The search for trading partners and the cross-border merger decision

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Abstract

We investigate the merger decision between two firms in a vertical outsourcing relationship. The inter-firm relationship is subject both to ex ante matching uncertainty and to contractual efficiency issues. Cross-border merger is assumed to solve the latter, but curtails search. Unlike previous models, but in line with Chinese data, the share of FDI in vertical interfirm trade increases over time. Firms merge more quickly with lumpy contracts and/or a poor contracting environment - as long as trade is not deterred altogether. In support of Nunn’s (2007) empirical finding, a poor legal environment affects trade more in lumpy, differentiated industries.

JEL classifications: F12, F23.

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1 Introduction

Alongside the rapid growth in world trade in recent decades, there has been an even faster increase in international trade in intermediate goods. It is becoming increasingly common for goods to be produced by a vertical supply chain that stretches over several countries – a process known as ‘vertical fragmentation’ (Feenstra, 1998; Hummels et al., 2001; Yi, 2003). In consequence, the share of imported components in spending on final goods has generally been rising. For example, Spencer (2005) reports that, from 1974 to 1993, imports as a proportion of total purchases of electrical equipment and machinery rose from 4.5% to 11.6% in the USA and from 13.2% to 30.9% in Canada.

The drastic increase in vertical fragmentation and the international sourcing of intermediate goods raises the question: how are vertical, cross-border business relationships organised? We analyse the procurement process of a downstream firm in the North that wants to buy components from, or have them processed by, an upstream firm in the South. The downstream Northern firm must choose between two possible structures for its vertical trading relationship: vertical foreign direct investment (FDI), where it merges with a Southern component supplier, and outsourcing,\(^1\) where it trades with a Southern firm through an arm’s length contract.

Figure 1 below, which is taken from Spencer (2005), charts the huge growth of China’s manufacturing exports between 1988 and 2003. In 2003, the majority (57%) of manufacturing exports from China were so-called ‘processing exports’, represented by the sum of the black and grey bars in the figure. ‘Processing exports’ are exports produced using imported inputs, so the processing activity in China forms part of an international supply chain, and the data allow us to analyse how such vertical trade is organised.

The black bars in Figure 1, labelled ‘FIE Processing Export’, are the exports of processed components by foreign-owned enterprises (‘Foreign Invested Enterprises’) in China, and they result from vertical FDI in China. The grey bars, on the other hand, are exports of processed components that result from outsourcing contracts between foreign buyers and independent Chinese firms.

\(^1\)Note that we are using an industrial organisation definition of outsourcing (purchasing from another firm). Some of the trade literature would see any import of intermediate inputs as outsourcing, even if they come from a wholly-owned subsidiary.
The message of Figure 1 is that vertical ‘processing’ trade with China is increasingly organised through FDI rather than outsourcing – the black bars grow in size over time relative to the grey bars. Our model of the FDI/outsourcing decision is consistent with this observation that vertical FDI grows in importance relative to outsourcing over time.

The baseline version of our model analyses a Northern firm’s search for a trading partner in the South. By paying a fixed search cost, the Northern firm meets a randomly chosen Southern firm. The randomness relates to the quality of the match between the two firms; that is, the total profitability of the vertical trading relationship. Next, the Northern firm must choose how to structure its relationship with the Southern firm. The choice – between merging (vertical FDI) and contracting (outsourcing) – incorporates the key trade-off in our model.

A merger is irreversible (demerger is assumed to be prohibitively costly), but it maximises the value from the vertical trading relationship. In contrast, outsourcing relationships are more flexible (arm’s length contracts last for only one period), but – due to contractual inefficiencies – they waste some of the value in the trading relationship. (The contractual friction might arise from relationship-specific investments that are only partially contractible.) Therefore, unlike previous papers (Grossman and Helpman, 2002, Rauch and Casella, 2003, Rauch and Trindade, 2003) we focus on the search process whereby firms find trading partners (as opposed to concentrating on matched pairings, once search has been completed).

After the Northern firm has made its merge/contract choice, output is produced at the end of the first period. Following a merger, the pairing of firms remains together into the infinite future. However, a contract is dissolved after one period, and the Northern firm searches again and repeats the entire process in the next period. We assume that match quality is independently and identically distributed through time.

We follow Grossman and Helpman (2002) in adopting a “transactions cost” approach to the integration/outsourcing decision. This is in the tradition of Coase and Williamson, and it views integration as entirely resolving contractual problems. (McLaren, 2000, also adopts a ‘transactions cost’ approach.) An alternative approach to analysing contractual frictions is the “property rights” theory of Grossman and Hart (1986), and Hart and Moore (1999). Antràs (2003) analyses the integration/outsourcing decision in this tradition, as do Antràs and Helpman (2004). In the ‘property rights’ approach, vertical integration does not
resolve contractual frictions. However, by reallocating ‘residual control rights’ over assets (i.e. ownership of assets), integration alters the ‘threat point’ that emerges when the contract breaks down or doesn’t apply.

Whether the ‘transactions cost’ or ‘property rights’ approach is preferred depends upon the exact details of the vertical relationship one has in mind. To the extent that integration entails joint profit maximisation (as merger does) and the acquirer obtains the target’s blueprints and is able to exploit them as efficiently as the target could, then the ‘transactions cost’ approach (integration resolves contractual frictions) seems appropriate.

We derive the cut-off between contracting and merging by comparing present values. The present values of both merging and contracting are increasing in the match quality that the Northern firm draws. However, the present value of merging is more sensitive to the match-quality draw because, following merger, the pairing of firms remains together forever. Therefore, merger becomes ‘more likely’ as match-quality rises, and we derive a unique cut-off between contracting and merging. Ceteris paribus, we show that contracting is made more attractive by rises in contract quality, and falls in the discount rate (more patience) and the fixed search cost. These results are intuitive.

Although firms are ex ante identical, pairings that turn out to be of a higher quality are ‘more likely’ to lead to FDI. Moreover, trading relationships organised through vertical FDI earn higher profits than do those organised through outsourcing. This is consistent with the empirical findings of Helpman, Melitz and Yeaple (2004) on the profitability of MNEs relative to other types of firm.

Over time, the likelihood that a firm will have merged rises. When a firm enters a new country to source components, outsourcing provides an attractive, flexible means of exploring the market for trading partners. Eventually, after (perhaps) several contractual relationships with different temporary partners, the firm finds a suitable permanent partner for merger. Therefore, in our model, outsourcing is equivalent to “ongoing search”, whereas vertical FDI is chosen by ‘matched’ pairings.

The pattern of Chinese ‘processing exports’ over time in Figure 1 is consistent with our results. The relative importance of vertical FDI grows over time as Northern firms become more familiar with the host country. Accounting for the outsourcing/FDI mix in Figure 1 is an important achievement. For example, Grossman and Helpman (2002) find that thick markets with many potential trading partners favour
outsourcing. However, this is not the picture in China. In Figure 1, as China has industrialised since the mid-1980s and its export-oriented manufacturing sector has expanded, we have actually observed a growth in vertical FDI relative to outsourcing. Thus, market thickness appears to be positively correlated with vertical FDI.

We allow for the simultaneous free entry of firms at the start of the search process. Because higher contract quality raises the present value of contracting, host countries with higher contract quality attract more entry by searching firms from the North. Therefore, in the long-run steady state, when firms are matched through vertical FDI, contract quality is positively correlated with national inward FDI intensity. Therefore, the result of the OLI framework (Markusen, 1995) that greater contract quality (e.g. stronger intellectual property rights) favours outsourcing over “internalisation” through FDI is primarily a short-run result. We further extend the model to allow for endogenous contract length and growing markets.

The plan of the remainder of the paper is as follows. In the next section we set out our modelling framework. In section 3 we examine the individual firm’s choice between merging and contracting, taking the rest of the economic environment as given. In section 4 we solve for the industry equilibrium by allowing for free entry of Northern firms into the search process. Finally, section 5 concludes.

2 Model

We set up a partial equilibrium model of an industry in a two-country world, the two countries being the North and the South.\(^2\) The market for final goods is in the North. Production requires two stages, upstream and downstream. Upstream firms sell semi-finished goods to downstream firms, who then complete the manufacture and sell the final products to consumers.\(^3\) We assume that the upstream stage is located in the South and that the downstream stage is in the North, reflecting the underlying pattern of comparative advantage.

All firms are of equal \textit{ex ante} expected efficiency. However, there is an ongoing fixed coordination cost

\(^2\)This two-country set-up is not, strictly speaking, necessary. We require that the downstream firms compete on the same product market. We discuss below the implications of the existence of multiple Southern countries.

\(^3\)For simplicity, we assume that an upstream and a downstream firm operate exclusively together as a pairing, whether or not they are vertically integrated by merger.
which varies depending on the goodness of fit of the match, $\mu$. We assume that $\mu$ is uniformly distributed on $[0, \mu_M]$, where $\mu_M$ represents the best match. Consequently, we can always say that there is a probability of $1 - (\mu/\mu_M)$ of finding a match of better quality than any given $\mu$. For tractability, we restrict ourselves to a model where all pairs of firms have identical and constant marginal costs.

Figure 2 below shows a decision tree for a downstream firm in the North.

At first, the downstream firm in the North pays a one-off sunk cost of entry into the industry, $E$. Next, the firm pays a fixed search cost of $S$ and receives a single introduction to a trading partner in the South. As described above, the quality of the match, $\mu$, is randomly distributed on $[0, \mu_M]$. The firm must then choose between contracting with this partner or merging.

Merger aligns the motivations of the two firms, avoiding problems of coordination (for example, ensuring blueprints are secure). Consequently, merger generates maximal value from the match but is irreversible. We denote the per-period profits of a merged pairing by $\pi + \alpha \mu$. The variable $\pi$ captures the influence of product-market competition, and thus we would expect $\pi$ to be strictly decreasing in $N$, the number of firm pairings in the industry. (For notational ease and since variations in $N$ will play only a minor part in our analysis, we suppress the influence of $N$ on $\pi$ in what follows.) We do not need to be specific about the exact form of product market interaction; our basic story is compatible with both monopolistic competition and oligopoly. The variable $\alpha$ measures the return to match quality or the importance of goodness of fit between the downstream and upstream firms. (Thus, for example, small $\alpha$ implies that, on both sides of the market, firms are relatively homogeneous or “adaptable”/“flexible”.) Note that we are assuming that match quality enters joint profits additively through fixed (rather than variable) costs; we make this assumption.

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4 Note that although we carry out much of the analysis from the standpoint of the Northern, downstream firm, the merge/contract decision is based on joint profits, so decision-making could just as easily be seen from the perspective of the Southern, upstream firm. **ADD TO MAIN TEXT?** Following Antras, we assume that the downstream firm can appropriate the entire expected value of the bilateral trading relationship. This simplifies our analysis greatly. Given that the $\mu$ draw is idiosyncratic to a particular pairing, we could assume that, following search, the Northern firm is presented with (at least) two equally good fits, who then compete in lump-sum payments to be paired with $N$. Following Antras, this will reduce the Southern firm’s expected profits to zero, and enable the $N$ firm to appropriate the entire value of the bilateral relationship.

5 The existence of a sunk cost of entry ($E$) is empirically plausible (e.g. Roberts and Tybout, 1997), and it also simplifies our analysis. We assume that $E$ is sufficiently high so that, ex post, contracting generates positive single-period profits even for the worst quality match. This means that we can ignore an "inactivity for a period" option for incumbent firms. Without $E$, some firms (those with $v$ bad quality matches) would face the prospect of making a loss (for a period) – even though the expected (ex ante) value of search might be positive!
for simplicity.\textsuperscript{6}

A contract, on the other hand, lasts for just one period (although the length of a contract period may vary across industries). (See below – FN XXX – for some justification of one-period contracts.) Per-period profits under contracting are denoted by $\pi + \alpha \mu - \beta c$, where the variable $c \geq 0$ measures the additional cost of contracting relative to merging and $\beta$ measures the contract intensity of the joint activity. For example, if contracts are to some extent incomplete, then the two parties might withhold valuable information for fear that it will subsequently be used by a rival to gain a competitive advantage. Thus, $c = 0$ corresponds to the case of no contractual difficulties. Note that we are assuming that the profit disadvantage of contracting is independent of the quality of the match, $\mu$; we make this assumption for simplicity.\textsuperscript{7}

Following the merge/contract decision, output is produced at the end of the period.

If a merger occurred, then search has ended and output is produced every period into the infinite future. We assume demerger to be prohibitively costly. Alternatively, if a contract was chosen, then at the start of the next period the downstream firm searches again and repeats the whole process.\textsuperscript{8} Match quality is independently and identically distributed through time. \textit{This is a kind of ‘thick market’ assumption: The distribution of unmerged firms remaining in the barrel (to be found through search) is assumed to be independent of the characteristics of the firms that have already merged. Alternatively, we could say that "match quality" is an idiosyncratic property of the pairing, and is independent of the characteristics of the two constituent firms.}

As we discuss in the next section, our model is a variant of standard search models (Kohn and Shavell, 1974). The most important theoretical feature of these models is that there exists an unique switchpoint, $R$, at which a player is indifferent between continuing with her current partner and searching afresh for a new partner. We term $R$ the \textit{reservation match quality}.

\textsuperscript{6}McLaren (2000) makes the same assumption. Usefully, it limits the influence of PMC on the merge/contract choice and ensures that, for given $N$, each firm faces a stationary environment over time. (If, for example, $\mu$ affects marginal costs – perhaps differentially between contracting and merged pairs – then a firm’s variable profits in any period will depend on all other firms’ $\mu$ draws and contract/merge choices – BUT DOESN’T PI JUST WASH OUT??) Also, the analysis is considerably less tractable when $\mu$ affects marginal costs or when $\mu$ and $c$ interact in fixed costs.

\textsuperscript{7}In a previous version of the paper, we assumed that the “contractual difficulty” related to the extent to which the full profitability of the match quality could be realised under contracting – essentially, we interacted $c$ and $\mu$ multiplicatively, with $c \in [0,1]$ measuring contract quality. This alternative formulation gives identical qualitative results to ours, but its mechanics are considerably more messy. For additional details, please contact the authors.

\textsuperscript{8}The intuitive justification for one-period contracts runs as follows. If a pairing wished to stay together for two periods, they would also want to stay together forever because the environment is stationary over time. However, in the case of an infinitely-lived pairing, a merger dominates a contract in profit terms. Therefore, contracts will last only for one period.
3 The Merge versus Contract choice

A firm will choose between contracting and merging with its present partner on the basis of which yields the greater expected present value. The present value to the pairing of merging is

\[ V_M = \sum_{t=1}^{\infty} \frac{\pi + \alpha \mu}{(1 + \rho)^t} = \frac{\pi + \alpha \mu}{\rho}. \]  

(1)

As discussed in the previous section, \( \mu \) is the match-quality draw, \( \pi \) is the minimum profit of the worst partnerships (and can be taken as a reflection of competitive pressures in the industry). For the moment, we take \( \pi \) as given. \( \alpha \) reflects the sensitivity of profits to match quality. \( \rho \) is the discount rate expressed per contract period (so that \( \rho = (1 + r)^T - 1 \) when contracts last for \( T \) years).

A contract lasts for only one period. After that, it is dissolved and the firms search again. Therefore, the present value to the pairing of contracting is

\[ V_C = \frac{\pi + \alpha \mu - \beta c + V_S}{1 + \rho}, \]

(2)

where \( \beta \) is contract intensity, \( c \) the cost of the contract environment and \( V_S \) is the expected present value to an incumbent firm of initiating a new search and is given by

\[ V_S = \Pr\{\text{contract}\} \cdot V_C + \Pr\{\text{merge}\} \cdot V_M - S. \]

(3)

\( S \) is the transactions cost of seeking a new match.

In (3), \( V_M \) is the expected present value of a profitable merger. \( V_C \) is the expected value of contracting taken over the range of \( \mu \) where contracting is optimally preferred to merger, rather than over all \( \mu \in [0, \mu_M] \). Note also that \( V_S \) is independent of the current match quality draw (i.e. \( \partial V_S / \partial \mu = 0 \)) since firms who start a new search abandon their current match.

To determine the firm’s merge/contract choice, we proceed as follows. We solve the model under the assumption that there is a unique switchpoint between contracting and merging, \( \mu_R \), and we then show
that our solution is consistent with this assumption.\(^9\) Contracting is chosen on \(\mu \in [0, \mu_R]\) and merger on \(\mu \in [\mu_M, \mu_M]\). Without loss of generality we can choose units such that \(\mu_M = 1\), so that \(\Pr\{\text{contract}\} = \mu_R\) and \(\Pr\{\text{merge}\} = 1 - \mu_R\). Likewise, if \(V_C\) and \(V_M\) are defined over these two intervals, then we get
\[
V_C = \frac{1}{1+\rho} (\pi + \alpha \frac{\mu_R}{2} - \beta c + V_S) \quad \text{and} \quad V_M = \frac{1}{\rho} \left( \pi + \alpha \frac{\mu_R + 1}{2} \right).
\] It follows that

\[
V_S = \frac{\mu_R}{1+\rho} \left( \pi + \alpha \frac{\mu_R}{2} - \beta c + V_S \right) + \frac{1-\mu_R}{\rho} \left( \pi + \alpha \frac{\mu_R + 1}{2} \right) - S, \tag{4}
\]

\[
= \frac{\alpha (1+\rho - \mu_R^2) + 2\pi (1+\rho - \mu_R) - \rho (\beta c + (1+\rho) S)}{2\rho(1+\rho - \mu_R)}. \tag{5}
\]

It is clear that, as expected, \(V_S\) is increasing in \(\pi\) and thus decreasing in \(N\).\(^10\) We would expect entry into the industry to continue until \(V_S\) is driven down to \(E\), the one-off sunk cost of entry.\(^11\)

Next, we solve for \(\mu_R\), which is defined as the \(\mu\)-value at which \(V_M = V_C\), treating \(V_S\) as endogenous. For the marginal firm \(f\), where \(\mu_f = \mu_R\), the marginal present expected value of contracting for one period and starting a new search is
\[
V_{CR} = \frac{\pi + \alpha \mu_R - \beta c + V_S}{1+\rho}, \tag{6}
\]
while the present value of merging now is
\[
V_{MR} = \frac{\pi + \alpha \mu}{\rho}. \tag{7}
\]

Setting the result equal to (1), and solving, gives a quadratic in \(\mu_R\):

\[
\alpha \mu_R^2 - 2\alpha (1+\rho) \mu_R + (1+\rho) [\alpha - 2\rho (\beta c + S)] = 0. \tag{8}
\]

Only the smaller root of (8) lies within \(0, 1\). Thus, the reservation match quality is

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\(^9\)Our model is a variant of standard search models, whose most important theoretical feature (Kohn and Shavell, 1974) is that there exists a unique switchpoint at which a player is indifferent between continuing with her current partner and searching afresh for a new partner.

\(^10\)Note that we show below that the equilibrium value of \(\mu_R\) is independent of \(\pi\).

\(^11\)We assume that \(E\) is sufficiently large so that \(\pi \geq \beta c\) in free-entry equilibrium. This means that there is a positive single-period return from contracting with even the lowest-quality match (\(\mu = 0\)). By implication, therefore, there is a positive single-period return from contracting with any match quality, which means that firms will never choose to be inactive for a period after learning their possible match quality.
If the model parameters are all strictly positive, then it is straightforward to show that $\mu_R < 1$; that is, merger is always chosen with strictly positive probability. Again assuming strictly positive parameters, we can show that $\mu_R > 0$ if and only if

$$\alpha > 2\rho(\beta c + S);$$

that is, it is possible for merger to be chosen with probability one. Intuitively, a higher value of $\alpha$ increases the potential gains from renewed search. Only if these exceed the costs of renewed search (which depend positively on $\rho$, $\beta$, $c$ and $S$, will it be worth searching across a succession of partners, as opposed to accepting the first partner available. For the rest of this paper, we will assume this condition holds.

Figure 3 below plots $V_M$ and $V_C$ against $\mu$ for specific parameter values\textsuperscript{12}

$$[INSERT\ FIGURE\ 3\ HERE]$$

In Figure 3, $V_M$ is steeper than $V_C$, as is clear from differentiating (1) and (2), because the current match-quality draw is more significant for lifetime profits under merger, where the two partners will stay together forever. The unique intersection of $V_M$ and $V_C$ gives the value of $\mu_R$, the reservation match quality. Figure 3 shows that for low $\mu$ ($\mu < \mu_R$) the firms choose to contract, while for high $\mu$ ($\mu > \mu_R$) they merge.

It should now be clear that our assumption of a single Southern upstream country is not restrictive. If there were multiple Southern countries, each with their own values for the exogenous parameters and thus $\mu_R$, then each incumbent Northern firm would choose between them as locations for search by comparing their values of $V_S$. Thus, except in a knife-edge case, all Northern firms will search in the same Southern country.\textsuperscript{13} This observation justifies our focus on just one Southern country.

\textsuperscript{12}$\rho = 0.2$, $\mu_M = 2.5$, $\alpha = 1$, $\beta = 0.5$, $c = S = 1$ and $\pi = 2$. Note that these values satisfy $\pi \geq \beta c$, so contracting yields a positive single-period return for all $\mu$ draws. These values imply $V_S = E = 16.417$ and $\mu_R = 1.183$, which (as a consistency check) is indeed the $\mu$-value at which $V_M$ and $V_C$ cross.

\textsuperscript{13}Grossman and Helpman (2005) present a model where Northern firms simultaneously outsource in two countries in equilibrium. This possibility is created by general-equilibrium wage responses to the location of outsourced activity, which are absent from our partial equilibrium model.
3.1 Comparative statics

In this section, we examine in more detail the determinants of $\mu_R$ in (9). Firstly, we note that $\mu_R$ is independent of per-period baseline profits, $\pi$, because these are equal under merging and contracting. Importantly, this implies that changes in the number of Northern firms in the industry do not affect the probability that a searching firm will merge in any period.

First, differentiating $\mu_R$ with respect to $\rho$ yields

$$
\frac{\partial \mu_R}{\partial \rho} = 1 - \frac{(1 + 2 \rho) [\alpha + 2 (\beta c + S)]}{2 \sqrt{\alpha \rho (1 + \rho) [\alpha + 2 (\beta c + S)]}}.
$$

This is negative for any nonnegative value of $S$. Hence a rise in $\rho$ reduces $\mu_R$, making merger more likely or quicker. This result is intuitively appealing because merger maximizes the value of the current match, whereas contracting sacrifices some current value in return for the prospect of a future gain with a better match (following a new search). Recalling that $\rho = (1 + r)^T - 1$, where $r$ is the annual interest rate and $T$ is the contract length (in years), this result also implies that $\mu_R$ is decreasing in $T$: longer contracting periods, which Antràs (2005) terms “lumpier” contracts, increase the likelihood of merger.

From inspection of (9), falls in $c$, which may represent an improvement in the contracting environment ($c$) or a fall in contract intensity ($\beta$), and $S$ both increase $\mu_R$, i.e. make contracting more likely. The reasoning is clear: For a Northern firm that has just been introduced to a potential match, both of these are costs that will be incurred again only under contracting. However, merger still occurs with strictly positive probability even if future contracting-specific costs are zero (i.e. $c = S = 0$).\textsuperscript{14} This is because, compared to contracting, a merger gives a firm certainty that it will retain its current trading partner – and when $\mu$ is high, the lock-in effect of merger is a plus.

Differentiating $\mu_R$ with respect to $\alpha$ yields

$$
\frac{\partial \mu_R}{\partial \alpha} = \frac{\rho (1 + \rho) (\beta c + S)}{\alpha \sqrt{\alpha \rho (1 + \rho) [\alpha + 2 (\beta c + S)]}},
$$

which is clearly positive, given we are assuming that $\alpha$, $\beta c$ and $S$ are positive. Intuitively, more heterogeneity

\textsuperscript{14}From (9), it is clear that $\mu_R < 1$ when $c = S = 0$.  }
in the returns to matches (represented by higher $\alpha$) increases the likelihood that a firm will want to renew search.

### 3.2 Free entry

In equilibrium with free entry, $N$, the number of downstream Northern firms in the industry, is implicitly defined by $V_S = E$, the sunk cost of entry for a new firm. We define the value of $\pi$ which equates $V_S = E$ as $\pi^*$, the zero profit condition for new entry. We also assume that new entry is occurring into the industry (so that this equation holds). The dynamics of entry work as follows: A rise in $N$ reduces $\pi$, variable profits per pairing, and from (??), this reduces $\pi$ to $\pi^*$. (We do not specify the exact form of product-market competition – or, equivalently, the exact functional dependence of $\pi$ upon $N$. All we require is that $\pi$ be strictly decreasing in $N$ – a very weak condition indeed, which is satisfied by all the models of monopolistic competition and oligopoly of which we are aware.)

Solving (??) to equate $V_S = E$, we derive

$$\pi^* = \rho(E - \beta c) - (1 + \rho)\alpha + \sqrt{\alpha \rho (1 + \rho) [\alpha + 2(\beta c + S)]},$$

(13)

$\pi^*$ is clearly increasing (and hence $N$ is decreasing) with respect to search cost $S$ and sunk entry cost $E$. Either of these will reduce competition in the industry. The effects of $\beta$ and $c$ are slightly more ambiguous, since

$$\frac{\partial \pi^*}{\partial \beta c} = -\rho + \frac{\alpha \rho (1 + \rho)}{\sqrt{\alpha \rho (1 + \rho) [\alpha + 2(\beta c + S)]}},$$

(14)

which contains both positive and negative elements. However, rearranging this shows that $\frac{\partial \pi^*}{\partial \beta c}$ equals zero when $\alpha = 2\rho(\beta c + S)$, which is exactly the condition in (10) for $\mu = 0$. Since we are concentrating on the range of outcomes where $\mu > 0$, we need a higher value of $\alpha$ than this, which means that $\frac{\partial \pi^*}{\partial \beta c} > 0$. Hence worse contracting conditions (in the form of higher $\beta$ or higher $c$) will discourage entry into the industry.

In addition,

$$\frac{\partial \pi^*}{\partial \alpha} = -(1 + \rho) + \frac{\rho (1 + \rho) [\alpha + \beta c + S]}{\sqrt{\alpha \rho (1 + \rho) [\alpha + 2(\beta c + S)]}},$$

(15)

which implies that increasing sensitivity to match quality has potentially complex effects upon entry. How-
ever, $\frac{\partial \pi^*}{\partial c}$ is negative as long as when $\alpha > \frac{\beta c + S}{1 + \sqrt{1 + \rho}}$. If we remember that the condition in 10 is that $\mu_R > 0$ if and only if $\alpha > 2\rho (\beta c + S)$; then all values of $\alpha$ which satisfy 10 will yield negative $\frac{\partial \pi^*}{\partial c}$, implying competition rises with $\alpha$, as long as $\rho < 0.2367$. Only with higher discount rates (lumpier contracts) than this is it possible that increasing sensitivity to match quality will decrease competition.

Considering the “lumpiness” of contracting in Antràs’s (2005) terminology, while we have shown that a fall in $\rho$ increases the $s\mu_R$ and the probability of contracting, there is a second effect, through raising $\overline{V_S}$. To analyse the overall effect, we make a substitution $\beta' = \frac{\beta}{\alpha}, S' = \frac{S}{\alpha}, \pi''' = \frac{\pi'}{\alpha}, E' = \frac{E}{\alpha}$. Substituting into (13) and differentiating, we find that

$$\frac{\partial \pi''}{\partial \rho} = -(1 + \beta' c - E') + \frac{(1 + 2\rho) \left[1 + 2 \left(\beta' c + S'\right)\right]}{\sqrt{\rho (1 + \rho) \left[1 + 2 \left(\beta' c + S'\right)\right]}}. \quad (16)$$

Start by assuming $E' = 0$. $\frac{\partial \pi''}{\partial \rho}$ is greater than zero when $-\frac{1}{2(1 + \rho)} < \beta' c < -\frac{1}{2(1 + \rho)}$. Again, noting that both $\beta c$ and $S$ are nonnegative, we can derive that this condition must hold from (10). The implication is that higher discount rates or lumpier contracts imply a fall in competition - which is broadly intuitive. If we now increase $E'$, the effect of $\rho$ upon $\pi'''$ is even more marked - so that lumpier contracts reduce competitive pressure still further.

Nunn (2007) finds, empirically, that poor contract quality deters trade. Our model is consistent with this: a rise in $c$ cuts $\overline{V_S}$ (which implies that there will be fewer firms, and less aggregate production/trade, in the industry). Moreover, Nunn (2007) also finds that the trade-reducing effect of poor contract quality is stronger, the more specialised or differentiated the goods concerned are. If we follow the literature in assuming that the more differentiated or specialised products are, the lumpier contracts tend to be, then we can examine this empirical finding within the context of our model. Differentiating (16) with respect to $\beta' c$ (the order of a double differentiating being irrelevant), and substituting $\theta = 1 + 2 \left(\beta' c + S'\right)$, we can deduce that

$$\frac{\partial}{\partial \beta' c} \left(\frac{\partial \pi'''}{\partial \rho}\right) = \frac{1 + 2\rho - 2\sqrt{\rho (1 + \rho) \theta}}{2\sqrt{\rho (1 + \rho) \theta}}. \quad (17)$$
Ignoring the minus root, this will equal zero when
\[ \rho = -\frac{1}{2} - \frac{1}{2} \sqrt{\theta(\theta - 1)} - \frac{1}{2}. \]

It follows that, as long as this condition happens, \( \frac{\partial}{\partial \theta} \left( \frac{\partial \pi^{**}}{\partial \theta} \right) = \frac{\partial}{\partial \theta} \left( \frac{\partial \pi^{**}}{\partial \theta} \right) > 0 \). It follows that a poorer contracting environment reduces entry more markedly, the lumpier are contracts - consistent with Nunn’s (2007) finding. However, for higher values of \( \beta c \) and \( S \), this finding may be reversed.

4 Discussion

We first examine the effect of growth over time in the number of Northern firms on the merged/contracting composition of the industry. Assume that \( N \) grows at some steady rate, \( g \), over time, due to increases in unmodelled aspects of the \( \pi \) function (perhaps final demand is growing). Denote by \( M_t \) the expected number of contracting firms in period \( t \). These consist of those firms which were merged at \( t-1 \), plus a proportion of those firms which were unmerged at time \( t-1 \) and of new firms:

\[ M_t = M_{t-1} + \text{Pr} \{ \text{merge} \} (N_{t-1} - M_{t-1} + gN_{t-1}), \]

where the term in brackets on the RHS is the number of unmerged firms at the start of period \( t \). Rearranging and dividing through by \( N_t \), we get

\[ m_t = \text{Pr} \{ \text{merge} \} + \frac{\text{Pr} \{ \text{contract} \}}{1 + g} m_{t-1}, \]

where \( m_t \) is the expected share of merged firms in the industry at the end of period \( t \). Equation (19) defines a stable AR(1) process (since the coefficient on \( m_{t-1} \) is strictly less than one), with an equilibrium value of

\[ 15^{\text{REDO: We focus on positive growth for empirical reasons, and also because it means that no incumbent firm will ever have to consider the prospect of exiting the industry. In combination with a non-declining level of demand over time (which means that the market price is in line with that charged by new entrants?), positive growth ensures that firms face a stationary environment. Non-declining demand is important because it means that merged pairings will never exit the industry – check}} \]
\[ m^* = \frac{\Pr\{\text{merge}\}(1 + g)}{\Pr\{\text{merge}\} + g} = \frac{(1 + g)(1 - \mu_R)}{1 - \mu_R + g}. \] (20)

If \( g = 0 \), then \( m^* = 1 \), as expected. The differential \( \frac{\partial m^*}{\partial g} = \frac{-\mu_R(1-\mu_R)}{(1-\mu_R+g)^2} < 0 \), implying that, if \( g > 0 \), then \( m^* \in (0, 1) \) and \( m^* \) is declining in \( g \). So, a faster steady-state growth path implies a higher ratio of contracting firms to merging ones.

Differentiating \( m^* \) with respect to \( \mu_R \), \( \frac{\partial m^*}{\partial \mu_R} = \frac{-g(1+g)}{\mu_R^2} < 0 \). Since \( \mu_R \) is decreasing with respect to \( \rho \) or \( c \), it follows that, for a given growth rate of demand, the long-run equilibrium share of contracting to merged firms is lower, the lumpier is contracting or the poorer the contracting environment, (higher \( c \)).

We would like to consider how this might relate to the Chinese data shown in the introduction. At time 0, (roughly 1980), Chinese industry was opened both to trade and FDI. Over time, \( m \) would be expected to rise towards \( m^* \), the long-run rate of merger in steady-state growth. This is what we see. However, the fact that Chinese trade is growing fast is one reason why we would not expect \( m^* \) to reach 1.

Our story about the effects of increasing market thickness on the buy/build decision differs from other accounts (e.g. McLaren, G and H). Others stress the potential of thick markets to encourage outsourcing – but this seems to be somewhat at odds with the Chinese data...

Next, we consider some efficiency issues. We consider how changes in the reservation match quality, \( \mu_R \), affect social welfare. We will start by considering two polar opposite cases. In the first case, we hold the number of firms in the industry, \( N \), constant; this means that there are no welfare effects through consumer surplus.\(^{16}\) Thus, the division of the industry between merged and contracting firms affects social welfare solely through its impact on fixed costs.\(^{17}\)

We assume that the market opened with \( N \) unmatched Northern firms at the start of period 1. In period \( J \geq 1 \), the expected number of contracting firms is \( N\mu_R^J \), where \( \Pr\{\text{contract}\} = \mu_R \). Thus, in period \( J \), the total expected reduction in fixed costs per firm is

\(^{16}\) Typically, of course, changes in exogenous parameters will alter both \( \mu_R \) and \( V_S \).

\(^{17}\) CHECK: Note also that because \( N \) is fixed and the merge/contract decision affects only fixed costs, the social planner’s intertemporal problem will be identical to that faced by a representative firm’s – i.e. they will both choose the same \( \mu_R \) cut-off. (That is, the problems of maximising expected profits and maximising expected social welfare are identical.)
This shows that welfare grows over time. There is an interesting trade-off between short-run and long-run welfare. Increasing $\mu_R$ increases long-run welfare, which we think of as the expected fixed-cost reduction when all firms are merged; that is, it increases the average quality of a merger.\(^{18}\) However, increasing $\mu_R$ also makes firms slower to merge, which means that they incur the costs of contracting for longer. This reduces short-run welfare. (For example, setting $J = 1$ and differentiating (21) with respect to $\mu_R$, we get \[
\frac{dE(R_1)}{d\mu_R} = \left(\frac{\alpha}{2} + \beta c\right) < 0.\]) In essence, a higher $\mu_R$ results in better mergers (which is good in the long run) but also slower mergers (which is bad in the short run).

An alternative approach to considering welfare is in the case with free firm entry. We start at time zero (before trade and mergers start) and look forwards, taking present values. In this case, free entry and the zero expected profit condition mean that the net present discounted benefit to firms of changes in our various parameters is zero. The more important effect is on consumers: the higher is $N$, the greater will be the value of consumer surplus. Therefore, any of the factors which raise $N$ (lower $\rho, S, E, \beta$ or $c$) will benefit consumers. Moreover, consumers start gaining (in terms of increased competition and greater variety) as soon as firms enter, even though many firms may initially be making losses (due to not yet having found satisfactory partners). Effectively, search for trading partners is a type of capital expenditure, which incurs a cost to firms while the investment in search is going on, but yields a long-run normal rate of return to firms, and a benefit to consumers.

\(^{18}\text{IMPORTANT:}\) Note that we are here treating $\mu_R, \mu_M, \alpha, S$ and $\beta c$ as independent. Thus, from (9), the underlying cause of the variation in $\mu_R$ must be a change in $\rho$. 

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5 Conclusions

In common with a number of previous studies, we have examined the role of search in the choice between an outsourcing relationship or vertical FDI. The main difference is that search is seen as an ongoing process, with aspects of learning-by-doing, and the value of outsourcing is its relative flexibility, while the main value of FDI is to reduce transational costs, which in turn vary according to the national legal/institutional environment. As such, our analysis is in the tradition of Nunn (2007) in emphasising the importance of legal/institutional quality as a determinant of trade, at least within differentiated industries with high relationship-specific costs.

A key feature of our model is that it differentiates static and dynamic results. Poor institutional quality is particularly costly to outsourcers. On the one hand, it may deter search altogether, by raising the reservation price of searching firm pairings in a particular market. However, if underlying comparative advantage is strong, then this may offset the increased search costs, so that firms still engage in search. In this case, the FDI decision will be sped up - consequently, we would agree in the short-run with Markusen’s (1995) OLI finding that poor contract quality favours FDI, although adding the caution that this does not apply in a long-run steady-state, where all firms will merge in our framework.

The dynamics of our model indicate that, as a new exporter grows in size, outsourcing will tend to precede FDI. This is somewhat contradictory to Grossman and Helpman’s (2002) prediction (based on a thin markets model with search before trading) that increasing market size will imply an increasing share of outsourcing. We argue that the Chinese experience 4tends to support our predictions, and perhaps supports the existence of a search-by-matching process.

References


