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Trust and the market for technology

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ABSTRACT

Conditional on the decision to enter the market for immature technology, we test for the effects that trust—proxied by the context in which the negotiating parties first met—has on the likelihood that these negotiations are successful. Using survey responses from 860 university–firm and firm–firm technology transactions, we find that trust matters: parties with high levels of trust (i.e. know each other from a previous business) are between 6 and 23 per cent more likely to conclude a transaction compared with those with low levels of trust (i.e. cold-callers). We also find that patents can effectively substitute for a lack of trust and that trust is more important in upstream stages (basic or applied science).

1. Introduction

In this empirical paper, we explore the efficiency of one increasingly important class of transactions: the purchase of technology and technology rights. Much progress has been made in understanding the determinants of inter-organisational trade and in analysing the problems associated with contracting over technology in general (see Mowery, 1983; Zeckhauser, 1996; Arora and Gambardella, 2010). Indeed, the importance of both formal and informal mechanisms in governing these purchases between and within organisations is well known (e.g. Mayer and Argyres, 2004; Baker et al., 2002; Ryall and Sampson, 2009; Gil, 2013). Surprisingly, little of this work has emphasised the facilitating role of trust within this market. We address this lacuna by focusing squarely on the role that trust plays in enabling markets for technology.

Our research question is: conditional on the decision to start serious negotiations, do differences in *ex ante* trust between the two parties affect the likelihood that the negotiations are successful? And if so, does it vary with the characteristics of the technology? Given that the market for technology incorporates all of the canonical inter-firm contractual hazards (thin markets with imperfect property rights and unobservable quality), it is surprising that these issues are not studied more.[1]

To investigate these questions, we assume that trust influences how parties evaluate the expected gains from trade and that this evaluation is reflected by a higher probability of a successful negotiation. The key issue for our analysis is the measurement of trust. Rather than ask the negotiating parties a direct question about their (subjective) views on their mutual level of trust, we proxy trust with an objective measure of how the parties first met each other. Our contention is that the differences in the social and professional ties underpinning the negotiation play differing roles in mitigating the contractual hazards associated with the market for technology.

Our study focuses exclusively on the market for ideas which are not commercial-ready but require further work in order to be useful or deliver a final product. That is, all of the technologies in our sample require further development to take them to market. This contrasts with markets for mature technology—technologies traded through patent pools or franchises—wherein the decision to trade is driven by issues associated with competition and price.[2] In this 'ready-to-wear' environment, technologies are proven, a consumer market exists and traders typically concern themselves with how a sale will affect market share and incentives for their competitors to 'invent around'. In our market on the other hand, the motives for licensing or trading technology are concerned with specialisation and risk sharing. The research questions instead focus on 'how'

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[1] Indeed, the only study we have discovered on the role of trust in markets for technology was concerned with the trade of commercial-ready technology (de Ruyter et al., 2001). In contrast, our study focuses on transactions relating to technology that requires additional development before it is market-ready.

[2] There is a different stream of literature examining these issues; see, for example, Gallini (1984), Katz and Shapiro (1986), Rockett (1990), Gallini and Wright (1990), Arora and Fosfuri (2000), Kamien and Tauman (2002), Bessen (2005), Gallini (2011) and Spulber (2013). For a review, see Arora and Gambardella (2010).

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and 'why' firms collaborate in order to develop and commercialise an idea. We argue that it is not appropriate to combine the mature and immature technology motives into a single model of behaviour as this will conflate two distinct phenomena.

Our analysis is informed by a unique dataset based on a survey of technology go-betweens or intermediaries in Australia. The list of intermediaries—which included in-house business development managers and independent brokers—was purpose built for this study. Types of transactions covered in the survey include the license or sale of IP and know-how, contract research, research and development (R&D) partnerships and the sale of technology-intensive companies. To ensure random variation in the explanatory variables and a reasonable sample size for each possible outcome, each intermediary was asked about their 'last completed' and their 'last abandoned' technology transaction. This provides us with information about a pair of technology transactions handled by each intermediary. Importantly, asking about the last transaction (as opposed to letting the respondents choose which transactions to report) ensures that the transactions in our sample are not systematically correlated with the success of the negotiations. The final survey dataset consisted of 467 completed and 393 abandoned transactions (totalling 860 observations) of which 68 per cent occurred between 2009 and 2011.[3]

Our results provide two main contributions to the literature. First, we find that the depth of prior relationship and circumstantial knowledge about each other matters, and matters a lot. We estimate that greater trust between parties can add between 6 and 23 per cent to the probability that negotiations will conclude in a transaction. Second, we find that patents can effectively substitute for a lack of trust. These findings are all the more significant given the considerable variation in the depth of trust that exists between players in technology markets. This variability stands in contrast to the uniformly high level of trust in conventional markets which trade raw materials, machinery or electricity. In these conventional markets, the products sold are highly developed, homogeneous or regulated and there is rarely a question over trust. Although our findings are unsurprising, this is the first time that rigorous, systematic evidence of the importance of trust in the market for immature technology has been documented. They reveal considerable scope for governments (and professional associations) to stimulate deeper connections between actors in the market for technology and thereby achieve gains from technology trade.

To assess the sensitivity of our results to unobserved heterogeneity, we evaluate the strength of endogenous selection on unobservables following Altonji et al. (2005). We use this method and not the instrumental variable approach because of the absence of suitable instruments in our dataset. One may argue that unobservables, such as the *ex ante* reputation of the parties, could influence both where the parties first met and the likelihood of a successful negotiation. It is probably easier to cold call a lesser-known buyer to pitch the sale. However, if it is also more costly to prepare the sales pitch, then those with a less attractive technology to sell might be more likely to use cold calling. We do not find our results to be sensitive to such endogeneity problems. We also produce both unweighted and weighted estimates to assess the sensitivity of our results to the sampling design (effectively our data oversample one type of outcome over the other, unless the true proportion of outcomes is split evenly).

There remain some important clarifications. First, our measure of 'success' relates to whether negotiations to complete the transaction were successful rather than the more complex issues surrounding whether the transaction was eventually profitable. Successful negotiations are of course a necessary, but not sufficient, condition for successful commercialisation. Second, we only focus on one of many linkages in the value-added chain—there might be many other linkages during the commercialisation process that we do not observe and we therefore cannot shed any light on the relative importance of the numerous linkages. Finally, we focus on technology transfer between organisations that are based on contractual agreements. There are other important modes of transferring technology—for example, the transfer of tacit knowledge via labour movements (e.g. Arora, 1995)—but these are outside the scope of this study.[4]

The rest of the paper is organised as follows. Section 2 provides some background and Section 3 provides descriptive statistics on the survey data. Section 4 sets up the econometric model. Section 5 discusses the results and Section 6 concludes.

2. The relational context and the market for technology

Despite considerable reflection about the contractual hazards associated with trading in the market for technology (Arora et al., 2001, 2004; Cesaroni, 2004; Zuniga and Guellec, 2009; Arora and Gambardella, 2010), little empirical effort has been devoted to study the role of trust in this field. This is somewhat surprising given that trust, transaction costs and relational contracting have been examined in great detail in the literature on the boundaries of the firm more generally (see, for example, Baker et al., 2002; Lyons, 1994). In this section of the paper, we provide some background to our analysis of trust, incomplete contracts and the market for technology.

In their papers on the R&D boundaries of the firm, Mowery (1983) and Pisano (1990) argue that there are three features of an exchange which can erode confidence to the point where market transactions collapse: uncertainty, non-codifiability and opacity. Uncertainty about future cost- or demand-side conditions can create an expectation that *ex post* renegotiations will be needed later as unforeseeable circumstances unfold. If there is a fear that the other party will behave opportunistically, parties may choose not to transact with each other (Williamson, 1985).[5] In addition, where it is difficult to accurately codify the nature of the product traded, parties may fail to trade if there is reason to believe the other party will act on the literal terms—rather than the spirit—of the agreement. Finally, when quality is opaque—if, for example, trade is infrequent or quality is only revealed through use—then an exchange can also fail to occur. Legal remedies (litigation) are poor solutions as these can be uncertain and their victories pyrrhic.

We expect that uncertainty, non-codifiability and opacity will affect the market for immature technologies (vis-à-vis mature technologies) *a fortiori* for a number of reasons. First, unformed technologies are by definition still highly uncertain. Second, property rights, if they exist, can be fuzzy if the technology is so immature that it is subject to a primitive level of codification. As a consequence, it is hard to determine a price for the technology as it is not easy to articulate what is being bought and sold. Third, assessing the quality of work done or knowledge provided

[3] Intermediaries that were thought to regularly buy and sell technology were asked to complete details for four transactions: bought or sold for both completed and abandoned.

[4] There are many ways in which organisations may exchange knowledge, including via meetings and conferences, consultancy and contract research, joint research, training, and employee mobility. However, our survey does not cover all of the channels of technology transfer between organisations, only those that occur via formal contractual exchanges.

[5] The problem of uncertainty and unspecified contingencies exists even without the producer investing in specific assets. The situation could be one where party A has been contracted to produce product B and if part way through the contract a situation arises that means it makes more sense to produce <***>B' than B, technically party A literally follows the contract and just produces B.