STARTING SMALL IN AN UNFAMILIAR ENVIRONMENT

James E. Rauch*
Department of Economics
University of California, San Diego
La Jolla, CA 92093-0508

and

National Bureau of Economic Research
Cambridge, MA 02138

Joel Watson
Department of Economics
University of California, San Diego
La Jolla, CA 92093-0508

November 2002

We design a simple model of a developed country buyer's search for a less developed country supplier and the subsequent relationship between the two parties. Matched firms can "start small" with a trial order to gain information about the ability of the LDC supplier to successfully fill a large order. We show that the propensity for the buyer to start small increases with the cost of search for a new supplier and decreases with the probability that the current or new supplier can fulfill the large order successfully after training. We provide supportive empirical evidence for these and other results.

JEL codes: L24, D83

Keywords: outsourcing, search, technology transfer, uncertainty

*858 534-2405 (v), 858 534-7040 (f), jrauch@ucsd.edu.

I. **Introduction**

Partnerships often begin in a state of uncertainty, where there is some doubt about the prospect of success. In such an environment, the partners may "start small" by first attempting small-scale projects and then, if they are successful, graduating to larger ones. In this way, the parties structure their relationship in order to learn about one another before committing a great deal of resources to the enterprise. When deciding how to interact, partners also consider the chance that they will eventually terminate their relationship. The value of termination depends on how easily other matches can be made and on the information available about prospective new partners.

The partnerships with which we are concerned in this paper are between developed country (DC) buyers and less developed country (LDC) suppliers. We design a simple model in which a DC buyer engages in costly search in a heterogeneous pool of potential LDC suppliers, chooses between starting with a small or a large order, and decides whether to maintain a successful supplier relationship or abandon it in favor of a newly discovered supplier. At the beginning of a buyer-supplier relationship, the DC buyer is uncertain of whether the LDC supplier has the ability to successfully fill large orders. Our results allow us to make sense of the various empirical observations reported in section II, including the propensity of DC buyers to start with small orders when dealing with LDC suppliers in the same contracting environment that supports starting with large orders in relationships with DC suppliers. Another observation supported by the model is the reduction in the persistence of relationships between DC buyers and LDC suppliers following improvements in the LDC matching environment. We are also able to make new testable predictions concerning the interaction between starting small and persistence of relationships.

One of the conclusions to which our analysis leads is that the decision to start small cannot be understood without taking account of the need for DC buyers to make irreversible investments in training LDC suppliers. Insofar as this training involves transfer of technological know-how, starting small can be said to facilitate technology transfer from DCs to LDCs, in a sense to be made precise in section III below. This is an example of how the improved understanding of the formation of relationships between DC buyers and LDC suppliers generated by studying the process of starting small can yield other valuable insights. In our concluding section we will show how our results provide a new perspective on the literature regarding characteristics of LDC exporting firms.

The key elements of our model – (a) costly search in a heterogeneous pool of potential partners, (b) choice between different ways of building a relationship (starting small or big) under uncertainty, (c) the decision whether to maintain a supplier relationship or abandon it in favor of a newly discovered supplier – have been studied individually in the previous literature. The literature on optimal experimentation addresses element (b). For example, Moscarini and Smith (1998) examine a setting in which a decision maker can conduct variable-sized experiments before deciding whether to take an irreversible action. The outcome of the experiments yields information about the action's payoff. Under assumptions that are reasonable for some applications, Moscarini and Smith show that the optimal level of experimentation at any given time is increasing in the decision maker's assessment of the probability that the action will generate a high payoff. Thus, there is a sense in which a pessimistic decision maker "starts small."[1]

Element (b) is also addressed by the literature on irreversible investment under uncertainty (e.g., Dixit and Pindyck, 1994). Horstmann and Markusen (1996) analyze the choice by a multinational firm seeking to enter a new (foreign) market between direct investment and contracting with a local sales agent. Information gained from the agency contract is useful in the decision whether to pursue direct investment. Hence, the agency contract is analogous to "starting small" (though unlike starting small in that it may be desirable to extend it indefinitely).

In addition, the literature contains some complementary work in which starting small arises due to asymmetric information. For example, in the analysis of Ghosh and Ray (1996) and Watson (1996, 1999, 2002), agents start small when they are pessimistic about whether their partners will have the incentive to cooperate over time. Watson provides a full study of the dynamics of cooperation under incomplete information; he shows that it is optimal to start small and gradually raise the stakes in such an environment. Ghosh and Ray's model includes matching. In the "social equilibrium" they study, all agents choose to start small due to the presence of completely myopic types.[2]

---

[1]Aghion, Bolton, Harris, and Jullien (1991) and Keller and Rady (1999) study how a firm experiments to learn the demand curve. Bergemann and Välimäki (2000) and Bolton and Harris (1999) examine experimentation by several agents who observe each other's experimental results. See also the references cited in these papers.

[2]Datta (1996) and Kranton (1996) also discuss how starting small can serve a disciplining role in games. Carmichael and MacLeod (1997) demonstrate how a social convention requiring the exchange of gifts at the beginning of relationships can help sustain cooperation.

Element (a) has been analyzed in the literature on matching. For example, Smith (1997) and Smith and Shimer (2000) look at frictional matching between agents in a heterogeneous pool; the agents' production function exhibits complementarity. These authors find conditions under which assortative matching occurs in equilibrium. Element (c) is somewhat addressed by the labor literature. Jovanovic (1979), for example, models a worker who learns about the quality of his match over time and who can move from one firm to another over time. However, firm-worker pairs do not have the option to start big in that they cannot skip the phase where they learn about the quality of their match and make a relationship-specific investment that can earn larger, immediate returns. In the theoretical exercises of the other papers discussed above, there is no analysis of the supplier switching decision, so these models are not equipped to address issues such as the relationship between starting big and persistence.

Our modeling exercise generates novel insights by combining elements (a)-(c) and exploring how these different components of relationships interact. Following the section on empirical motivation, in section III we present the assumptions and notation of our model and establish the existence of a unique solution. Our results are derived in section IV. Conclusions and suggestions for further research are presented in section V. The Appendix contains all of the formal proofs.

II. Empirical Motivation

Development of our model was motivated by our desire to understand a characteristic way in which developed country (DC) buyers make their decisions regarding cooperation with potential less developed country (LDC) suppliers. Egan and Mody (1992) surveyed United

States buyers operating in LDCs, including “manufacturers, retailers, importers, buyers’ agents, and joint venture partners” (p. 322), and found that “buyers often begin with small orders, perhaps for a simple product, and let the relationship [with the LDC supplier] build gradually” (p. 330). The purpose of the small order is to learn about the capabilities of the LDC supplier’s manager and workers to meet the DC buyer’s requirements for price, quality, and delivery. Egan and Mody state (p. 326):

> Buyers looking for either new sources of supply or joint venture partners search for suppliers who manage their factories efficiently, often regardless of the level of technology those factories currently employ; interviewees commonly felt that new machines could easily be installed so long as workers already had the ability to use them efficiently and absorb training readily. For many buyers, management was the most important factor in defining an ideal supplier....As one buyer phrased it, “I do not invest in plant X but in Mr. Y. It all depends on the people.”

Tewari (1999) studied the relationships between European buyers and Indian woolen knitwear suppliers from the latter’s point of view. She confirms both the tendency to start with small orders and the use of these orders to discover the capabilities of the LDC suppliers: “The emphasis on smaller contracts is not to suggest that volumes are not important – they are – but that one might usefully think in terms of a sequence of learning on a small-scale and in a focused way, and then subsequently achieving larger scale and going for volumes....If they [the suppliers] continue to make mistakes, the large bulk buyer may simply go elsewhere” (p. 1664).

The method of payment typically used by DC buyers purchasing from LDC suppliers is the letter of credit, issued by a bank in the developed country that acts as an intermediary between the buyer and supplier. If the LDC supplier does not meet the provisions of the letter of credit, which can include a certificate of satisfactory inspection as well as a delivery date, etc., the issuing bank (and thus the DC buyer) does not have to pay.[3] This is similar to the buyer's legal right to reject delivery and withhold payment in the domestic U.S. context, described by Taylor and Wiggins (1997, p. 598). They show that such a contracting environment supports a regime of large orders from U.S. suppliers with which the U.S. buyer has done no previous business. Why then do U.S. buyers start small with LDC suppliers? Our answer turns on three key differences between the DC and LDC supplier conditions.

First, unlike with DC suppliers, buyers placing large orders with new LDC suppliers usually need to make a substantial investment in training them. On the basis of their aforementioned survey, Egan and Mody (1992, p. 328) report, "The buyer may send international experts to train local workers and supervisors....Buyers may also arrange short-term worker training in a developed country plant." In their survey of Korean exporters of manufactures, Rhee, Ross-Larson, and Pursell found that even in this relatively advanced LDC many firms required training by DC buyers (1984, p. 61): "Almost half the firms said they had directly benefitted from the technical information foreign buyers provided: through visits to their plants by engineers or other technical staff of the foreign buyers, through visits by their engineering

---

[3]Since the issuing bank must transmit payment if the provisions in the letter of credit are fulfilled, this method of payment also protects the seller relative to the cheaper and less cumbersome method of "open account," in which payment is completely at the buyer's discretion (Mann 2000). This security for the LDC supplier allows it to use the letter of credit as a means of obtaining working capital from its subcontractors: they are more willing to provide components in advance of payment knowing that the supplier is highly likely to receive the means to pay them.

staff to the foreign buyers." The training often covered how to organize production and quality control using the new equipment needed to fulfill large orders (Schmitz and Knorringa 2000). Buyers are willing to make such a training investment because they can obtain goods at much lower cost from LDC than DC suppliers thanks to cheap LDC labor. As noted by Pack and Page (1994, pp. 220-221), this training investment may involve transfer of technological know-how:

> to obtain still lower-cost, better quality products from major suppliers whose products account for a significant percentage of profits....they [the purchasers] are willing to transmit tacit and occasionally proprietary knowledge from their other OECD suppliers. Such transfers of knowledge are likely to characterize simpler production sectors such as clothing and footwear or more generally those older technologies that are not hedged by restrictions adopted to increase appropriability, such as patents and trade secrets.

Under the letter of credit method of payment, it is this training investment rather than the expenditure on the order itself that is at risk if the LDC supplier cannot meet the DC buyer's terms for price, quality, and delivery.

This brings us to the second key difference, which is that the probability of non-performance is much greater for LDC than DC suppliers. LDC suppliers may simply not have requisite managerial capability to learn how to meet international quality and delivery standards. Through starting small, the DC buyer discovers the LDC supplier's capability and willingness to learn to deliver a good to the buyer's specifications on time before making the investment in training that will allow the supplier to do so with a large order.[4] One objective indicator of the

---

[4]Clearly the DC buyer is more likely to learn the LDC supplier's relevant capabilities, the more the initial order resembles the product(s) that the DC buyer ultimately wants in large quantity. This may entail more expense than starting with a simpler product, in teaching design specifications for example. In Rauch and Watson (1999) we therefore not only allow the DC

lower quality of management in LDCs is the rate of ISO 9000 certification.[5] A U.S. buyer comparing the supplier environment in Europe with that in Latin America, for example, would have found in 1998 that the number of ISO 9000 certificates per industrial worker is nearly 15 times higher in the former than in the latter region.[6]

---

buyer to choose whether or not to start small but also to choose the intensity with which it starts small. This complicates our model considerably without significantly altering our results.

[5]The ISO 9000 standards are "generic management system standards" (International Organization for Standardization 1999, Preface). Nadvi (1999, p. 1606) states, "The upgrading required [to implement such standards] necessitates a capacity to learn both at the level of the individual firm and in the relations between firms." Evidence from Banerjee and Duflo (2000) indicates that ISO 9000 certification is *not* a way for a firm to signal that it is not a (myopic) shirker. They found that Indian software firms that were ISO 9000 certified were neither more nor less likely to be offered time and materials rather than fixed price contracts by foreign buyers.

[6]The numbers of ISO 9000 certificates per million industrial workers in 1998 were 1,908 for Europe and 130 for Latin America. The numbers of ISO 9000 certificates in 1998 are from International Organization for Standardization (1999, Annex A). The numbers of industrial workers are computed using the shares of industrial workers in the labor force for 1990 from *World Development Report 1997* (World Bank 1997, Table 4) and the sizes of the economically active populations in 1998 from *World Development Indicators 2000*. The European certification rate is even higher relative to that for Latin America if we use all nonagricultural workers as the base. We have included Eastern Europe but excluded former Soviet Union countries in the International Organization for Standardization figures for Europe; we have

The main cost of starting small is delay in realizing the profits from a large order. For some LDC suppliers the DC buyer may judge these profits to be great enough that it prefers to risk forfeiting its training investment and go with a large order right away rather than starting small. It is then reasonable to ask why a DC buyer would start small and build up to a large order with a less attractive supplier rather than simply look for a better one. This question leads to the third key difference between the DC and LDC supplier environments, which is that the cost of search for alternative suppliers is much higher in LDCs than in DCs due to inferior communication and transport infrastructure. Again comparing Europe with Latin America, we find, for example, that in 1990 the number of telephones per industrial worker is nearly six times greater in the former than in the latter region.[7] It is this higher search cost combined with the

---

added Mexico to the International Organization for Standardization figures for Central and South America to get our definition of Latin America. Bosnia, Cuba, Puerto Rico, Sweden, Yugoslavia, and all countries with population less than one million are excluded from the calculations due to missing labor force share data.

[7]We use 1990 data because so many countries have missing observations in later years. Even in 1990, however, number of telephone data are missing for 13 European countries and two Latin American countries. The numbers of telephones per thousand industrial workers in 1990 are 2,281 for Europe and 385 for Latin America. The numbers of telephones in 1990 were from an infrastructure database described in Canning (1998). The numbers of industrial workers are computed using the shares of industrial workers in the labor force for 1990 from *World Development Report 1997* (World Bank 1997, Table 4) and the sizes of the economically active populations in 1990 from *World Development Report CD-ROM 1999*. The number of telephones

greater risk of non-performance that leads to our title description of the LDC environment as "unfamiliar."

Once a DC buyer enters into a partnership with an LDC supplier it gains access to an information network composed of firms engaged in similar partnerships. Egan and Mody (1992, p. 329) report that "virtually all buyers first seek information within their own network. This network is a tight system of product-specific buyers and suppliers of both finished goods and components." Through this network, new potential LDC suppliers may come to the DC buyer's attention without the latter having to engage in costly search – for example, one DC buyer may introduce another to a supplier it encountered that makes a product variant that is better suited to the other buyer. Nevertheless, a new supplier is placed at a disadvantage relative to an existing supplier because the cost of training the latter has already been sunk and because the DC buyer's uncertainty regarding the capabilities of the existing supplier has already been (favorably) resolved. Indeed, Egan and Mody found that "U.S. buyers prefer to stay with [LDC] suppliers they know."

By the same logic, the tendency of partnerships between DC buyers and LDC suppliers to persist should be undermined if the probability of non-performance perceived by the former decreases. This is confirmed by a natural experiment observed by Nadvi (1999). In May 1994 the U.S. Food and Drug Administration (FDA) restricted imports of Pakistani-made surgical

---

per worker in Europe is even higher relative to that for Latin America if we use all nonagricultural workers as the base. For consistency we use the same definitions of Europe and Latin America as we did for computing ISO 9000 certification rates, with the same countries excluded from the calculations due to missing labor force share data.

instruments for failing to meet Good Manufacturing Practices (GMP), a set of quality assurance standards closely related to the ISO 9000 standards. By late 1997, 133 of the roughly 300 manufacturers in the Sialkot, Pakistan surgical instrument cluster were certified by the FDA as conforming to GMP standards, up from zero before the FDA action. Nadvi reports (1999, p. 1624) "GMP certification has for some buyers meant a return to arms-length contracts with local producers. Such buyers could loosen their longstanding ties with local producers and search out cheaper alternative suppliers."

In the next section we develop a model that incorporates the key features we have discussed of the matching environment between DC buyers and LDC suppliers. We will see in section 4 that this model both delivers results consistent with the findings reported so far and makes new testable predictions regarding the interaction between starting small and the persistence of relationships.

III. The model

A. Assumptions and notation

A DC buyer searches in discrete time over a large (infinite) pool of LDC suppliers. Suppliers are identical except for their per-period production cost for a large order, which is denoted by c. We let μ be the distribution of c in the pool of suppliers. The DC buyer pays γ to locate a supplier from the pool. The value of c for this supplier is observed immediately. However, whether the supplier will be able to fulfill large orders to the buyer's specifications is not known initially. Either the supplier will be *successful*, in which case large orders generate gross per-period sales of z for the DC buyer at the seller's per-period cost c, or the supplier will be *unsuccessful*, in which case gross sales are zero. Let p denote the ex ante probability that the supplier will be successful.

In addition, before trade between the buyer and supplier can take place, the buyer must invest I to perform supplier training necessary to produce large orders. This investment reveals whether the supplier will be successful or unsuccessful; i.e., training may or may not work. The buyer can also learn the supplier's capabilities before investing I by starting with a small order that yields no profit but, at the end of k periods, reveals whether the supplier will be successful with large orders (whether training will pay off).[8] The buyer also has the option not to work with this supplier and to search again in the next period.

When the DC buyer is engaged in a successful relationship with the LDC supplier, earning per-period profits $z - c$, it gains access to a network through which, at the end of every period, with probability q it is introduced to a new supplier (and learns the new supplier's per-period cost) without incurring any search cost. In the following period the buyer can either stay with its current supplier or go with the new one, in which case it must again choose whether to start with a small order or invest I immediately. Obviously a low value of c for the new supplier will encourage the buyer to switch.

We summarize and label the three options of the DC buyer that has just drawn an LDC supplier from the pool as follows:

Big: Invest I. If the supplier is successful, place large orders and receive $z - c$ each

---

[8]We could relax the assumption that the small order has no yield other than this information by, for example, allowing the small order to reduce the investment required for the large order on a less than one-for-one basis, without qualitatively changing any of our results.

period; if unsuccessful, return to the pool next period.

Learn: Place a small order. If k periods later it reveals large orders will be successful then invest I and place large orders; otherwise return to the pool.

Out: Reject the supplier and return to the pool next period.

We also define:

$v(c)$: The value of a successful relationship with a supplier with per-period cost c;

w: The value, inclusive of search cost, of selecting a supplier from the pool at random.

Letting δ be the buyer's discount rate, the following equations respectively describe the values of *Big*, *Learn*, and *Out*:

$$u^B(c) = pv(c) + (1-p)\delta w - I \quad \textbf{(1)}$$

$$u^L(c) = \delta^k[p(v(c) - I) + (1-p)\delta w] \quad \textbf{(2)}$$

$$u^O(c) = \delta w. \quad \textbf{(3)}$$

Now define

$$u(c) \equiv \max\,\{u^B(c), u^L(c), u^O(c)\}. \quad \textbf{(4)}$$

We have:

$$w = \begin{cases} E[u(c)|c\sim\mu] - \gamma & \text{if } E[u(c)|c\sim\mu] > \gamma \\ 0 & \text{otherwise (DC buyer does not search)} \end{cases} \quad \textbf{(5)}$$

$$v(c) = z - c + (1-q)\delta v(c) + q\delta E[\max\,\{v(c), u(c')\}|c'\sim\mu]. \quad \textbf{(6)}$$

Note from equation (6) that if $q = 0$ then $v(c) = (z - c)/(1 - \delta)$, which is the present discounted value of DC buyer profits from a stream of orders filled successfully by an LDC supplier with per-period cost c.[9]

We complete our model of search by a DC buyer and its ongoing relations with LDC suppliers with the following additional assumptions:

μ is a continuous distribution with support $[\underline{c}, \bar{c}]$;

$$\bar{c} > z - (1-\delta)I \text{ and } \underline{c} < z - \frac{(1-\delta)I(1-\delta^k p)}{p(1-\delta^k)}. \qquad \textbf{(A)}$$

Assumption (A) ensures that the model has an interior solution, where *Big*, *Learn*, and *Out* each occur with positive probability; this assumption is used to prove Proposition 2 in the following section.

The solution of the model is given by functions u^B, u^L, u^O, u, and v, and a number w, that satisfy equations (1)-(6).

B. Solution

To solve our model we start by characterizing the choice between *Big*, *Learn*, and *Out*.

---

[9]As is clear from comparing equations (1) and (2), the risk associated with an LDC supplier that is avoided by starting small is that the DC buyer will lose I without gaining $v(c)$. Suppose that, instead of making a training investment that reveals whether the supplier can fill large orders, the buyer simply purchases a large order and with probability $(1-p)$ earns a loss L due, say, to having to replace faulty products; in this case, the buyer also does not obtain $v(c)$ and thus returns to the matching pool in the next period. In this case we have $u^B = pv(c) + (1-p)(\delta w - L)$ and $u^L = \delta^k[pv(c) + (1-p)\delta w]$. The results for this environment are the same as those reported below, with L in place of I.

This choice is represented in the Figure.[10] It is easy to verify that $\partial u^O(c)/\partial c = 0 > \partial u^L(c)/\partial c > \partial u^B(c)/\partial c$, as depicted in the Figure. Note also from (4) that $u(c)$ is continuous and weakly decreasing. Cutoff values c^B and c^L are defined by $u^B(c^B) = u^L(c^B)$ and $u^L(c^L) = u^O(c^L)$. By definition,

$$\begin{array}{ll} \textit{Big} & \text{is selected for all } c \in [\underline{c}, c^B) \\ \textit{Learn} & \text{is selected for all } c \in [c^B, c^L) \\ \textit{Out} & \text{is selected for all } c \in [c^L, \bar{c}]. \end{array} \qquad \textbf{(7)}$$

As expected, the DC buyer rejects high cost suppliers and is willing to start with a large order and risk losing its training investment for low cost suppliers, leaving intermediate cost suppliers as the group with which the DC buyer prefers to start small. It may be that c^B and/or c^L is not in the interval $[\underline{c}, \bar{c}]$, in which case one or more of these options will not occur in the solution, given the pool of LDC suppliers. This is addressed in Proposition 2 below.

Next, let $c^*(c)$ define the cutoff value for the DC buyer's decision whether to go with a new supplier to which it is introduced; the DC buyer abandons its current LDC supplier to initiate a relationship with a new one with per-period cost c' if and only if $c' < c^*(c)$. We have $c^*(c)$ defined by

$$v(c) = u(c^*(c)) \qquad \textbf{(8)}$$

for all c. Note that, since $I > 0$ and $p < 1$, the buyer strictly prefers to stay with its current supplier rather than go with a new one who has the same per-period cost, implying $c^*(c) < c$.

The following result establishes existence of a solution and characterizes when it is optimal for a DC buyer to engage in search.

Proposition 1: *There is a unique solution to the model. Further, holding all parameters other*

---

[10]In the Figure $u^B(c)$ and $u^L(c)$ are drawn with constant slope for ease of representation only.

than γ *fixed, there exists a number* $\underline{\gamma} > 0$ *such that* $\gamma > \underline{\gamma}$ *implies that* $w = 0$ *and no search takes place, whereas* $\gamma < \underline{\gamma}$ *implies search with* $w > 0$.

The proof uses standard techniques to analyze the fixed point problem defined by equations (1)-(6). This Proposition implies that $c^*(c)$ is well-defined and characterizes the buyer's optimal supplier switching rule. This is because (i) functions $v(c)$ and $u(c)$ are well-defined, (ii) $u(c) < v(c)$, (iii) $u(c')$ can be made as large as desired for small enough c', and (iv) $u(c)$ is continuous and decreasing. It is possible that $c^*(c) < \underline{c}$, in which case the DC buyer never severs a relationship with an LDC supplier with per-period cost c that has successfully filled a large order.

IV. Results

A. Starting small

We begin by establishing that the outcomes *Big*, *Learn*, and *Out* all occur with positive probability under our assumptions.

Proposition 2: *If* q *is sufficiently close to zero and* γ *is sufficiently close to* $\underline{\gamma}$*, then* $\underline{c} < c^B < c^L < \bar{c}$.

This proposition provides a simple sufficient condition. The requirement that q be small — which is also used in later propositions — ensures that the value of a successful relationship, $v(c)$, is not dominated by the possibility that the DC buyer will meet a new supplier while being matched. In other words, the characteristics of the current supplier are important relative to the characteristics of potential future suppliers. Technically, for Proposition 2, the qualifications on q and γ allow us to examine the fixed point problem for $v(c) \approx (z - c)/(1 - \delta)$ and $w \approx 0$.

As can be seen from the Figure, $c^B < c^L$ also yields c^L to the right of the intersection of u^B and u^O because $\partial u^L(c)/\partial c > \partial u^B(c)/\partial c$. It follows that the existence of a range of per-period costs over which starting small is chosen extends the set of LDC suppliers to which the DC buyer might be willing to transfer technology by investing in training. In other words, the option to start small facilitates the transfer of technology to LDC suppliers by increasing the number of suppliers that the DC buyer does not reject immediately.

We next show how the productive environment (search costs, uncertainty, training cost) determines the extent to which the DC buyer will use the *Big*, *Learn*, and *Out* options with different potential LDC suppliers. First, we demonstrate that increased search costs induce the DC buyer to choose *Learn* with a larger set of potential suppliers and to select *Big* and *Out* with fewer potential suppliers each.

Proposition 3: *If q is sufficiently small, then an increase in* γ *causes* c^B *to fall and* c^L *to rise.*

To see the intuition behind this proposition, note that the DC buyer chooses to start small with suppliers that do not generate high enough expected profits (do not have low enough costs) to induce it to place a large order right away despite the risk of forfeiting its training investment. The buyer could simply reject these suppliers and return to the pool, but this alternative becomes less attractive, the higher are search costs. The fact that returning to the pool is less attractive not only encourages the buyer to start small but also discourages it from starting with a large order, since this latter choice itself carries a risk of having to return to the pool immediately.[11]

---

[11]Technically, we can observe that an increase in γ causes w to decrease and $v(c)$ to decrease, for all c. The change in $v(c)$ is negligible when q is close to zero, since in this case we have $v(c) \approx (z - c)/(1 - \delta)$; that is, once involved in a successful match with little prospect of meeting another potential supplier without costly search, the DC buyer gets a profit stream that is independent of γ. From equations (1)-(3), we see that a decrease in w has a greater negative impact on u^B and u^O

Like increasing search costs, lowering the probability of success (making the DC buyer less optimistic) increases the probability that the DC buyer will start with a small order and reduces the probability that it will start with a large order from the LDC supplier.

Proposition 4: *If q is sufficiently small and γ is sufficiently close to $\underline{\gamma}$, then a decrease in p causes c^B to fall and c^L to rise.*

Intuitively, a lower probability of success increases the chance that the DC buyer will forfeit its training investment, which is precisely the outcome that starting small is intended to avoid. We therefore expect an increased probability that the DC buyer chooses *Learn* and a reduced probability that it chooses *Big*.[12]

---

than it does on u^L (since return to search is delayed with *Learn*). Given the way these functions intersect (see the Figure), the result follows. The formal proof makes this more precise and extends the idea for q near zero.

[12]To gain a technical understanding, again take the case in which $q = 0$, so that $v(c) = (z - c)/(1 - \delta)$. Consider the effect of a decrease in p on c^B. First, it has a larger direct negative impact on u^B than it does on u^L. Second, it has an indirect effect through w; but with $q = 0$, p does not affect $v(c)$. Examining equations (1)-(2), we see that a decrease in p causes a corresponding downward adjustment of w. This indirect negative impact is larger for u^B than for u^L (since with *Learn* the random draw is delayed), so both the direct and indirect effects of a decrease in p cause c^B to fall. Regarding the effect on c^L, consider as well that γ is close to $\underline{\gamma}$, so that $u^L(c^L) = u(c^L) \approx \delta w \approx 0$ (implying $v(c) - I \approx 0$). Then, in the comparison between u^L and u^O at $c = c^L$, the only non-negligible effect of the decrease in p is from the corresponding decrease in w. This causes the value of *Learn* to decrease more slowly than does the value of *Out*, implying that

A larger required training investment has a negative influence on the propensity for the DC buyer to start with a large order, as we would anticipate given the intuition for the preceding proposition, but the impact on the probability of starting with a small order is ambiguous.

Proposition 5: *An increase in I causes c^B to fall.*

On the attractiveness of starting small (which is not covered by this proposition), we know that if *I* equals zero then the DC buyer will never select *Learn*. Thus, larger values of *I* are, in a sense, associated with a higher propensity to start small. The reason we cannot establish a general monotone relationship between *I* and the attractiveness of *Learn* is that we have no simple parameter restrictions, as we did for Proposition 4, that eliminate the possibility that *Out* will become more attractive relative to *Learn*, causing c^L to fall.[13] If c^L falls, then whether the DC buyer starts small with a higher probability is sensitive to the distribution of per-period supplier

---

c^L rises.

[13]Both a fall in *p* and a rise in *I* make the LDC supplier drawn and all LDC suppliers in the pool less attractive. The former effect reduces the value of *Learn* more, whereas the latter effect reduces the value of *Out* more. While the difference between the impacts on *Learn* and *Out* will in general be small, it is ambiguous and thus returning to the pool could be favored relative to starting small. As described in the preceding footnote, it is possible to avoid this possibility by restricting the parameter space so as to make negligible the impact of a lower *p* on the value of the LDC supplier drawn, but this does not work for a higher *I*. In contrast, the negative effect of an increase in *I* on c^B is straightforward, because both the direct negative effect through the value of the LDC supplier drawn and the indirect negative effect through the value of LDC suppliers in the pool are larger for u^B than for u^L.

costs.

B. Persistence of relationships

In section III we noted that the DC buyer will not switch to a new supplier to which it is introduced unless the new supplier's per-period cost is strictly less than that of the current supplier with which it enjoys a successful relationship. The next proposition demonstrates that the gap between the cutoff level of per-period cost of the new supplier, $c^*(c)$, and the per-period cost of the current supplier, c, is reduced when a parameter change causes the DC buyer to become less cautious with new suppliers. It follows that such a parameter change also lowers the expected duration of relationships between DC buyers and LDC suppliers.

Proposition 6: *If q is small then an increase in p or a decrease in I causes $c^*(c)$ to rise (weakly) for all c.*

The intuition behind this proposition is straightforward. Relative to a current successful relationship with an LDC supplier, the DC buyer is discouraged from trying a new supplier because of the uncertainty regarding whether it can fulfill a large order and the required training. If either of these factors is mitigated, the degree to which the new supplier must be more efficient than the incumbent is lessened.[14]

---

[14]Formally, an increase in p or a decrease in I causes both u and v to increase. This would seem to have an ambiguous effect on $c^*(c)$ since this is defined by equation (8). However, the parameter change has a direct effect on u and only an indirect effect on v (through the expected utility of new suppliers to which the DC buyer is introduced). Further, when q is small, the effect on v is negligible compared to the effect on u. Since u is a decreasing function, the parameter

Some evidence supporting Propositions 3-6 was presented in section II. To our knowledge no evidence of the type cited in section II either supports or contradicts the remaining predictions in this subsection, but it would be straightforward to test them using an appropriate survey of DC buyer relationships with LDC suppliers. These new predictions all follow from the fact that a DC buyer is more likely to choose *Big* with an LDC supplier, the lower is the per-period cost of the supplier.

Proposition 7: *The persistence of relationships between DC buyers and LDC suppliers that were initiated with a large order will be greater than those that started small.*

A relationship with a low per-period cost is less likely to be broken by the DC buyer finding a more attractive supplier.

Two related results concern relationships with new LDC suppliers to which DC buyers have switched.

Proposition 8: *Consider two groups of relationships: those formed through search by unmatched DC buyers and those initiated by DC buyers switching from another LDC supplier. The fraction of relationships that begin with investment and a large order (*Big*) is higher in the latter than in the former group.*

Proposition 9: *There is a positive correlation between the duration of a relationship and the likelihood that the DC buyer starts with a large order (*Big*) with a new LDC supplier.*

The intuition for Proposition 8 is that the per-period costs of LDC suppliers to which DC buyers have switched from existing relationships will be lower on average, because the DC buyers only switch to suppliers with strictly lower costs than suppliers with which they already have successful relationships (the existing ones). Relationships with lower-cost suppliers are more likely to start with large orders. For Proposition 9, note that a buyer will stay with an existing

---

shift requires a compensating increase in $c^*(c)$.

supplier longer on average the lower its per-period cost, hence suppliers to which buyers switch from long-lasting relationships will also tend to have lower per-period costs, causing the buyers to start with large orders.

C. Results possible with more structure on per-period costs

We have not taken any stand on why per-period costs should differ across LDC suppliers in our model. Greater knowledge of the causes of these differences can allow the model to generate additional predictions. For example, suppose the suppliers forming the pool are all from the same country and factor prices are roughly uniform across the country. Differences in the quality of management are then the most likely source of differences in cost. If, as is typical, we think of management as a Hicks-neutral shifter of the production function, our model predicts that demands for inputs associated with a given level of output will tend to be lower for relationships that began with large orders. This prediction is reversed if differences in factor prices are believed to be the main cause of differences in per-period costs.

Since our model predicts that lower per-period costs are associated with starting with large orders, it is tempting to conclude that DC buyers searching for LDC suppliers are more likely to choose *Big* than *Learn* (or *Out*) in countries with lower factor prices. Insofar as lower factor prices generate a lower distribution of per-period costs, our model does yield this result, *ceteris paribus*. However, countries with lower factor prices also tend to be countries with higher search costs and lower probabilities of successful large orders, which we have shown to favor starting small.

V. Conclusions and Suggestions for Further Research

In this paper we studied a characteristic way in which developed country buyers build partnerships with less developed country suppliers. We focused on the role that an unfamiliar environment plays in inducing the DC buyers to "start small" in their relationships with LDC suppliers and on the persistence of these relationships in the face of opportunities for the DC buyers to form new partnerships. We found that the propensity for the DC buyer to choose to start with a small order increases with the cost of search for a new LDC supplier and decreases with the probability that the current or new supplier will be able to fulfill the large order successfully after training. Starting small was shown to facilitate transfer of technology to LDCs by extending the set of LDC suppliers for which the DC buyer might be willing to invest in training. We also found that an increase in the probability of success or a decrease in the required training investment reduces the expected duration of relationships in which the LDC suppliers have successfully filled large orders. These results are consistent with a number of studies of interactions between DC buyers and LDC suppliers. Finally, we predict that the expected duration of relationships that started with large orders will be greater, and that DC buyers are more likely to start with large orders with LDC suppliers for which they have dropped successful relationships, and the longer was the duration of these relationships. With additional assumptions on the cause of cost differences across LDC suppliers, our model also made predictions about the association between starting with large orders and input demands per unit of output.

Formation of a successful relationship between a DC buyer and an LDC supplier usually implies exports from the LDC to the DC, which allows us to link our results to the literature analyzing firm-level export behavior using large LDC data sets that has grown rapidly following the dramatic increase in the amount of manufacturing in LDCs for markets in DCs.[15] One of the most robust findings of this literature is that the more efficient LDC firms are the ones that become exporters (Aw, Chung, and Roberts, 2000; Clerides, Lach, and Tybout, 1998). Our results are consistent with these findings in that we predict the DC buyers will select LDC suppliers on the basis of their per-period costs, choosing to search again rather than start small or big with the least efficient producers. Recent papers in this literature find industry "rationalization" effects from reduction of trade barriers: the expansion of more efficient firms and the exit of less efficient ones is accelerated (Muendler, 2002; Pavcnik, 2000). In our model a reduction in search costs is the analogue of a reduction in trade barriers, and the result (Proposition 3) that the DC buyer starts big with more of the efficient firms and rejects more of the inefficient firms also has the effect of promoting industry rationalization. Future research could examine whether the less efficient firms that nevertheless enter export markets show a more gradual expansion of their export volumes than the more efficient firms, as our model of

---

[15]The "developing country" share of imports of manufactured goods (SITC 5 to 8 less 68) to "developed market economies" increased from 4.8 percent in 1970 to 14.5 percent in 1991 (UNCTAD, 1994, Table 3.3B, p. 94, with definitions of country groups provided in Tables 1.1 and 1.2). Gereffi (1995) notes that LDC firms participate in exports of "branded" products to DCs in four different ways: export-processing (or in-bond) assembly, component-supply subcontracting, original equipment manufacturing, and original brand-name manufacturing. Only the last of these does not necessarily involve participation by DC firms, and is the exception rather than the rule.

starting small would predict.

Appendix: Proofs

Proof of Proposition 1: First note that any solution is characterized by (v,w), with equations (1)-(4) defining the other functions. Let V be the set of functions from **R** to **R**, let y denote a generic such function, and let x denote a real number. For any number c', define

$$f(y,x,c') \equiv \max\{\delta x,\ \delta^k p(y(c') - I) + \delta^k(1-p)p\delta x,\ py(c') + (1-p)\delta x - I\}.$$

Note that, using (1)-(4), $u(c') = f(v,w,c')$. Define a functional operator $F\colon V\times\mathbf{R} \to V\times\mathbf{R}$ by

$$F = \begin{pmatrix} F_1 \\ F_2 \end{pmatrix}, \text{ where}$$

$$F_1(y,x)(c) \equiv z - c + (1-q)\delta y(c) + q\delta\, \mathrm{E}\,[\max\{y(c), f(y,x,c')\} \mid c' \sim \mu]$$

for all c, and

$$F_2(y,x) \equiv \max\{\mathrm{E}\,[f(y,x,c') \mid c' \sim \mu] - \gamma,\ 0\}.$$

In these definitions, E denotes expectation. The F_1 component represents equation (6), while the F_2 component is associated with equation (5).

A solution (v,w) to the DC buyer's problem is a fixed point of F. We prove that there exists a unique solution by demonstrating that F is a contraction mapping. We use the sup norm, where

$$\|(y,x) - (y',x')\| \equiv \max\{\|y - y'\|, |x - x'|\}.$$

Note that $\|y - y'\|$ is the supremum distance between functions y and y', over all c.

Take any (y,x) and (y',x') and let $\Delta \equiv \|(y,x) - (y',x')\|$. Observe that, from the definition of f,

$$|f(y,x,c') - f(y',x',c')| \leq [p + (1-p)\delta]\Delta$$

for all c'. This implies that

$$|F_1(y,x)(c) - F_1(y',x')(c)| \leq \delta\Delta,$$

for all c, and

$$|F_2(y,x) - F_2(y',x')| \leq [p + (1-p)\delta]\Delta.$$

F is thus a contraction with modulus $p + (1-p)\delta$.

Furthermore, F_2 decreases in γ and F_1 and F_2 are increasing in x. These facts imply that w (the second component of the fixed point) is decreasing in γ, which yields the second conclusion of the proposition. *Q.E.D.*

Proof of Proposition 2: Suppose $q = 0$ and then let $\gamma = \underline{\gamma}$. In this case, we have $w = 0$, $u^B(c) = p(z - c)/(1-\delta) - I$, $u^L(c) = \delta^k p[(z-c)/(1-\delta) - I]$, and $u^O(c) = 0$. Then, solving $u^B(c^B) = u^L(c^B)$ and $u^L(c^L) = u^O(c^L)$ to find c^B and c^L, we get

$$c^B = z - [I(1-\delta^k p)(1-\delta)] / p(1-\delta^k) \quad \text{and} \quad c^L = z - I(1-\delta).$$

Algebra reveals that $c^B < c^L$. Further, it is easy to check that under assumption (A), $\underline{c} < c^B$ and $c^L < \bar{c}$. *Q.E.D.*

Proof of Proposition 3: Let $v(q,\gamma)$ and $w(q,\gamma)$ denote the DC buyer's solution (the fixed point of F) as a function of q and γ. As γ rises, w decreases and v decreases for every c. We show below that if q is close to zero, then v can be made to decrease arbitrarily more slowly (for each c) than does w. Using equations (1)-(3) and the definitions of c^B and c^L, this clearly implies that c^B falls and c^L rises.

To show that w decreases faster than does v, let us define functional operator $G: V \to V$ by

$$G(y;\, q,x)(c) \equiv (z - c)/[1 - (1 - q)] + [q\delta/(1 - (1 - q))]\ \mathrm{E}\,[\max\{y(c), f(y,x,c')\} \mid c' \sim \mu].$$

We use the definitions of V and f from the proof of Proposition 1. One can check (just as we did for F above) that G is a contraction. In fact, we can find a number $\beta \in (0,1)$ that is a modulus of G for all values of the parameters q and x. Let $v'(q,x)$ denote the fixed point of G. Note that $v'(q,w(q,\gamma)) \equiv v(q,\gamma)$. Let G^n denote n applications of G. Then for any y, the triangle inequality implies

$$\|G^n(y;\, q,x) - y\| \le \|G^n(y;\, q,x) - G^{n-1}(y;\, q,x)\| + \|G^{n-1}(y;\, q,x) - G^{n-2}(y;\, q,x)\| + \cdots$$
$$+ \|G^1(y;\, q,x) - y\|.$$

Also note that $\|G^m(y;\, q,x) - G^{m-1}(y;\, q,x)\| \le \beta\|G^{m-1}(y;\, q,x) - G^{m-2}(y;\, q,x)\|$. Iterating this, noting that $G^1(y;\, q,x) = G(y;\, q,x)$, and using the previous inequality, we get

$$\|G^n(y;\, q,x) - y\| \le [1 + \beta + \beta^2 + \cdots + \beta^{n+1}]\|G(y;\, q,x) - y\|.$$

Taking the limit as n approaches infinity and noting that $G^n(y;\, q,x)$ converges to $v'(q,x)$, we have

$$\|v'(q,x) - y\| \le [1/(1 - \beta)]\|G^1(y;\, q,x) - y\|.$$

For any q, γ, and γ', setting $y = v(q,\gamma)$ and $x = w(q,\gamma')$, the last inequality becomes

$$\|v'(q,w(q,\gamma')) - v(q,\gamma)\| \le [1/(1 - \beta)]\|G(v(q,\gamma);\, q,w(q,\gamma')) - v(q,\gamma)\|.$$

Note that $v'(q,w(q,\gamma')) = v(q,\gamma')$. In addition, observe that $v(q,\gamma) = G(v(q,\gamma);\, q,w(q,\gamma))$. Using these substitutions, we have

$$\|v(q,\gamma') - v(q,\gamma)\| \le [1/(1 - \beta)]\|G(v(q,\gamma);\, q,w(q,\gamma')) - G(v(q,\gamma);\, q,w(q,\gamma))\|. \qquad \textbf{(9)}$$

Consider another fact about G. For all $\sigma > 0$, there exists a number $\underline{q} > 0$ such that $q < \underline{q}$ implies

$$\|G(y;\, q,x) - G(y;\, q,x')\| < \sigma|x - x'|.$$

Combining this with inequality (9) yields the following conclusion. For every $\varepsilon > 0$, there exists $\underline{q} > 0$ such that $q < \underline{q}$ implies

$$\|v(q,\gamma') - v(q,\gamma)\| \leq \varepsilon|w(q,\gamma') - w(q,\gamma))|,$$

which means

$$|v(q,\gamma')(c) - v(q,\gamma)(c)| \leq \varepsilon|w(q,\gamma') - w(q,\gamma))|$$

for every c. This is sufficient to prove the result. *Q.E.D.*

Proof of Proposition 4: Taking derivatives of the solution functions u^B and u^L with respect to p and substituting terms using (1) and (2), we obtain

$$du^B(c)/dp = u^B(c)/p - \delta w/p + I/p + pdv(c)/dp + (1-p)\delta dw/dp$$

and

$$du^L(c)/dp = u^L(c)/p - \delta^{k+1}w/p + \delta^k pdv(c)/dp + \delta^{k+1}(1-p)dw/dp.$$

Note that $u^B(c^B) = u^L(c^B)$, by the definition of c^B. Thus, at $c = c^B$,

$$du^B(c^B)/dp - du^L(c^B)/dp = -\delta w(1-\delta^k)/p + I/p + p(1-\delta^k)dv(c^B)/dp$$
$$+ (1-p)\delta(1-\delta^k)dw/dp.$$

The last two terms are positive. Thus, the difference in derivatives is positive if

$$I - \delta w(1-\delta^k) \geq 0,$$

which holds for γ close enough to $\underline{\gamma}$ (so w is close to zero). Since the slope of u^B (with respect to c) is less than the slope of u^L, this implies that c^B increases in p.

The same type of calculation establishes that, at $c = c^L$,

$$du^L(c^L)/dp - du^O(c^L)/dp = u^L(c^L)/p - \delta^{k+1}w/p + \delta^k pdv(c^L)/dp$$
$$- \delta[1 - \delta^k(1-p)]dw/dp.$$

If q is close to zero and γ is close to $\underline{\gamma}$, the first two terms can be made arbitrarily close to zero ($u^L(c^L) = \delta w \approx 0$), while the last term in negative and bounded away from zero. Further, the argument in the proof of Proposition 3 ensures that the third term can be made arbitrarily small in magnitude compared to the last term. Since u^L intersects u^O from above, we have that c^L is decreasing in p. *Q.E.D.*

Proof of Proposition 5: We use the same technique employed in the proof of Proposition 4 to establish that, at $c = c^B$,

$$du^B(c^B)/dI - du^L(c^B)/dI = -p(1-\delta^k)v(c^B)/I - (1-p)\delta w(1-\delta^k)/I$$
$$+ p(1-\delta^k)dv(c^B)/dI + (1-p)\delta(1-\delta^k)dw/dI.$$

All of the terms on the right side are negative (all but the third strictly so). Since u^B intersects u^L from above at c^B, this implies that c^B is decreasing in I. *Q.E.D.*

Proof of Proposition 6: We know that as p increases or I decreases, $u(c)$ and $v(c)$ both increase for all c. Using the argument from the proof of Proposition 3 we establish the following fact. If q is sufficiently close to zero then the increase in $v(c)$ is small compared to the increase in $u(c')$, for all c, c'. Since $c^*(c)$ solves $u(c^*(c)) = v(c)$, and u is decreasing, it must be that $c^*(c)$ rises. *Q.E.D.*

Proof of Propositions 7, 8, and 9: Since u is weakly decreasing, the distribution of LDC supplier cost, conditional on initiating a relationship, is a truncated version of μ. For relationships that are formed through search, the truncation is at c^L. For relationships that form by switching from an existing partner, the truncation is at $c^*(c)$. We know that $c^*(c) < c \leq c^L$ for each cost in an existing relationship, because u is decreasing and $v(c^L) > u(c^L)$. Recalling (7), we see that a lower truncation point implies a higher conditional probability of starting big, proving Proposition 8. Regarding Proposition 9, longevity of an existing relationship is negatively correlated with the per-period cost of the current supplier. A lower current per-period cost implies a lower truncation point for the cost of a new supplier to which the DC firm switches. To prove Proposition 7, we simply note that the probability of switching to a new LDC supplier is increasing in the cost of the current supplier, because $c^*(c)$ is increasing. *Q.E.D.*

We thank Ashoka Mody for valuable discussions and two anonymous referees for helpful comments. Financial support was provided by NSF grants #SBR 97-09237 (Rauch) and 96-30270 (Watson).

References

Aghion, P., P. Bolton, C. Harris, and B. Jullien, 1991, Optimal learning by experimentation, Review of Economic Studies 58, 621-654.

Aw, B. Y., S. Chung, and M. J. Roberts, 2000, Productivity and turnover in the export market: Micro-level evidence from the Republic of Korea and Taiwan (China), World Bank Economic Review 14, 65-90.

Banerjee, A. V. and E. Duflo, 2000, Reputation effects and the limits of contracting: A study of the Indian software industry, Quarterly Journal of Economics 115, 989-1017.

Bergemann, D. and J. Välimäki, 2000, Experimentation in markets, Review of Economic Studies 67, 213-234.

Bolton, P. and C. Harris, 1999, Strategic experimentation, Econometrica 67, 349-374.

Canning, D., 1998, A database of world stocks of infrastructure, 1950-95, World Bank Economic Review 12, 529-547.

Carmichael, H. L. and W. B. MacLeod, 1997, Gift giving and the evolution of cooperation, International Economic Review 38, 485-509.

Clerides, S. K., S. Lach, and J. R. Tybout, 1998, Is learning by exporting important? Evidence from Colombia, Mexico, and Morocco, Quarterly Journal of Economics 113, 903-947.

Datta, S., 1996, Building trust, London School of Economics and Political Science Discussion Paper No. TE/96/305.

Dixit, A. K. and R. S. Pindyck, 1994, Investment under uncertainty (Princeton University Press, Princeton, NJ).

Egan, M. L. and A. Mody, Buyer-seller links in export development, World Development 20, 321-334.

Gereffi, G., 1995, Global production systems and third world development, in: B. Stallings, ed., Global change, regional response: The new international context of development (Cambridge University Press, New York) 100-142.

Ghosh, P. and D. Ray, 1996, Cooperation in community interaction without information flows, Review of Economic Studies 63, 491-519.

Horstmann, I. J. and J. R. Markusen, 1996, Exploring new markets: Direct investment, contractual relations and the multinational enterprise, International Economic Review 37, 1-19.

International Organization for Standardization, 1999, The ISO survey of ISO 9000 and IS0 14000 certificates: Eighth cycle–1998 (International Organization for Standardization, Geneva).

Jovanovic, B., 1979, Job matching and the theory of turnover, Journal of Political Economy 87, 972-990.

Keller, G. and S. Rady, 1999, Optimal experimentation in a changing environment, Review of Economic Studies 66, 475-507.

Kranton, R., 1996, The formation of cooperative relationships, Journal of Law, Economics, and Organization 12, 214-223.

Mann, R. J., 2000, The role of letters of credit in payment transactions, Michigan Law Review 98, 401-438.

Moscarini, G. and L. Smith, 1998, Wald revisited: The optimal level of experimentation, Yale Department of Economics Working Paper.

Muendler, M., 2002, Trade, technology, and productivity: A study of Brazilian manufacturers, 1986-1998, University of California, Berkeley Department of Economics Working Paper.

Nadvi, K., 1999, Collective efficiency and collective failure: The response of the Sialkot surgical instrument cluster to global quality pressures, World Development 27, 1605-1626.

Pack, H. and J. M. Page, Jr., 1994, Accumulation, exports, and growth in the high-performing Asian economies, Carnegie-Rochester Conference Series on Public Policy 40, 199-257.

Pavcnik, N., 2000, Trade liberalization, exit, and productivity improvements: Evidence from Chilean plants, National Bureau of Economic Research Working Paper 7852.

Rauch, J. E. and J. Watson, 1999, Starting small in an unfamiliar environment, National Bureau of Economic Research Working Paper 7053.

Rhee, Y. W., B. Ross-Larson, and G. Pursell, 1984, Korea's competitive edge: Managing the entry into world markets (Johns Hopkins University Press, Baltimore).

Schmitz, H. and P. Knorringa, 2000, Learning from global buyers, Journal of Development Studies 37, 177-205.

Smith, L., 1997, The marriage model with search frictions, University of Michigan Working Paper.

Smith, L. and R. Shimer, 2000, Assortative matching and search, Econometrica 68, 343-370.

Taylor, C. R. and S. N. Wiggins, 1997, Competition or compensation: Supplier incentives under the American and Japanese subcontracting systems, American Economic Review 87, 598-618.

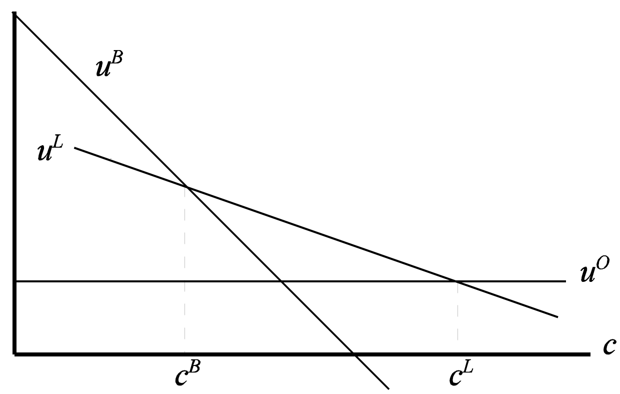
Tewari, M., 1999, Successful adjustment in Indian industry: The case of Ludhiana's woolen knitwear cluster, World Development 27, 1651-1671.

United Nations Conference on Trade and Development (UNCTAD), 1994, Handbook of international trade and development statistics (United Nations, New York).

Watson, J., 1996, Building a relationship, University of California, San Diego Working Paper No. 95-30.

Watson, J., 1999, Starting small and renegotiation, Journal of Economic Theory 85, 52-90.

Watson, J., 2002, Starting small and commitment, Games and Economic Behavior 38, 176-199.


u^B
u^L
u^O
c
c^B
c^L

Legend for the Figure:

Values of *Big*, *Learn*, and *Out* as functions of per-period cost