firm's location choice has strategic ramifications.

Further, unlike FDI, formation of a joint venture (or merger) enables the firms to learn some information about each other's idiosyncratic cost – the types of information that are not revealed through common market activities. We call this the information-sharing effect. Importantly, unlike the learning of common country-specific cost through the common-shock effect, sharing each other's idiosyncratic cost information does not directly cause the firms' strategies to be correlated.[6] While recent work, most notably Qiu and Zhou (2006) has considered how FDI may be chosen to acquire information about local demand, to the best of our knowledge, the cost learning aspect as well as its interaction with the common-shock effect has been unexplored. Furthermore, as cost information has

---

[5] This common-shock effect could be further decomposed into two components, one reflecting the learning aspect and the other reflecting the correlation of costs without the learning aspect. In Creane and Miyagiwa (2007) we study an environment in which only the correlation exists, separating out the learning that is inherent here.

[6] The information-sharing effect has been extensively studied in the literature in context of whether contracts exists such that in equilibrium all firms will agree to share their information with all of their rivals (for an overview, see Vives 1990; for the specific case of cost learning, see, e.g., Gal-Or 1986). The main contribution here is to examine how the information-sharing effect interacts with the common-shock effect, which is induced one-sidedly only by the foreign firm.

private-valued aspects, the strategic effects are starkly different from demand information (common-valued). Finally, the information sharing aspect of FDI (that is, there is bilateral learning from FDI – each firm learns about the other's costs – while in e.g., Qiu and Zhou the learning in unilateral – home firms do not learn about a foreign investor's home demand) has gone unnoticed.

To focus on purely informational aspects of formation of a joint venture we depart from the convention of treating a joint venture as a potential collusive device, but instead assume that firms in a joint venture continue to compete in the product markets, as with FDI. Qiu and Zhou (2006) take a similar approach to isolate the information-gathering aspect of merger from its collusive aspect in their study of international merger. Furthermore, the real word abounds with examples of such non-collusive production joint ventures, the best-known case being NUMMI (New United Motor Manufacturing, Inc), in which Toyota and the General Motors produce cars under their own names at the Freemont, California, plant. Indeed, governments typically will only sanction a joint venture if it can be shown to be non-collusive.[7]

To fix these ideas, we consider a foreign firm competing with a home firm in the home country. We use the convention that FDI (locating an independent plant in the foreign country) results in the firms facing a common cost shock, while a joint venture (producing in a joint factory with the home firm) leads additionally to spillovers of each other's idiosyncratic cost aspects. The firms play a three-stage game. First, the foreign firm decides whether to export, or to sell from an independent subsidiary or to set up a joint venture with the home firm, with the home firm's agreement. Then nature chooses cost values and each firm discovers its own costs but not the rival's

---

[7] From this GM has learnt a great deal from Toyota regarding quality and efficiency in production (Teresko 2006). Other auto examples include the Flat Rock plant where Ford produces rear-wheel drive vehicles and trucks while Mazda produces front-wheel drive vehicles (Sawyer 2004) and in Poland where Ford shares a factory with Fiat with each producing a different car (Polish Press Agency 2005). Additional examples include flat screen televisions (Masaki 2006), flash memory (DeTar 2000), vegetable juice (where part of the agreement is the use of different suppliers, Smith 2001), silicon wafers (Van Grinsven 2000), steel (Cullison 1989) and beer (e.g., Kirin in the US is brewed at an Anheuser-Busch plant). Additional examples can be found in Morasch (2000).

idiosyncratic costs unless there is a joint venture. Finally, the firms compete in the home market, given the plant location chosen in stage one.

Our analysis shows that whether the foreign firm exports or chooses between FDI and a joint venture hinges crucially on the interactions of the common-shock and the information-sharing effect, which in turn depends on the type of competition (price or quantity). We find that, if the firms compete in quantities the common-shock effect is negative, making both types of foreign investment a less attractive option than exporting. However, the information-sharing effect is positive, thereby making a joint venture a more attractive choice relative to FDI. Price competition leaves the common-shock effect intact but the information-sharing effect becomes negative, making FDI relatively more attractive than joint ventures.

We also examine the effect on home country welfare. The home country's most preferred option can differ from the foreign firm's choice, in which case the home government has incentive to intervene so as to influence the latter's decision. Thus, our analysis can throw new light on the formation of home country policy towards foreign investment. To illustrate the possible conflict between the foreign firm and the home country government, suppose that firms engage in Cournot competition with a homogeneous good. In this case, the common-shock effect is negative, making exporting more profitable than FDI, but as we show below the information-sharing effect dominates the common-shock effect, making a joint venture more profitable than exporting. Thus, the firms prefer a joint venture to either exporting or FDI. However, home country welfare is greatest with exporting. Thus, the welfare-maximizing home country government may have a rationale for banning joint ventures and mergers between home and foreign firms even if such ventures are not collusive. The collusive aspect of joint ventures then augments the home government's skepticism against joint ventures and mergers.

Finally, to explain a firm's access mode decision much of the literature introduces some asymmetries in country or firm characteristics; for example, a firm incurs transport cost when

exporting, and setup or fixed cost with foreign investment (FDI).[8] To prevent such asymmetries from driving our results, we assume away any trade cost or setup cost, and assume equal variances for each type of cost uncertainty, so that in the absence of uncertainty the firms are completely indifferent among the three options we consider. The symmetry we impose on our model has additional benefits. First, it is straightforward to introduce asymmetries into the uncertainty from which additional results can be obtained. Second, the symmetry allows us to readily apply our model to other settings and examine other issues; for example, it is straightforward to extend the model to a two-country setting to offer an explanation as to why the bulk of foreign investment today flows between high-income economies instead of from the rich to the poor countries (Markusen, 1995 and 2002, chapter 1), or why similar firms in a developed country may chose differing plant locations when selling in a new market.

The remainder of the paper is organized in five sections. Section 2 sets up the model. Section 3 compares expected profits and host-country welfare from exporting, FDI and a joint venture for quantity competition. Section 4 does the same with price competition. Section 5 discusses additional results that asymmetric cost variances can bring. Section 6 concludes.

2. Environment

Suppose that a foreign firm (firm 1) competes with a home firm (firm 2) in the home market (market 2). Firm *i* faces inverse demand $p_i = \quad - q_i - \quad q_k$, where [0, 1] is a measure of product substitutability. The case in which =1 corresponds to the classic Cournot model. Firm 2 always produces in country 2, but firm 1 is footloose; it may export from country 1 or produce in country 2. Production costs are linear and separable between a country-specific component and a firm-specific component: $c_i(q) = (c_{i,N} + c_{i,F})q_i$, where the subscript N indicates country- or nation-specific cost and

[8] See, e.g., Helpman, Melitz and Yeaple (2004), Horstmann and Markusen (1992), Motta (1992) and Horn and Persson (2001).

F indicates firm-specific or idiosyncratic cost.[9] To prevent asymmetry from driving the results, the characteristics of the distribution from which each cost component is drawn, are assumed identical: G(c) with $E[c_{iK}] = c_e$ and $Var[c_{iK}] =$ ^{2}, while the effect asymmetries can have will be examined in section 5. Assume further that exporting requires no transport cost and FDI and a joint venture involve no setup or additional fixed costs. These symmetry assumptions imply that in the absence of uncertainty, firm 1 is completely indifferent among the three options it faces, as is firm 2 to firm 1's choice.

We model the interaction between the firms in three stages. In stage one firm 1 chooses a mode of access to country 2 buyers among exporting, FDI and a joint venture. In stage two, nature moves and draws values for the costs, and each firm learns its own country-specific and firm-specific cost realizations. In addition, depending on the plant location choice made in the first stage as discussed below, the firm may learn its competitor's cost realization(s). In stage three the firms compete in the product market, given the choice from stage one.

If exporting is chosen, production takes place in separate countries, and hence neither firm learns about the rival's cost realizations. Thus, the stage-three game is one of incomplete information as regards country-specific and firm-specific costs. With FDI, the firms learn the common country-specific shock but are ignorant of each other's idiosyncratic cost, so they play a game of incomplete information regarding only idiosyncratic costs. Finally, with a joint venture the firms learn about each other's idiosyncratic cost, as well, and so they play a game of complete information. We begin with quantity competition.

3. Quantity competition

In this section we assume that the firms compete in quantities. To derive the equilibrium we

[9] As noted earlier, adding additional idiosyncratic cost components that the rival could never learn does not change our qualitative results.

first characterize the third stage for all possible outcomes and then work back to each previous stage.

3.A The third stage

In the third stage each firm simultaneously sets output. Firm *i* maximizes expected profit

$$E[(\quad - q_i - \quad q_k - (c_{i,N} + c_{i,F}))q_i].$$

From the first order condition firm *i*'s best response is

$$q_i = [\quad - (c_{i,N} + c_{i,F}) - \quad E(q_k)]/2. \tag{1}$$

Note that firm *i*'s output is linear in firm *k*'s choice and its own costs. To ease calculation of equilibrium outputs, it is useful to first calculate the outcome as if there were no uncertainty, i.e., each cost parameter equals its mean. In such a case, the Cournot-Nash equilibrium output is

$$q_{ei} = [\quad (2 \quad) - 2(c_{ei,N} + c_{ei,F}) + \quad (c_{ek,N} + c_{ek,F})]/ \tag{2}$$

where $\quad 4 \quad ^2$ and the subscript *ei* indicates the expected for firm *i*.

With this preliminary calculation made, we derive the equilibrium outputs and profits for exporting, FDI and a joint venture. With exporting, the firms learn neither a rival's country-specific nor firm-specific cost shocks and so they play a game of incomplete information. Noting that firm *i*'s expectation of firm *k*'s output equals q_{ek}, the Bayesian-Nash equilibrium outputs and profits are straightforward to derive from (1) and (2):

$$q_i^X = [\quad (2 \quad) - 2(c_{i,N} + c_{i,F}) + \quad (c_e + c_e)]/ \quad + \quad ^2[(c_{i,N} \quad c_e) + (c_{iF} \quad c_e)]/2$$

where the superscript X represents firm 1 choosing to produce and export from country 1. Firm *i*, after setting its output, expects its third stage profits to be (i.e., conditioned on its observation $\{c_{i,N}, c_{i,F}\}$)

$$E_{c_i}[\quad _i^X] = [\quad - q_i^X - \quad E_{c_i}[q_k^X] - (c_{i,N} + c_{i,F})] q_i^X = [q_i^X]^2 .$$

With FDI, firm 1 produces at an independent plant in country 2, by which the firms learn common country-specific cost shocks but not each other's idiosyncratic cost shocks. Using (1) and

modifying (2) in this setting yields the equilibrium levels of output of:

$$q_i^{FDI} = [\quad (2 \quad) - 2(c_{2,N} + c_{i,F}) + \quad (c_{2,N} + c_e)]/ \quad + \quad ^2(c_{i,F} \quad c_e))/2 \quad .$$

Firm *i*, after setting its output, expects its third stage profits to be

$$E_{c_i}[\ _i^{FDI}] = [\quad -q_i^{FDI} - \quad E_{c_i}[q_k^{FDI}] - (c_{i,N} + c_{i,F})]\, q_i^{FDI} = [q_i^{FDI}]^2 .$$

Finally, with a joint venture, in addition to country-specific costs, the joint factory results in firm-specific aspects of costs also being revealed to the rival. The firms thus play a game of complete information, so the usual calculus yields equilibrium outputs and profits. Outputs are

$$q_i^J = [\quad (2 \quad) - 2(c_{2,N} + c_{i,F}) + \quad (c_{2,N} + c_{k,F})]/ \quad ,$$

where J indicates joint venture. With complete information firm *i* knows at the beginning of the third stage what its profits will be

$$_i^J = [\quad -q_i^J - \quad q_k^J \quad - (c_{i,N} + c_{i,F})]\, q_i^J = [q_i^J]^2 .$$

Now all the third-stage games have been characterized. In stage two Nature moves, revealing relevant information to the firms. We are ready to proceed to the first stage.

3.B The access mode decision

The first thing to note is that in the first stage the expected output is the same independent of the firm's access mode decision. That is, from the definitions above of q_i^X, q_i^{FDI}, and q_i^J we can see that in stage one (before costs are realized) their expectations are equal: $E[\,q_i^X\,] = E[\,q_i^{FDI}\,] = E[\,q_i^J\,]$. It is convenient to define this "mean" output as(q. Note that(q_1 =(q_2 by symmetry. It follows from the definitions of profits in section 3.A that the profit evaluated at the expected cost are also equal across access model decisions and firms: $_i^X(c_e) = \ _i^{FDI}(c_e) = \ _i^J(c_e)$ for i = 1, 2, which allows us to focus on a representative firm. In particular, it is useful to define this common profit by:( ) .

We can now write the stage-one expectation of the profits in a useful manner. When firm 1

chooses exporting, each firm observes its own costs but not the competitor's, so neither firm responds to the competitor's cost realizations. Hence, the competitor's cost cannot introduce variance into the firm's profits as it only enters linearly. Firm *i*'s expected profits are

$$E[\ {}^{X}_{i}\ ] = (\ ) + {}^{2}/4 + {}^{2}/4 \qquad (3)$$

where the first variance term corresponds to firm *i*'s idiosyncratic cost term and the second to its country-specific cost term.

With FDI, taking the expectation yields

$$E[\ {}^{FDI}_{i}\ ] = (\ ) + {}^{2}/4 + {}^{2}/(2+\ )^{2}. \qquad (4)$$

Here again the first term is the variance representing the firm's idiosyncratic cost shock and is identical to that with exporting. The second variance term, reflecting the country-specific cost uncertainty, differs from its counterpart with exporting, now that both firms face the same country specific shock. This difference is what we termed the common-shock effect. Using (3) and (4), we state our first result (Q indicates quantity competition).

Lemma 1Q: ***With quantity competition the common-shock effect is negative.***

To gain an intuitive understanding of the common-shock effect, suppose that firm 2 has a higher-than-average country-specific shock and contracts its output, benefiting firm 1. However, with FDI firm 1 also faces the same high cost and contracts its output as well – the common-shock effect. In contrast, with exporting the firm's costs are uncorrelated and firm 1 is ignorant of firm 2 having high cost, so this has no effect on firm 1's output. Thus, the common-shock effect makes profits less convex, and hence is negative, implying that firm 1 is better off with exporting than with FDI. By symmetry firm 2 also prefers exporting to FDI. Finally, observe that due to the symmetry both firms have exactly the same preference between the two access modes firm 1 chooses.

Turning to a joint venture, the first-stage expected profits are calculated to be

$$E[\ {}^{J}_{i}\ ] = (\ ) + 4\ {}^{2}/(4\quad {}^{2})^{2} + \ {}^{2}/(2 + \ )^{2} + \ {}^{2}\ {}^{2}/(4\quad {}^{2})^{2}. \qquad (5)$$

The middle variance term is the same as with FDI and reflects the common-shock effect discussed above. With a joint venture, however, the first variance term, which reflects the firm's idiosyncratic uncertainty, differs from its counterpart under exporting or FDI. Furthermore, there also appears a third variance term, ${}^{2}\ {}^{2}/(4\quad {}^{2})^{2}$. These differences between FDI and a joint venture capture the information-sharing effect. Using (4) and (5) we obtain

Lemma 2Q: ***With quantity competition the information-sharing effect is positive.***

To intuitively understand the nature of the information-sharing effect, consider first the third variance term in (5). This is the variance in the rival's idiosyncratic cost. Suppose that firm 2 draws a higher-than-average firm-specific cost. Then, firm 2's best-response function shifts down, which benefits firm 1 at any output level it produces. But if it knows that firm 2 has a high cost, firm 1 can increase output and earn an even greater profit. By the same logic, if firm 2 has a low cost, it is bad for firm 1, but firm 1 could minimize the damage by contracting its output if it knew firm 2 has a high cost. Thus, knowing firm 2's idiosyncratic cost shocks allows firm 1 to react optimally and raises expected profits to firm 1.

Turning now to the first variance term in (5), we see that the own firm-specific cost variance also is larger than with FDI. The intuition is similar to the previous intuition. If firm 1 has a lower-than-average cost, it can capture a larger market share if firm 2 is informed and contracts output than if firm 2 does not respond. Although by the same logic firm 1 is hurt more when it has a higher cost and firm 2 responds, the benefit from being able to expand output when its cost is low more than offsets the harm when its cost is high.[10] In sum, the information-sharing effect is positive, as a

[10] As discussed in the introduction this is a well-know feature of the models analyzing similar issues; see, e.g, Qiu (1994) and Creane and Miyagiwa (2005) in an international trade setting and more generally, see Vives (1990). As

comparison of (5) with (4) shows, implying the firms always prefer a joint venture to FDI.

We can now examine location choice so as to characterize the trade-offs between the two effects. Since the common-shock effect and information-sharing effect have opposite signs, the choice between exporting and a joint venture depends on which effect dominates. Intuitively, the more substitutable the products, the more convex the profits are, and hence the greater the information-sharing effect – the first and third variance terms in (5). On the other hand, starting from independent products (= 0), as the substitutability increases, the common-shock effect intensifies, reducing expected profits. As a result, there is a range of positive in which exporting is preferred to a joint venture. Denote this critical by *, which is defined as the unique root of { ^{3} 12 ^{2} + 8 = 0} on the interval [0,1] (* 0.7). By an explicit comparison of (3) and (5) we can now characterize

Proposition 1Q*: With quantity competition*

(a) FDI is less profitable than either exporting or a joint venture.

(b) A joint venture is the most profitable strategy if > *; exporting is the most profitable strategy otherwise.

For reference to the literature, in the classic Cournot case of homogeneous goods the firms prefer a joint venture to exporting, and exporting to FDI.

3.C. Host country policy

We next examine the effect on country 2 welfare, given by the sum of consumer surplus and profit to firm 2. The main focus is when the firms' and the host-country (country 2) government's plant location choices diverge, and what type of government interventions can be inferred from it.

---

previously noted, one difference here is that the foreign firm can make a unilateral decision to force information sharing between firms. This can be important when firms compete, instead, in prices (see the footnote after lemma 2P in section 4) because then their incentives can be opposed.

To make welfare comparisons possible we introduce preferences that would generate the demand specified in the previous subsections. Assume that there is a continuum of identical consumers with separable, linear utility in the numeraire good and quadratic preferences for the differentiated goods. For the demand specified in quantity competition this implies that utility is represented by the quadratic function

$$U(q_1,q_2) = \quad (q_1 + q_2) - (1/2)(q_1^2 + 2\ q_1q_2 + q_2^2), \quad > 0,\ 1 \geq \quad > 0.$$

Hence, welfare is

$$W(q_1,q_2) = U(q_1,q_2) \quad p_1q_1 \quad p_2q_2 +)\ _2.$$

Using the consumer's first order conditions (i.e., the inverse demand facing each firm), consumer surplus is

$$CS(q_1,q_2) = q_1^2 + \quad q_1q_2 + q_2^2.$$

As firm 2's profits have already been derived in (3) – (5), we need only derive the expected consumer surplus for each access mode choice, using $q_i^X, q_i^{FDI}, \ q_i^J$. Again, given the certainty equivalence of these outputs, we need only calculate the variance in stage one for each of the three options, letting $\overline{CS}_2$ denote consumer surplus evaluated at the expected costs.

If firm 1 exports, consumers are subject to all shocks, two country-specific and two firm-specific shocks, which are all uncorrelated. Thus, expected consumer surplus is

$$E[CS_2^X] = \overline{CS}_2 + \quad ^2/8 + \quad ^2/8 + \quad ^2/8 + \quad ^2/8 \qquad (11)$$

where the convention remains the same on the variance terms: the first is firm 1's idiosyncratic noise, the second is the variance on country 1's noise, the third is firm 2's idiosyncratic variance and the last is country 2's country-specific variance.

With FDI, country 2 consumers are no longer affected by country 1 specific noise but are

subject to the correlation of strategies. Thus, expected consumer surplus is

$$E[CS_2^{FDI}] = \overline{CS}_2 + \ ^2/8 + \ ^2(1+\ )/(2+\ )^2 + \ ^2/8 \qquad (12)$$

where the middle term is the variance arising from country 2's noise, reflecting the correlation of strategies. Correlated strategies under FDI reduce price variability, making consumer surplus less convex, which reduces the opportunity to diversify, and harms consumers.

With a joint venture, expected consumer surplus is

$$E[CS_2^J] = \overline{CS}_2 + \ ^2(4\ \ 3\ ^2)/2(4\ \ \ ^2)^2$$

$$+ \ ^2(1+\ )/(2+\ )^2 + \ ^2(4\ \ 3\ ^2)/2(4\ \ \ ^2)^2. \qquad (13)$$

Comparing (13) with (12) we find that expected consumer surplus is greater with FDI than with a joint venture. The following then summarizes consumers' preferences.

Proposition 2Q: ***With quantity competition, country 2 consumers always prefer exporting to FDI, and FDI to a joint venture.***

Turning to host country (country 2) welfare, the common-shock effect is negative, so country 2 consumers' and firm 2's preferences align, implying that welfare is greater with exporting than with FDI. Comparing welfare with FDI and that with a joint venture, recall that the information-sharing effect is positive, meaning the firm's expected profit is greater with a joint venture than with FDI. However, it is consumers' preference ranking that dictates the welfare ranking because the consumers always gain more than the firms when prices vary more. Thus,

Proposition 3Q*: *With quantity competition, country 2 welfare is greatest with exporting and lowest with FDI.

Thus, the product characteristics are key in determining the welfare ordering.

It is clear that there can be conflict between country 2 and firm 1. For example, if the firms

produce strong substitutes (> *), or more specifically, if they produce homogenous goods, firm 1 would prefer a joint venture to exporting (Proposition 1Q), while country 2 would prefer exporting (proposition 3Q). In such a case, the country 2 government may want to ban or tax foreign investment so as to encourage exporting. Furthermore, if it cannot, perhaps for political reasons, stop the foreign firm from investing, then the host country government would encourage a joint venture over an independent plant. While other work has attempted to explain these host country government policy choices through asymmetry, i.e. assuming that the home firm acquires knowledge that the foreign firm has, here no asymmetry has been imposed.

4. Price competition.

Following the strategic trade literature (e.g., Eaton and Grossman 1986), assume that price-setting firms produce differentiated goods and, by the appropriate choice of units, write demand for good *i* as

$$q_i = A - p_i + dp_k,$$

where d (0,1) measures the degree of product differentiation between the two goods. Thus, profits are

$$(A - p_i + dp_k)(p_i \quad (c_{1,N} + c_{1,F})).^{11}$$

The remainder of the analysis closely follows the steps from the previous section.

4.A The third stage

Firms simultaneously set their price. From the maximization of profits, firm *i*'s best response is

$$P_i = [A + (c_{i,N} + c_{i,F}) + d\,E(p_k)]/2. \qquad (6)$$

[11] Alternatively, we could invert the inverse demands from the previous section to derive the demands for this section. The results would not change. However, there would be significantly more notation.

Note that as with output competition firm *i*'s price is linear in firm *k*'s choice and its own costs. As a result, it is again useful to calculate the equilibrium prices when there is no uncertainty, i.e., each cost parameter equals its mean. In such a case, the equilibrium prices are

$$p_{ei} = [2(A + c_{ei,N} + c_{ei,F}) + d(A + c_{ek,N} + c_{ek,F})]/ \qquad (7)$$

where 4 d^2 and the subscript *ei* indicates the expected cost for firm *i*.

When firm 1 exports, neither firm learns a rival's cost. Following the analysis from section 3.A, the Nash equilibrium prices are:

$$p_i^X = [A(2 + d)) + 2(c_{i,N} + c_{i,F}) + d(c_e + c_e)]/ \quad d^2[(c_{i,N} \quad c_e) + (c_{i,F} \quad c_e))/2 \quad .$$

Firm *i,* after setting its price, expects its third-stage profits to be (i.e., conditioned on its observation $\{c_{i,N}, c_{i,F}\}$)

$$E_{c_i}[\ {}_i^X(p)] = (A - p_i^X + d\,E_{c_i}[p_k^X])(p_i^X \quad (c_{i,N} + c_{i,F})) = [q_i^X(p)]^2$$

where q(*p*) is to indicate outputs when firms compete in prices.

With FDI the equilibrium prices are

$$p_i^{FDI} = [A(2 + d) + 2(c_{2,N} + c_{i,F}) + d(c_{2,N} + c_e)]/ \quad d^2(c_{i,F} \quad c_e))/2 \quad .$$

Firm *i*, after setting its price expects its third stage profits to be

$$E_{c_i}[\ {}_i^{FDI}(p)] = (A - p_i^{FDI} + d\,E_{c_i}[p_k^{FDI}])(p_i^{FDI} \quad (c_{i,N} + c_{i,F})) = [q_i^{FDI}(p)]^2 .$$

Finally, if the firms engage in a joint venture, prices are

$$p_i^J = [2(A + c_{2,N} + c_{i,F}) + d(A + c_{2,N} + c_{k,F})]/ \quad .$$

With complete information firm *i* knows at the beginning of the third stage that its profits will be

$${}_i^J(p) = (A - p_i^J + d\,E_{c_i}[p_k^J])(p_i^J \quad (c_{i,N} + c_{i,F})) = [q_i^J(p)]^2 .$$

We can now proceed to the first stage and the firm's access mode decision.

4.B The access mode decision

As with quantity competition, in the first stage the expected output is the same across access modes. That is, from the definitions above, outputs in expectation are equal: $E[q_i^X(p)] = E[q_{i1}^{FDI}(p)] = E[q_i^J(p)]$ ($q_i(p)$. Given the definitions for profits it follows that the profits evaluated at the expected cost are also equal across access modes and firms. Let( ) denote this common profit.

If the firm 1 exports, then firm *i*'s expected profits are

$$E[\ _i^X(p)] = (\ ) + \ ^2/4 + \ ^2/4. \qquad (8)$$

This is the same as (3) from the previous section. With FDI, taking the expectation yields

$$E[\ _i^{FDI}(p)] = (\ ) + \ ^2/4 + \ ^2(1\ \ d)^2/(2\ \ d)^2. \qquad (9)$$

This again is analogous to (4), its quantity competition counterpart. Although the common-shock effect manifests itself differently in (4) and (9), the condition remains the same as with quantity competition; the common-shock effect does not depend on the type of competition. That is, a comparison of (8) with (9) shows that the results with quantity competition (lemma 1Q) hold with price competition as well. We denote results that hold in both quantity and price competition with a star, and so

Lemma 1*: ***With quantity or price competition the common-shock effect is negative.***

Turning to a joint investment, the first-stage profits are

$$E[\ _i^J(p)\ ] = (\ ) + \ ^2(d^2\ \ 2)^2/(4\ \ \ d^2)^2 + \ ^2(1\ \ d)^2/(2\ \ d)^2 + \ ^2d^2/(4\ \ \ d^2)^2. \qquad (10)$$

As in quantity competition, the information-sharing effect represents a change in profits between a joint venture and FDI. However, in this case a comparison between (9) and (10) shows that in contrast to the result with quantity competition

Lemma 2P: ***With price competition the information-sharing effect is negative.***

To understand the intuition behind this result, consider a change in the firm's idiosyncratic cost, the first variance term. If firm 1 draws a low cost, and lowers the price, firm 2 would also lower its price if it knew firm 1's cost is low, which reduces profits to firm 1. Although by the same logic profit to firm 1 is greater if it draws a high cost and firm 2 also raises its price, the inability to expand when the price is low harms firm 1; that is, learning under a joint venture reduces the size of variance in idiosyncratic cost, and makes expected profit less convex. Further, although the third variance term, which reflects variance of firm 2's idiosyncratic cost and has a similar interpretation, adds to expected profit, given symmetry, it is insufficient to reverse the outcome. As a result, with price competition the information-sharing effect is negative, making FDI a more attractive choice than a joint venture.

Both the common-shock effect and the information-sharing effect work in the same direction, giving an unambiguous decrease in expected profit as the firm switches from exporting to FDI or a joint venture, and from an FDI to a joint venture:

Proposition 1P. ***With price competition, exporting is more profitable than FDI, which is more profitable than a joint venture.***

Thus, while a joint venture is more attractive an option than FDI under quantity competition (proposition 2Q), it is reversed under price competition.

Finally, while the type of competition is critical to the optimal mode of access, in comparing across propositions 1Q and 1P, we see that some results are independent of the type of competition. In particular, because of the common-shock effect, exporting is always more profitable than FDI, and if the products are sufficiently weak substitutes, then exporting is the most profitable mode of access.

4. C Host country policy

The demand specified in the price competition setting implies that utility is represented by

the quadratic function $U(q_1,q_2) = A(q_1 + q_2)/(1 \ \ d) - (1/2)(q_1^2 + 2dq_1q_2 + q_2^2)/(1 \ \ d^2)$, $A > 0$, $1 > d > 0$. Otherwise, the derivations follow the previous section and so are omitted.

With firm 1 exporting, country 2's expected consumer surplus is

$$E[CS_2^X(p)] = \overline{CS}_2 + \ \ ^2/8 + \ \ ^2/8 + \ \ ^2/8 + \ \ ^2/8 \qquad (14)$$

which is identical to is quantity counterpart, (11). With FDI, it is

$$E[CS_2^{FDI}(p)] = \overline{CS}_2 + \ \ ^2/8 + \ \ ^2(1 \ \ d)/(2 \ \ d)^2 + \ \ ^2/8 \qquad (15)$$

where now the middle term is the variance arising from country 2's noise, and with a joint venture it is

$$E[CS_2^J(p)] = \overline{CS}_2 + \ \ ^2(4 \ \ 3d^2)/2(4 \ \ d^2)^2 + \ \ ^2(1 \ \ d)/(2 \ \ d)^2 + \ \ ^2(4 \ \ 3d^2)/2(4 \ \ d^2)^2 \qquad (16)$$

Note that the idiosyncratic variance and the country-specific variance terms once again look similar to those with quantity competition. Algebraic manipulation of (8-10) and (14-16) reveals that while the firms' preferences depend critically on the type of competition, consumers' preferences do not:

Proposition 2*: ***With either quantity or price competition, country 2 consumers prefer exporting to FDI, and FDI to a joint venture.***

Turning to welfare we can also use (8-10) and (14-16) to obtain:

Proposition 3P: ***With price competition country 2 welfare is greatest with exporting and lowest with a joint venture.***

Finally, using propositions 3Q and 3P, we can compare across price and quantity competition to obtain welfare results that are independent of the type of competition.

Proposition 4*: With either quantity or price competition, country 2 welfare is greatest with

exporting

5. Extensions

As we discussed in the introduction, the specific, symmetric structure we imposed on our model helps make the effects transparent. A second benefit of this structure is that there are straightforward extensions and applications that can be made. As the strategic effects of the access model is driven by the uncertainty, in this section we focus on the effects of relaxing the symmetry imposed on the cost distribution. To save space, we will not consider the entire set of possible cases, but limit ourselves to quantity competition.

6.A Role of differing country-specific costs shocks

Suppose first that the country-specific costs no longer have the identical variance. Let $\text{Var}[c_{1,N}] = \ _{1,N}^2$ and $\text{Var}[c_{2,N}] = \ _{2,N}^2$. Since firm 2 always produces in country 2, this change in assumption does not change its expected profits, whether firm 1 chooses exporting or FDI. Thus, proposition 1 holds for firm 2. Turning to firm 1, profit with exporting is

$$E[\ _1^X] = (\ ) + \ ^2/4 + \ _1^2/4 \qquad (3\ )$$

while profit with FDI is now

$$E[\ _1^{FDI}] = (\ ) + \ ^2/4 + \ _2^2/(\ +2)^2. \qquad (4\ )$$

If $\ _2^2 > \ _1^2$, then FDI increases the size of country-specific variance for firm 1, affecting the common-shock effect. This can reverse some of our early results. For example, with equal variance, the common-shock effect is negative and so FDI is less profitable. Now, if $\ _2^2$ is sufficiently greater than $\ _1^2$ FDI becomes more profitable to firm 1 because the very act of locating a plant in country 2 makes expected profit more convex to firm 1; compare (3) with (4). Thus, we can generalize parts of proposition 1Q to

Proposition 1Q : ***With quantity competition firm 1 prefers FDI to exporting, if and only if*** $<$ ***2(*** $_{2,N}^2$ $_{1,N}^2$***)/*** $_{1,N}^2$ ***(*** $_{2,N}^2$ ***is the variance of country-2 specific uncertainty).***

For example, if = 1; i.e., the goods are perfect substitutes, the inequality in proposition 1Q is satisfied if $_{2,N} > 3$ $_{1,N}/2$. In such cases, firm 1 prefers FDI, but firm 2's profits are still greater if firm 1 chooses exporting. Interestingly, then, firm 2 would want to petition the government to block FDI.

As the above example illustrates, asymmetries in variance of the country-specific costs can alter the common-shock effect. However, that is not the case with idiosyncratic costs variances, because they are independent of plant locations. Thus, an asymmetry in the size of variance of firm-specific costs would not change the firms' preferences between exporting and FDI; see (3) and (4). Similarly, the information-sharing effect is unaffected; therefore, a joint venture remains more profitable to both firms than FDI; compare (4) and (5).[12]

6.B Role of differing distributions on the cost shocks

We now consider what results when all four variances could differ. Any new results we might obtain however would depend primarily on the size of the country-specific cost variance relative to that of the firm-specific cost variance. From the analysis of the previous subsection, there is thus no loss of generality by holding the firm-specific cost variances equal.[13] Further, by inspecting (3) and (4) we see that asymmetries in the size of variances between country-specific and firm-specific costs do not affect the firms' preference rankings between exporting and FDI, so we

---

[12] With price competition an asymmetry can affect the information-sharing effect, which was negative under symmetry. If the rival's variance is greater, the firm can increase convexity of profit if it sets up a joint venture. But since the rival is harmed, it would not agree to a joint venture.

[13] Recall from the previous subsection that asymmetries in variance of firm-specific costs have no effect on our results.

focus on the preference orderings involving a joint venture.

First, comparing (3) and (5), we see that, if variances of the country-specific costs are sufficiently small relative to those of the idiosyncratic costs, then a joint venture is preferred to exporting for all [-1,1], partially reversing the results in proposition 2Q. The underlying intuition is straightforward: if country-specific variance is trivial, the decision is driven by the information-sharing effect, which is positive and so the firms prefer a joint venture to exporting.

In the reverse case; i.e., if the firm-specific variances are sufficiently small, then the common-shock effect dominates. Since the common-shock effect is negative, the firms would prefer separate countries of production. Thus, for all [0,1] exporting is more profitable than a joint venture, given that the country-specific variances are equal. If the firm-specific variances are sufficiently small but the country-specific variances differ, the common-shock effect is affected as described in the previous section. For example, if $_2^2$ is sufficiently larger than $_1^2$, firm 1 would choose a joint venture or FDI over exporting. But then firm 2 would be worse off and object to a joint venture so firm 1 would choose FDI.

6. Conclusions

A remarkable rise in multinational activity has spawned a growing interest in explaining why some firms choose foreign investment over exporting. Most of the literature explains the choice, exploiting asymmetries in firm and country characteristics. In this model, we focus on what we believe to the best of our knowledge are two new effects that drive our results: the common-shock and the information-sharing effect. While the propositions summarize our main findings, for comparison purposes it is useful to apply them to the standard model of homogenous-good Cournot duopoly. In this archetypal case, we find that the common-shock effect is negative, making exporting more profitable than FDI, but that the information-sharing effect dominates the common-shock effect, making a joint venture more profitable than exporting. Thus, firms choose a joint

venture over exporting, (proposition 2Q), while the host country consumers prefer exporting to a joint venture or FDI and home country welfare is also greatest with exporting (proposition 4Q). This implies that the home country government has incentives to ban joint ventures to ensure that firms choose exporting.

These results are obtained using a symmetric model. Introducing asymmetries in the variance of the cost shocks can introduce new results. For example, if there is greater country-specific uncertainty in the host country, then paradoxically, FDI may become more profitable than exporting for the foreign firm (proposition 1Q). As the last case demonstrates, introducing asymmetries may produce other interesting results. Due to the consideration of space, such extensions are left for future research.

Finally, our model can be applied to other settings. For example, we could apply the results to a North-South model in which two firms in a developed country choose between exporting and foreign investment in a less developed country that does not have a local firm.

References

Caves, R. E., 1996, *Multinational enterprise and economic analysis*, 2nd edition, London: Cambridge University Press.

Creane, A., and Miyagiwa, K., 2005, Information and disclosure in strategic trade policy, unpublished paper.

Creane, A., and Miyagiwa, K., 2007, Foreign direct investment and cost uncertainty: The correlation effect, unpublished paper.

Cullison, A.E., 1989, Kobe Steel plans joint production with USX, *Journal of Commerce*, February 15, 1989, p. 1A.

DeTar, J., 2000, Toshiba, SanDisk: Thanks for the memories, *Investor's Business Daily*, May 10, p. A6.

Eaton, J. and G.M. Grossman, 1986, Optimal trade and industrial policy under oligopoly, *Quarterly Journal of Economics,* 101(2), pp. 383-406.

Ethier, W. J., 1986, The multinational firm, *Quarterly Journal of Economics*. 101 (November) 805-833.

Gal-Or, E. 1986, Information Transmission – Cournot and Bertrand Equilibrium, *Review of Economic Studies* 53, 85-92.

Goldberg, L. S., and C. D. Kolstad, 1995, Foreign direct investment, exchange rate volatility and demand uncertainty, *International Economic Review* 36, 855-873

Helpman, E.; Melitz, M. J.; and Yeaple, S. R., 2004, Export versus FDI with heterogeneous firms. *American Economic Review* 94, 300-316

Horn, H., and Persson, L., 2001, The equilibrium ownership of an international oligopoly, *Journal of International Economics* 53, 307-333

Horstmann, I. J., and Markusen, J. R.; 1992, Endogenous market structures in international trade (natura facit saltum), *Journal of International Economics*, 32, vol. 1, 109-129

Kotseva, R, and N. Vettas, 2005, Foreign direct investment and export dynamics with demand learning, CERP Discussion Paper 5262.

Markusen, J. R.; 1995, The boundaries of multinational enterprises and the theory of international trade. *Journal of Economic Perspectives*, Vol. 9, No. 2, Spring, 169-189

Markusen, J. R., 2003, *Multinational firms and the theory of international trade*; Cambridge, MIT Press

Masaki, H., 2006, Sunset for Japanese chip makers?, Asia Times Online, January 27.

Morasch, K., 2000, Strategic alliances: a substitute for strategic trade policy? *Journal of International Economics*, 52 (1): 37-67 October 2000.

Motta, M., 1992, Multinational firms and the tariff-jumping argument: a game-theoretic analysis with some unconventional conclusions, *European Economic Review* 36 (December), 1557-1571

Polish Press Agency, 2005, Fiat and Ford to launch joint production in Tychy, Business, November 7.

Qiu, L. D., 1994, Optimal strategic trade policy under asymmetric information, *Journal of International Economics* 36, 333-354

Qiu L. D. and W. Zhou, 2006, International mergers: incentives and welfare, *Journal of International Economics* 68, 38-58.

Teresko, J., 2006, Learning from Toyota – again, *Industry Week*, 1 February.

Sawyer, C.A., 2004, Ford is fully flexed in flat rock, *Automotive Design & Production*, Nov.

Smith, C., 2001, Kagome links with Heinz in Japan, *Daily Deal*, July 26,

Sung, H., and H. E. Lapan, 2000, Strategic foreign direct investment and exchange-rate uncertainty, *International Economic Review* 41, 411-423

Van Grinsven, L., 2000, French, Dutch in chip venture, *Financial Times*, April 14, p. 12.

Viaene, J-M., and I. Zilcha, 1998, The behavior of competitive exporting firms under multiple uncertainty, *International Economic Review*, 39(3):pp. 591-609.

Vives, X. 1990. Trade association disclosure rules, incentives to disclose information and welfare. *Rand Journal of Economics* 21(3): 409-30.