Intra-Cluster Cooperation and Relational Contracting in Pakistan's Surgical Instrument Cluster: An Empirical Study

> Theresa Thompson November, 2004

# I. Introduction

Industrial clusters have been viewed as important in developing countries because they make sizeable contributions to their economies in terms of employment, output, and exports.<sup>1</sup> An industrial cluster consists of a group of firms that are specialized by sector. located in close geographic proximity and consist of mostly small and medium sized enterprises.<sup>2</sup> The benefits to firms from clustering are commonly referred to as active and passive collective efficiency. Passive collective efficiency refers to benefits accruing to a firm by virtue of being in a cluster, such as market access, access to a large pool of skilled labor, technological spillovers, flexible specialization, and reduced transactions costs. Active collective efficiency, on the other hand, stems from purposeful cooperation between the firms of the cluster to undertake a large-scale project to upgrade production. The above mentioned upgrading may take the form of *process upgrading*, which consists of reducing costs either by re-organizing production or by implementing new technology, functional upgrading, leading to a greater involvement of (manufacturing) firms in the design and marketing process, or *product upgrading* that entails producing more sophisticated (higher value-added) goods.<sup>3</sup> Cooperation is necessary because the individual firms are too small to carry out such a project.

This paper empirically examines the nature of cooperative relationships formed

<sup>&</sup>lt;sup>1</sup> Clusters produce a significant amount of output, with a great deal of this output bound for the export market. For example, India's Palar Valley clusters produce forty-five percent of the country's leather, where there are at least 600 tanneries in five clusters. In Tiruppur, India, there were at least 2000 clustered cotton knitwear firms in 1995, which produced about 70% of India's exports of this commodity (Banerjee and Munshi (2000)). In Ludhiana, India, there were 10,000 firms and 200,000 workers producing Rs 241 billion (almost \$10 billion in U.S. 1991 dollars) of woolen knitwear in 1991 (Tewari (1999)). In Agra, India, 5000 clustered firms were producing 300,000 pairs of shoes per day in 1991-92 (Knorringa (1999)). <sup>2</sup> For example, clusters in Sinos Valley (Brazil), Agra (India), and Guadalajara and Leon (Mexico) all produce footwear. Other clusters that have been studied specialize in the production of textiles, leather goods, and surgical instruments. <sup>3</sup> Schmitz and Nadvi (1999), pg. 1504.

between clustered firms. Two key aspects of collective efficiency, one passive and one active, are evaluated by empirically analyzing the surgical instrument cluster in Sialkot, Pakistan. In the first part, we study one aspect of passive collective efficiency: the transaction costs the clustered firms encounter in their dealings with customers and suppliers. Specifically, we test the hypothesis that relational contracting affects the amount of trust between firms, where trust is measured by the receipt of trade credit by customers from their suppliers. The firms receiving trade credit are either members of the cluster or firms that interact frequently with it. In the second part, we determine which firm and cluster characteristics contribute to firms' interest in intra-cluster cooperation to engage in functional upgrading or "joint action" to market their own goods, a form of active collective efficiency.

The main objectives of this study are to analyze the role of contract enforcement institutions in developing countries and the position of developing country producers in global supply chains, two major topics of interest in development economics today. In the first part of the study, we focus on relational contracting in Pakistan's surgical instrument cluster in order to deepen our understanding of contract enforcement in closely-knit communities in developing countries.

In the second part of the study, we examine the opportunities for clustered surgical instrument producers in Pakistan to market their own goods. Most firms in developing country industrial clusters are small and medium size enterprises that individually have limited access to markets in developed countries and often rely on multinational firms to distribute and market their goods. This is the case in Sialkot's surgical goods industry, as in other industrial clusters. These clusters may provide an opportunity for small and medium sized firms to assert their interests and collectively promote their goods in the world market. The second part of the study includes regressions to determine which factors influence the decision of exporting firms in the Sialkot surgical instrument cluster to engage in a hypothetical "joint action" initiative that would allow them to market their own goods. This analysis will help to shed light on the ability of other, similar clusters to undertake initiatives of this type.

Before proceeding further, it is important to discuss the theoretical foundations of relational contracting and joint action. These discussions will provide an overview of these two topics and define the hypothesized predictions that we will test empirically in later sections.

The importance of institutions, especially contract enforcement, has been well established in both theoretical and empirical economic literature. The absence of strong institutions has been recognized as a major constraint to economic growth in developing countries. As Douglass North argues in his seminal work on institutions:

...the inability of societies to develop effective, low-cost enforcement of contracts is the most important source of both historical stagnation and contemporary underdevelopment in the Third World.<sup>4</sup>

Research has shown that in the absence of an effective legal system or formal system of contract enforcement, individuals and firms must rely on informal means to enforce agreements. In many cases, bilateral relationships or third-party social pressure may either substitute for, or complement, a legal system in the enforcement of contracts. This type of informal enforcement of contracts is referred to as relational contracting. Relational contracts are "informal agreements sustained by the value of future relationships" (Baker, Gibbons, and Murphy (2002)). The methods of informal

<sup>&</sup>lt;sup>4</sup> North (1990), pg. 54.

enforcement have been laid out in the New Institutional Economics literature (see North (1990), Greif (1994), Kranton (1996)) and consist of the agents' ability to sanction individuals who have reneged on their agreements without relying on the legal system.<sup>5</sup>

North (1990) presented three major methods that can be used to informally enforce agreements. One method is for an agent to deal only with those who are known to them and can be trusted, so that trading partners are most likely to be friends and family members. Another approach is to develop self-enforcing agreements by dealing with the same agent repeatedly over an extended period of time, using the threat of breaking off the profitable trading relationship as a means to prevent the other party from cheating.<sup>6</sup> Finally, informal enforcement can also be carried out through community enforcement. In this situation, when an agent reneges on an agreement, all members of the community sanction this individual by refusing to trade with that agent. To be effective, community enforcement has two major requirements, i) that knowledge about cheaters is diffused through the community, and ii) that other members of the community are willing to refuse to trade with a known cheater. Community enforcement is therefore often limited to a specific geographic area and/or to agents of a common cultural or social background.

In practice, informal enforcement is carried out through a combination of the

<sup>&</sup>lt;sup>5</sup> Kranton (1996) studied a theoretical model of reciprocal exchange, where the value of long term relationships can support barter between two trading partners, and found that reciprocal exchange relationships can dominate in an economy even when they are a less efficient mode of exc hange. Greif (1994) explored the path dependence of contract enforcement institutions by examining the difference between the eleventh-century trading practices of Genoese and Maghribi traders and distinguished between the individualist and collectivist enforcement systems that were the precursors to modern-day institutions. The collectivist system, characteristic of contract enforcement institutions in developing countries today, relied strongly on community enforcement mechanisms and social sanctions.

<sup>&</sup>lt;sup>6</sup> Self-enforcing agreements may be characterized by high search costs and/or high transport costs to buy from alternate suppliers. A firm must be able to identify their trading partners (i.e. know who they are trading with at the time of the trade) and be able to determine if a trading partner has cheated.

three methods described above: trust, repeated interaction, and community enforcement. The combination used in practice depends on the environment in which the parties are contracting. The particular characteristics of clusters may make some contract enforcement mechanisms more effective than others. For instance, since all firms produce similar goods, the threat of an individual intermediate input supplier breaking off a trading relationship with a manufacturer (customer) is unlikely to prevent cheating unless there is community enforcement due the multiplicity of similar suppliers. Therefore we hypothesize that community enforcement is likely to be stronger force than sanction by an individual firm in a cluster.

An analysis of the second major topic of intra-cluster cooperation is presented in Thompson (2004), which develops a theoretical model of "joint action" for clustered firms to market their own goods. This paper examines the conditions under which clustered firms from a developing country that are heterogeneous in expected quality of output can functionally upgrade through cooperation to eliminate a foreign distributor from a developed country acting as an intermediary between the clustered manufacturers and the final market for the goods.<sup>7</sup> The model proves that joint action can occur among high quality type firms, but not with the participation of low quality firms. The model also shows that joint action is more likely to take place when i) the size of the cluster, the probability of producing high quality output by the high type firms, and the final market price of the good are high, and ii) when the probability of producing high quality output by the low type firms and the marketing cost are low. The high quality firms do not need to be in the majority for joint action to take place, although a critical mass of high quality firms must exist as a necessary condition. An important determinant of whether joint

<sup>&</sup>lt;sup>7</sup> There were two types of firms in the cluster: type A or "high quality" and type B or "low quality".

action occurs is the opportunity cost of such initiatives, as determined by the prices that the middleman is willing to pay for the cluster's goods.

As we have discussed in this section, the two main themes related to collective efficiency in this study are transactions costs originating from contract enforcement and the prospect of joint action for clustered firms to market their own goods. Our two main research questions and summary results appear below.

 What factors influence the amount of trust (associated with informal contract enforcement or relational contracting) between the clustered firms and their customers? Similarly, what factors influence the amount of trust that exists between clustered manufacturers and their intermediate input suppliers?

Our results show that firms are more likely to offer trade credit to their customers, (i.e. inter-firm trust is greater) when they believe in the effectiveness of formal contract enforcement through the court system. There is also some evidence of customer lock-in as a tool for contract enforcement since suppliers are more likely to give credit and allow customers to pay a larger portion of their bill with delay when relationships are of longer duration. This is because locked-in customers are less able to find alternate suppliers. Participation in business networks (that can be used to gather information about reliability and/or for social sanction) is also an effective tool in that suppliers that obtain information about customers to pay a larger portion of their bill with delay. Additionally, customers are less likely to receive credit when they are visited by suppliers before the first sale. If a customer receives a visit from the supplier before the first sale, this may indicate that it is a previously unknown trading partner, and therefore not fully trusted.

On the other hand, customers that visit their suppliers weekly are more likely to receive trade credit. These visits may assist the suppliers in gathering information about the reliability of the firms as well as to monitor informal contracts.

2) Under what conditions might clustered surgical instrument firms band together and form a cooperative to "break out" of their relationship with multinational buyers to market their own goods?

Our results demonstrate that firms are more likely to be interested in such initiatives once they have already had some direct experience in marketing, such as selling products under their own brand name and having already sold some goods directly to hospitals. Firms that have had relationships of longer duration with customers tend to be less likely to be interested in joint action initiatives. This indicates that a higher opportunity cost of engaging in joint action (as proxied by relationships of longer duration) reduces the likelihood of joint action initiatives in clusters.

## Organization of the Paper

This paper is presented in seven sections. In Section I, the introduction, we have defined and summarized the study. Section II discusses some of the empirical literature related to clusters. In Section III, the surgical instrument cluster of Sialkot (Pakistan) is introduced, along with the survey methodology and the estimation strategy for the relational contracting regressions. Sections IV and V present the results of the relational contracting regressions for trade credit offered to customers and trade credit received from suppliers. Section VI describes the estimation strategy and presents the results for the regressions on "joint action" that attempt to determine which firm and cluster

characteristics contribute to firms' interest in a theoretical joint marketing initiative. Our conclusions are presented in Section VII.

## II. Empirical Literature

Two earlier papers by McMillan and Woodruff (1999) and Johnson, McMillan, and Woodruff (2002) used an innovative survey instrument to test the hypothesis of relational contracting in two environments where the judicial system is not fully developed, first in Vietnam and then in Eastern Europe. As discussed above, informal relationships can substitute for third party enforcement through relational contracting. The measure of trust used as the dependent regression variable was the amount of trade credit that a supplier offered to its customers. In Vietnam, they found that the amount of trade credit given to a customer is positively related to the difficulty of finding a new supplier, a longer duration of the trading relationship, and the identification of customers through business networks. Johnson, McMillan, and Woodruff conducted a similar survey in five Eastern European countries: Poland, Slovakia, Romania, Russia and Ukraine. In addition to relational contracting variables, they included the role of the judiciary in this second study. This is because the court systems in Eastern Europe are considered to be stronger than those in developing countries such as Vietnam. Their study found that greater confidence in the court system made firms more likely to offer trade credit and to try new lower cost suppliers. The effect of courts was greatest at the beginning of a trading relationship.

We use a methodology similar to McMillan and Woodruff (1999) and Johnson, McMillan, and Woodruff (2002) and apply it to data from an industrial cluster in Sialkot Pakistan. Our research makes a unique contribution to the literature since this aspect of

9

relational contracting has not yet been studied empirically in the context of a cluster.

In a related study, Fisman and Raturi (2000) also used trade credit data to study inter-firm trust, though they use a different methodology. Studying trade credit data from Africa, they showed how competition could encourage long-term cooperative relationships when trading partners must make non-contractible investments at the beginning of the relationship.<sup>8</sup>

While most of the literature on the topic of industrial clusters in developing countries has consisted of case studies, there are a few papers that have empirically analyzed the effects of social network-based relationships on economic activity in clusters. Ilias (2001) and Banerjee and Munshi (2000) used empirical analysis to verify the existence and sometimes distortionary effects of these types of relationships in clusters.<sup>9</sup> Woodruff's (1998) case study of a shoe-producing cluster in Mexico demonstrated the importance of community sanctions for contract enforcement in a cluster.<sup>10</sup> Our paper extends the empirical literature on clusters to include results on relational contracting to enforce contracts.

<sup>&</sup>lt;sup>8</sup> Fisman and Raturi (2000) use fixed-effects regression analysis to show that greater competition is associated with higher provision of trade credit. Suppliers use trade credit in order to attract customers. Once a customer and supplier have invested in building trust, then the customer is "locked-in" to the relationship.

<sup>&</sup>lt;sup>9</sup> Ilias (2001) focuses on the role of family labor in the Sialkot surgical instrument cluster and the distortionary effects of the decision to use family versus non-family labor. He concludes that there existed a labor market distortion such that family managers are preferred to non-family and therefore firm output is correlated with family size. Banerjee and Munshi (2000) present a theoretical model and empirical testing of social network-based lending, comparing the investment and earnings profiles of migrants and established producers (a caste called the Gounders) in the Tiruppur knitwear cluster in India. They find that the established producers, with access to cheaper informal credit through a social lending network, have lower output growth but invest more at all levels of experience as compared to the migrants. <sup>10</sup> Woodruff (1998) presents a case study examining the impact of trade liberalization on the Mexican footwear industry, based on a qualitative analysis of surveys conducted in the Guadalajara and Leon clusters. He finds that trade liberalization weakened the ability of cluster manufacturers to use informal contract enforcement mechanisms (reputation) with respect to retailers.

# III. The Surgical Instrument Cluster in Sialkot (Pakistan): Description of the Survey and Estimation Strategy

There is a cluster of firms consisting of approximately 220 producers and 1500 subcontracting firms in Sialkot, a city in the Punjab province of Pakistan (see Table 1), which produces surgical instruments mainly for foreign markets including the United States and Western Europe, with 36 percent and 39 percent of instruments being exported to these destinations respectively.<sup>11</sup> For the most part, the U.S. imports Sialkot's disposable (single-use) instruments, and Europe imports re-useable instruments.<sup>12</sup> In addition to surgical instruments. This cluster also produces a small amount of veterinary and manicure/pedicure instruments. This cluster's output is significant, as verified by the \$124 million worth of goods exported in 2000-2001.<sup>13</sup> The firms of the cluster manufacture approximately 10,000 different types of disposable and re-useable surgical instruments.<sup>14</sup>

In the cluster, production of the surgical instruments takes place in stages, including input production, manufacturing, and complementary services. The large vendor segment consists of small firms that specialize in one or more stages of the production process. There is a negative correlation between firm size and the percentage of sub-contracted manufacturing processes, and the largest firms carry out 80-90 percent of production processes in-house.<sup>15</sup> Except for the largest manufacturers, production of a final good is not generally carried out in a single, vertically integrated firm.

<sup>&</sup>lt;sup>11</sup> SMEDA (2001), pg 16.

<sup>&</sup>lt;sup>12</sup> SMEDA (2001), pg. 17.

<sup>&</sup>lt;sup>13</sup> SMEDA (2001), pg. 13.

<sup>&</sup>lt;sup>14</sup> SMEDA (2001), pg. 21.

<sup>&</sup>lt;sup>15</sup> SMEDA (2001), pg. 39.

The cluster also has local business associations, including the Metal Industries

Development Centre, the Sialkot Dry Port Trust, the Sialkot Chamber of Commerce and

Industry (SCCI) and the Surgical Instrument Manufacturer's Association (SIMA).

Size of	Number of	Number of	Revenues	Capital
Firm	Firms	Employees	(\$)	-
Large	20	250-400	>1.5 million	(Rs 50-100 million)
			(Rs 60-100 million)	
Medium	50	100-250	150,000-1 million	(Rs 10-25 million)
			(Rs 10-60 million)	
Small	150	30-50	15,000-150,000	(Rs 1-5 million)
			(Rs 1-10 million)	
Vendors	1500	5-20	800-15,000	(Rs 50,000-1 million)
			(Rs 1-1.5 million)	
Traders	800-1000	na	na	na

Table 1: Surgical Instrument Firms in Pakistan (from '95-'96 Census of Manufacturing)

The cluster has a long and interesting history. Local blacksmiths began producing surgical instruments around the start of the 20<sup>th</sup> century at the request of the American Mission Hospital in Sialkot. In the 1930s, the cluster began exporting regionally to countries such as Egypt and Afghanistan, and it was a vital supplier to both Indian and Allied forces during World War II. The industry continued to expand in the decades after the Second World War. Strong pro-labor legislation passed in 1973 (applying to firms with 10 or more employees) dramatically increased labor costs and altered Sialkot's development trajectory, leading the industry to shift to extensive sub-contracting, referred to as "vendorization."<sup>16</sup>

At times, the cluster has experienced some problems with quality, which reached a crisis point in 1994 when the U.S. Food and Drug Administration (FDA) halted imports

<sup>&</sup>lt;sup>16</sup> SMEDA (2001), pg. 9 and pg. 52.

from Pakistan until the firms adopted Good Manufacturing Practice (GMP) standards. In general, the firms do not use the most technologically advanced equipment and manufacturing processes, since many of the machines have been built locally using reverse-engineering techniques. As with sub-contracting, the largest companies offer a contrast to smaller firms in that they tend to use more modern equipment. Nonetheless, the direct cause of the difficulties with the FDA were problems with the alloy composition of locally manufactured steel used for the disposable instruments, a problem that was accentuated by the lack of proper testing facilities.<sup>17,18</sup> To this day, the firms only have access to an outdated and unreliable facility to test steel composition, despite the fact that many Sialkot firms have already obtained GMP certificates.

## Description of the Survey Instrument

For purposes of this study, we designed and commissioned a survey of the surgical instrument cluster in Sialkot, Pakistan, based in large part on the survey questionnaire developed by McMillan and Woodruff (1999) for Vietnam and Johnson, McMillan, and Woodruff (2002) for their study in Eastern Europe and Russia. The faculty at the Lahore School of Economics in Lahore, Pakistan conducted the survey. A breakdown of the entire survey sample (before data cleaning) is provided in Table 2.

rable 2. Survey Sample (Am minis surveyed)								
	Number	% of	Average	Average age				
	of firms	sample	employment	of firms				
			(# of workers)	(years)				
Exporters	76	62%	91.8	19.9				
Vendors	47	38%	15.4	11.7				
All Firms	123		61.9	16.7				

Table 2: Survey Sample (All firms surveyed)

<sup>&</sup>lt;sup>17</sup> SMEDA (2001), pg. 49.

<sup>&</sup>lt;sup>18</sup> Imported steel is used for the re-usable instruments.

When the interviewer went to the cluster to begin the survey, she found that only about 180 of the 220 exporting firms that were listed by SIMA (the local business association) were actually in operation at that time.<sup>19</sup> Of these, 76 firms at least partially answered the survey, leading to a response rate of 43 percent. The interviewer then met with 47 vendor firms in the villages surrounding Sialkot, where the cottage industry is located.

## Estimation Strategy for Analysis of Relational Contracting

The first part of the study examines elements of relational contracting in the context of a cluster in a country where the institutional environment is characterized by weak third party enforcement. We adapted the survey instrument developed by Johnson, McMillan, and Woodruff (2002) in order to investigate mechanisms of contract enforcement in the Sialkot surgical instrument cluster in Pakistan.

The measure of trust used as the dependent regression variable in the relational contracting regressions is trade credit offered to customers or received from suppliers. More specifically, we asked each surveyed firm about the amount of trade credit they offered to two customers (their oldest and newest customers) and received from two suppliers (their oldest and newest suppliers). This approach helped to increase the number of observations and heterogeneity in the characteristics of the surveyed firms' customers and suppliers.<sup>20</sup>

<sup>&</sup>lt;sup>19</sup> The survey was carried out in Spring 2002.

<sup>&</sup>lt;sup>20</sup> As can be seen in Appendix Table 13, both exporter and vendors firms give and receive trade credit, but not in the same proportions. Exporters in the sample give trade credit in greater proportions than they receive, but the reverse is the case among the vendors. (Out of 53 exporters, 37 give trade credit, and 27 receive trade credit. Out of 42 vendors, 30 give trade credit and 39 receive trade credit.)

However, a potential problem arises if the duration of trading relationships is correlated with trade credit incidence, in which case sample selection is based in part on the error term. Specifically, the sampling of the oldest customers and oldest suppliers would create a sample selection bias. There is in fact a noticeable difference between the average duration of the relationship with the oldest and newest customer and between the average duration of the relationship with the oldest and newest supplier (see Table 3). However, we believe that the sample selection method will not cause bias in the estimates for two reasons. First, there is considerable variation in the duration of trading relationships within-group. Since there is considerable variation in the ages of firms in the cluster (from less than one year to more than forty years old), there is also substantial variation in the duration of the relationships (see Table 3). Among the oldest customers, the average duration of the relationship is 10.5 years, with a standard deviation of 7 years. Among the oldest suppliers, the average relationship is almost 12 years, with a standard deviation of more than 8 years. Secondly, all of the equations were estimated both with and without duration of the relationship as an explanatory variable, and the impact of removing duration was minimal.

	Old	New	Old	New
	Customers	Customers	Suppliers	Suppliers
Age of Firm				
Surveyed				
Mean	15.2	16.3	16.5	17.8
Std. Dev.	10.4	11.1	11.3	11.8

Table 3: Variation in Ages and Duration of Relationships in Sample<sup>21</sup>

<sup>&</sup>lt;sup>21</sup> Note that the mean, standard deviation and median of the age variable are referring to the age of the firm that was surveyed, not the age of the customer or supplier. The summary statistics for age of the firm surveyed varies slightly between old and new customers because the two samples are slightly different; there are 8 firms for which there was only sufficient data for their oldest customers, and 4 firms for which there was only sufficient data for their newest customers. Likewise, these statistics vary between old and new suppliers for the same reason; there are 11 firms for which there was only sufficient data for their oldest suppliers, and 2 firms for which there was only sufficient data for their newest suppliers.

Median	13.0	13.5	13.0	14.0
Duration of				
Relationship				
Mean	10.5	2.7	11.9	2.8
Std. Dev.	7.0	2.6	8.4	3.2
Median	10.0	2.0	10.0	2.0
Sample Size	68	64	61	52

In addition to questions about trade credit and the length of relationships with the oldest and newest customers and suppliers, firms were asked several other questions about the nature of their trading relationships and contract enforcement, including questions about their belief in the effectiveness of local courts, how often they visit customers and suppliers, how they were introduced to their customers and suppliers, how difficult it would be to find alternate customers or suppliers, and whether social sanctions existed for reneging on contracts.

In their study of Vietnamese firms, McMillan and Woodruff (1999) found support for the hypothesis that customers lacking alternate suppliers receive more trade credit, due to the lack of an outside option. If the customer's main competitor is located nearby, it is allowed to pay 13 percent less of its bill with delay. If a similar manufacturer is located within 1 km, it reduces by 1 percent the amount of a customer's bill it is allowed to pay after delivery. Also, customers receive more trade credit when i) the supplier inspects the customer directly before the start of the trading relationship (which increases by 8 percent the portion of the bill paid with delay) and ii) relationships are of longer duration, due to the supplier having better information about the reliability of a customer. An increase in the duration of relationship by one year increases by 7 percentage points the amount of the bill paid with delay. A supplier belonging to a network grants 20 percentage points more trade credit on average due to the ability to sanction cheaters, although business networks were stronger indicators than social networks. Suppliers that communicate at least monthly with other suppliers allow customers to pay 19 percent more of their bill with delay. Johnson, McMillan, and Woodruff (2002) obtained similar results in their study of Eastern European firms. They also found that belief in the effectiveness of the court system and membership in a trade association increased the amount of trade credit that firms were willing to offer to customers. Those firms that believed in the court system were 8 percent more likely to offer trade credit and allowed customers to pay approximately 5.5 percent more of their bill after delivery.

However, since the work of McMillan and Woodruff (1999) and Johnson, McMillan, and Woodruff (2002) was not related to clusters, the particular characteristics of clusters may yield somewhat different results from those obtained in the studies of Vietnam and Eastern Europe. For instance, one of McMillan and Woodruff's results in Vietnam was that firms were more likely to trust customers (and therefore offer trade credit) the more difficult it was for that customer to find an alternate supplier. In a cluster, manufacturing firms (as customers) have numerous alternate suppliers of similar (although perhaps not identical) intermediate inputs. Therefore, the absence of alternate suppliers is less likely be a deterrent to reneging on contracts unless intermediate inputs are highly specialized. Because of this, we hypothesize that information sharing and network effects are more likely to be significant determinants of trust and contract enforcement in a cluster environment.

We estimate a model of the probability that a firm offers positive trade credit to its customer (where trade credit is a proxy for inter-firm trust), applying the probit estimation method and using the following equation:

17

$$P_i = \mathbf{a} + \mathbf{b}R_i + \mathbf{g}B_i + \mathbf{d}S_i + \mathbf{f}Z_i + \mathbf{e}_i$$
(1a)

where  $P_i$  is the probability of offering trade credit to its customer,  $R_i$  is a vector representing factors that characterize the relationship between the firm and its customer,  $B_i$  is a vector of firm characteristics,  $S_i$  is a vector of customer characteristics, and  $Z_i$ represents firm-level controls.

We also estimate a model of the probability that a firm receives positive trade credit from its supplier, applying the probit estimation method, using the following equation:

$$P_i = \mathbf{a} + \mathbf{b}R_i + \mathbf{g}B_i + \mathbf{d}S_i + \mathbf{f}Z_i + \mathbf{e}_i$$
(1b)

where  $P_i$  is the probability of receiving trade credit from a supplier,  $R_i$  is a vector representing factors that characterize the relationship between the firm and its supplier,  $B_i$ is a vector of firm characteristics,  $S_i$  is a vector of supplier characteristics, and  $Z_i$ represents firm-level controls.

Similarly, the regression equation for the amount of trade credit offered to customers (where trade credit is a proxy for inter-firm trust) took the following form:

$$TC_i^* = \mathbf{a} + \mathbf{b}R_i + \mathbf{g}B_i + \mathbf{d}S_i + \mathbf{f}Z_i + \mathbf{e}_i$$
(2a)

where  $TC_i^*$  is the desired level of trade credit that a firm wishes to give its customer (trade credit is defined as the percentage of the bill paid with delay). Finally, we have the regression equation for the amount of trade credit received from suppliers:

$$TC_i^* = \mathbf{a} + \mathbf{b}R_i + \mathbf{g}B_i + \mathbf{d}S_i + \mathbf{f}Z_i + \mathbf{e}_i$$
(2b)

where  $TC_i^*$  is the level of trade credit that a firm desires from its supplier.

Since we can only measure observed trade credit that is restricted to values

between 0 percent and 100 percent<sup>22</sup>, a tobit model is estimated such that the censored dependent variable takes the following form:

 $TC_i$  is the observed level of trade credit, where:

$$TC_i = TC_i * for \ 0 < TC_i * < T$$

 $TC_i = 0$  for  $TC_i * \mathbf{f} 0$ 

$$TC_i = l$$
 for  $TC_i * 3l$ 

The relational contracting variables fall into four categories. First, we consider the lock-in of the customer or the ability of the customer to find an alternate supplier, which is measured by asking how long it would take a customer to find an alternate source if the supplier failed to deliver the inputs. The hypothesis is that "locked-in" customers will receive higher trade credit because it is more difficult for them to find alternate suppliers if they fail to pay. Second, information gathering by firms about their customers may increase trade credit, which is measured by the duration of the trading relationship (and duration-squared to measure non-linear effects) and visits between suppliers and customers. Duration may also be interpreted as customer lock-in; longer duration relationships may signify greater customer lock-in for a number of reasons including, but not limited to the following: i) inputs may become more specialized or more tailored to the customer's specifications over time, ii) production of specialized inputs may require a fixed investment by the supplier which is recouped over time, or iii) the customer has better information about a supplier that it has been working with for an extended period (i.e. the customer has better information about the reliability and

 $<sup>^{22}</sup>$  In the sample of trade credit offered to customers, 59 observations are censored at 0%, 24 observations are censored at 100%, and 49 observations are not censored. In the sample of trade credit received from suppliers, 40 observations are censored at 0%, 9 observations are censored at 100%, and 64 observations are not censored.

expected quality of a supplier) and becomes reluctant to change suppliers. Third, we have several variables to capture the positive effects of networks in increasing trade credit by building trust between a firm and its customers. These networks may assist in gathering information about a customer at the beginning of a trading relationship, such as if the firm was introduced to the customer or received information about the customer's trustworthiness through a business or social network. Networks may also increase trade credit by helping firms to sanction delinquent customers and with continuous information gathering, which is measured by the frequency with which the firm speaks to other suppliers. Lastly, we consider the effect of the firms' belief in formal and informal contract enforcement institutions on the decision to offer trade credit, as a way to measure the ability of firms to sanction delinquent customers. Formal contract enforcement is measured by a dummy variable that the respondent believes that courts can enforce contracts. Informal enforcement may be measured by dummy variables about the respondent's belief in the strength of social sanctions, such as the belief that other firms would find out about a cheating customer, or that a trade dispute would lead suppliers to demand higher advanced payments for inputs (in other words, less trade credit). We also control for other firm level characteristics, including firm size, age, and whether the firm is an exporter.

Regressions for the determinants of offering trade credit to a firm's customers are considered separately from regressions for receiving trade credit from its suppliers. Summary statistics on the Sialkot sample in Tables 4 and 7 show that the belief in the effectiveness of the court system is low, at an average of about 21 percent for all firms in the customer credit regressions, and 16 percent in the supplier credit sample. In contrast,

20

the average was about 74 percent for the Eastern European firms interviewed by Johnson, McMillan, and Woodruff (2002). However, the belief in courts in Pakistan is relatively higher than in Vietnam, where only 9 percent of firms answered this question affirmatively.

# IV. Relational Contracting Results I: Trade Credit Offered to Customers

First, we consider the impact of the relational contracting variables on the probability that a clustered firm offers trade credit to its customers and the amount of trade credit offered. Summary statistics on the variables used in the customer credit regressions are presented in Table 4. Once the dataset was cleaned and balanced, 132 observations remained for the customer credit regressions representing 72 unique firms in the survey. For 60 firms, there are two observations per firm (representing both their oldest and newest customers) and for 12 firms, there is only adequate information on one of their customers, either the oldest or the newest.

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
DEPENDENT							
VARIABLES							
Offer Trade Credit to							
Customer $(0,1)$	0.55	1.00	0.25	0.50	0.00	1.00	132
Amount of Trade Credit							
Offered (%)	35.91	25.00	1443.06	37.99	0.00	100.00	132
LOCK-IN							
Would Take Customer							
Less than a Week to							
Find Alternate Supply							
(0,1)	0.44	0.00	0.25	0.50	0.00	1.00	132
Would Take Customer							
More Than a Month to							
Find Alternate Supply	0.26	0.00	0.19	0.44	0.00	1.00	132
Maintain Inventory of							
Product Sold to							
Customer (0,1)	0.37	0.00	0.24	0.48	0.00	1.00	132

 Table 4: Customer Credit Summary Statistics

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
INFORMATION /							
LOCK-IN							
Duration of Trading							
Relationship (years)	6.74	4.25	43.96	6.63	0.08	30.00	132
INFORMATION /							
NETWORK EFFECTS							
Information about							
Customer Through							
Social Network (0,1)	0.13	0.00	0.11	0.34	0.00	1.00	132
Information about							
Customer Through							
Business Network (0,1)	0.44	0.00	0.25	0.50	0.00	1.00	132
Talk at Least Weekly							
With Other Producers							
(0,1)	0.63	1.00	0.24	0.49	0.00	1.00	72
Talk at Least Monthly							
With Other Producers							
(0,1)	0.76	1.00	0.18	0.43	0.00	1.00	72
ENFORCEMENT							
A Customer Has Failed							
to Pay After Delivery	0.00	0.00	0.10	0.40	0.00	1.00	
(0,1)	0.22	0.00	0.18	0.42	0.00	1.00	72
Customers Would Find							
Out About Dispute With						1.00	
Another Customer $(0,1)$	0.44	0.00	0.25	0.50	0.00	1.00	72
Businesses Would							
Refuse to Deal with							
Customer Who Cheated	0.40	0.00	0.05	0.50	0.00	1.00	70
(0,1)	0.42	0.00	0.25	0.50	0.00	1.00	12
Belief in the Court	0.01	0.00	0.17	0.41	0.00	1.00	70
System (0,1)	0.21	0.00	0.17	0.41	0.00	1.00	12
Export Dummy*Belief	0.00	0.00	0.00	0.20	0.00	1.00	70
in Courts (0,1)	0.08	0.00	0.08	0.28	0.00	1.00	12
CONTROLS		2.02		1.0.6	1 =0	( )=	
Ln(Employment)	3.23	3.02	1.11	1.06	1.79	6.37	72
Ln(1+age)	2.60	2.64	0.49	0.70	0.00	3.99	72
Receive Bank Credit	0.26	0.00	0.20	0.44	0.00	1.00	72
Average % of Bill Paid							
w/Delay to Suppliers	41.53	50.00	1051.33	32.42	0.00	100.00	72
Price Determined by							
Relationship with	0.01	0.00	0.01	0.15	0.00	1.00	
Customer (0,1)	0.01	0.00	0.01	0.12	0.00	1.00	72

# Customer Trade Credit Results

Table 5 contains the results of probit estimation of variables that affect the

likelihood that the interviewed firms offer trade credit to their customers and tobit estimates for the impact of variables on the amount of trade credit offered to customers.<sup>23</sup>

The results for the "lock-in" variables are mixed. One of the variables representing lock-in, that it would take a month or more for customers to find alternate supplies, is insignificant in the regressions. On the other hand, the duration of the trading relationship, which represents both lock-in and information gathering about the customer, is positive and significant at the 10 percent level in the probit regression and at the 5 percent level in the tobit regression. A one-year increase in the duration of the relationship increases the likelihood that a firm offers credit to its customers by about 3.5 percent, and increases by 9 percentage points the proportion of their bill paid with delay. Increasing the duration of the relationship by one standard deviation (from 6.74 to 13.37 years) increases the probability of offering trade credit by about 23 percent.

McMillan and Woodruff note that the duration variable may be biased upward, since both initial credit and duration of a trading relationship may be correlated with the level of initial trust that a firm has in a new customer. The duration variables may also theoretically bias the estimates of the other coefficients. However, repeating the regressions without the duration variables has mostly minor impacts on the coefficient estimates. Of the variables that were significant in the original regressions, only two coefficients (for control variables, ln(1+age) and the dummy variable for exporters) had noticeable changes in the estimates. These results can also be found in Table 5.

Obtaining information about customers through a business network appears to

<sup>&</sup>lt;sup>23</sup> The standard errors are made robust by correcting for the fact that data was collected about two customers from the same firm. The data for two customers of the same firm is considered "clustered" so that standard errors are calculated under the assumption that errors are independent across firms, but not necessarily within firms, in other words that the observations of the customers of the same firm may be correlated.

have a positive and significant impact, increasing the probability of offering credit by 26 percent and allowing customers to pay 44 percent more of their bill with delay. Also, talking frequently with other suppliers of a customer (another way of measuring a business network) has a significant effect, increasing the likelihood of offering credit by 19 percent.

There is support for the hypothesis that belief in the court system increases the likelihood that trade credit is offered. Firms that believe in the effectiveness of courts are about 30 percent more likely to offer trade credit and permit their customers to pay about 55 percent more of their bill with delay. The variable representing community sanctions (a dummy variable representing the belief of the surveyed firm that other businesses would refuse to deal with a customer who cheated) does not have a significant effect on the decision to offer trade credit.

Exporters are found to be more likely to offer trade credit to their customers and offer more trade credit, but the estimated coefficients are insignificant except for one of the tobit estimates (at the 10 percent level).

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
Would Take Customer More Than a	-0.069	0.49	-0.074	-5.37
Month to Find Alternate Supply	(-0.58)	(0.02)	(-0.68)	(-0.21)
INFORMATION/LOCK-IN				
	0.036	9.22		
Duration of Relationship (years)	(1.91)+	(2.08)*		
	-0.00088	-0.24		
Duration-squared	(-1.09)	(-1.24)		
INFORMATION/				
NETWORK EFFECTS				
Info. About Customer Through	0.26	44.44	0.28	46.45
Business Network	(2.59)*	(2.10)*	(2.81)**	(2.11)*
Talk To Other Suppliers of Customer	0.19	27.97	0.18	23.36
At Least Monthly	(2.09)*	(1.37)	(2.03)*	(1.12)
ENFORCEMENT				
Businesses Would Refuse to Deal With	-0.031	-25.41	-0.027	-25.01
Customer Who Cheated Manufacturer	(-0.36)	(-1.45)	(-0.34)	(-1.51)
	0.30	55.75	0.31	55.04
Belief in Court System	(3.23)**	(2.44)*	(3.63)**	(2.45)*
CONTROLS				
	-0.16	-25.45	-0.085	-6.12
Ln(1+Age)	(-2.86)**	(-1.94)+	(-1.67)+	(-0.56)
	0.081	22.67	0.079	24.45
Ln(Employment)	(2.31)*	(2.41)*	(2.42)*	(2.73)**
	0.059	41.54	0.033	33.31
Export Dummy	(0.58)	(1.82)+	(0.33)	(1.50)
Observations	132	132	132	132
R-Squared	0.18	0.043	0.14	0.03
$\overline{I}^{R}$ Relative Amount of Information	0.26	Not	0.23	Not
in Prediction <sup>24</sup>		applicable		applicable
Chi-Squared	31.69	24.09	24.93	16.79
	(dof=10)	(dof=10)	(dof=8)	(dof=8)
Prob>Chi-Squared	0.0005	0.0074	0.0016	0.032

Table 5: Regressions on Trade Credit to Customers (Marginal Effects) Probit and Tobit (Main specification) (Clustered errors)

 $<sup>{}^{24} \ \</sup>overline{I}{}^{R}$ , or the "relative amount of information in prediction" for models with qualitative dependent variables was developed by Betancourt and Clague (1981). Put simply, it assesses the amount of additional information imparted by the inclusion of explanatory variables to the model (i.e. the introduction of a theory) relative to the amount of information already contained in the sample proportions. It helps to deal with some of the undesirable properties of traditional  $R^2$  measures as they are applied to qualitative dependent variable models, for example that there cannot be a decomposition of total variation and questions about the correct upper-bound for binary-choice statistics.

An alternate specification of regression equations 1a and 2a is presented in Table 6. In this specification, different survey questions are used to derive alternate variables for "lock-in," "information and network effects" and "community enforcement." The results are quite similar to the main specification in Table 5 in terms of which categories of variables are significant and the size of the coefficient estimates.

We also estimate a tobit model using a similar specification to McMillan and Woodruff's (1999) specifications for firms in Vietnam. These results can be found in Appendix Table 1. The coefficients with the most similar results are for the duration variable, where estimates of the effect of increasing the length of the relationship on the amount of trade credit offered for both Sialkot and Vietnam are around 7 - 8 percent. Also similar in magnitude is the replication of McMillan and Woodruff's first regression for the effect of information obtained through a business network, with estimates of 26 and 20 percent in Sialkot and Vietnam respectively. For the effect of lock-in, age, employment and "price being set by the relationship with customer," the estimated coefficients have the same signs as McMillan and Woodruff, but are different in magnitude.

` <b>1</b>	· · ·			
	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
Would Take Customer Less than	0.12	14.18	0.11	14.26
a Week to Find Alternate Supply	(1.36)	(0.91)	(1.22)	(0.87)
Would Take Customer More	-0.042	1.32	-0.051	-3.29
Than a Month to Find Alternate	(-0.34)	(0.05)	(-0.45)	(-0.12)
Supply				
INFORMATION/LOCK-IN				
	0.034	8.82		
Duration of Relationship (years)	(1.94)+	(2.07)*		
	-0.001	-0.22		
Duration-squared	(-1.13)	(-1.20)		
INFORMATION/				
NETWORK EFFECTS				
Info. About Customer Through	0.24	41.22	0.25	43.83
Business Network	(2.39)*	(1.96)*	(2.58)**	(2.02)*
Talk To Other Suppliers of	0.20	28.30	0.20	27.72
Customer At Least Weekly	(2.54)**	(1.54)	(2.58)**	(1.47)
ENFORCEMENT				
Customers Would Find Out	-0.073	-17.42	-0.073	-15.96
About Dispute With Another	(-0.90)	(-1.06)	(-0.92)	(-0.98)
Customer				
	0.29	49.21	0.30	48.43
Belief in Court System	(3.16)**	(2.13)*	(3.49)**	(2.09)*
CONTROLS				
CONTROLS	0.1.6	21.57	0.070	2.07
	-0.16	-21.5/	-0.079	-2.07
Ln(1+Age)	(-2.85)^^	$(-1.03)^+$	(-1.62)	(-0.18)
L n(Employment)	(1.65)	(1.05)	(1.78)	$(2, 22)^*$
	$(1.03)^{+}$	(1.93)+	$(1.78)^{+}$	(2.23)*
Export Dummy	(1.25)	46.8/	0.099	38.93
Observations	(1.33)	(2.04)^	(1.00)	(1.09)+
Deservations	0.21	132	132	132
K-Squared	0.21	0.044	0.17	0.03
$I^{\kappa}$ Relative Amount of	0.30	INOL	0.23	INOL
Information in Prediction		applicable		applicable
Chi-Squared	36.58	26.12	33.45	17.86
	(dof=11)	(dof=11)	(dof=9)	(dof=9)
Prob>Chi-Squared	0.0001	0.006	0.0001	0.037

 Table 6: Regressions on Trade Credit to Customers (Marginal Effects)

 Probit and Tobit (Alternate Specification) (Clustered errors)

## Robustness

Additional regressions (Appendix Table 3) test for the robustness of the relational contracting results against alternate explanations for trade credit offered in the literature. A clear hypothesis does not arise with respect to the size or age of firms and trade credit. If trade credit serves as a way to assure quality, then larger and older firms should offer less trade credit since they should have a lower variance in quality (Long, Malitz, and Ravid (1993), Deloof and Jegers (1996)). On the other hand, if larger and older firms have better access to formal credit sources, then they should offer more trade credit on average (Peterson and Rajan (1997)). Trade credit may also be a price discrimination mechanism (Petersen and Rajan (1997)).<sup>25</sup> McMillan and Woodruff (1999) found for Vietnam that on average, larger and older firms offered less trade credit to their customers. Our results are mixed; smaller and older firms offer less trade credit to their customers on average.

A firm that has access to credit from formal sources, either from a bank or a credit association, may be more likely to offer trade credit, because it is less credit constrained. However, the regressions in Appendix Table 3 show that access to formal credit does not affect either whether trade credit is offered or the amount. The average percentage of trade credit received from suppliers, another source of credit that may loosen credit constraints, has a small but positive effect on the probability that firms offer credit to their customers (less than one percent) and on the amount of credit offered (also less than one percent).

In order to test the price discrimination hypothesis, McMillan and Woodruff

<sup>&</sup>lt;sup>25</sup> The discussion of alternate trade credit hypotheses was taken from McMillan and Woodruff (1999).

(1999) used a dummy variable representing when firms set their price based on the relationship with the customer. Since only one percent of the firms in our sample answered this question affirmatively, this variable could not be included in our specifications.

Two other variables included in the robustness regressions are a social network variable and an interaction variable between exporters and belief in the court system. The coefficient on the social network variable, in contrast to the business network variable, is not significant. The joint "court\*exporter" variable, which is also not significant, was included to see if courts are beneficial to all cluster firms or only to the exporting firms. In the tobit regression, inclusion of this interaction variable has a minor impact on coefficient estimate of the original variable for belief in the courts, but it is still significant at the 5 percent level.

Appendix Table 4 presents estimates of the main specification using an alternate (and more complex) estimation technique to correct for the survey sampling method, taking into account the stratification of the sample and the under-representation of vendors in the sample.<sup>26</sup> Since exporters and vendors were sampled separately, those two groups were considered different strata in the estimation. Probability weights were used to correct for the fact that exporters and vendors were sampled in different proportions than exist in the cluster. The probability weights assigned for the estimation in Appendix Table 4 were based on the number of each type of firm (exporters and vendors) in the cluster. Among the significant variables, the probit estimates with corrections for the survey sampling technique are larger in magnitude and more significant than the

<sup>&</sup>lt;sup>26</sup> Similar to the results contained in the main text (Tables 5 and 6), the standard errors in Appendix Table 4 are also corrected for the fact that data was collected about two customers from the same firm. The data for two customers of the same firm was considered "clustered".

estimates that only corrected for clustered errors (except for ln(1+age)). Among the significant variables in the tobit regressions, the estimates are more significant when corrections are made for the sampling technique, but are smaller in magnitude (except the dummy variable that the firm communicates with other firms at least monthly). The magnitudes and significance of the estimates calculated with this method are in general quite high, leading us to question whether they are in fact realistic.

Appendix Tables 5 and 6 re-estimate the main specifications in Table 5 using different samples. Append ix Table 5 uses a slightly smaller sample where the only observations that are included are those that have two customers per firm.<sup>27</sup> The results are very similar to those in Table 5, except that some coefficient estimates are slightly larger (in absolute value) and somewhat more significant. Appendix Table 6 uses only the exporter firms in the sample. Except for duration of the relationship and employment, most of the variables lose significance when only the exporter observations are used as compared to the full sample that includes the vendor firms. In addition, the effect of increasing the duration of the trading relationship by one year is larger in magnitude in the exporter-only sample (24 percent vs. 9 percent more of the bill being paid with delay), but it is only significant at the 10 percent level.

# V. Relational Contracting Results II: Trade Credit Received from Suppliers

Similar regressions were carried out for trade credit that firms receive from their suppliers. The set of variables varied only slightly, since the supplier credit section of the survey also included questions on visits by customers and suppliers before the first sale

<sup>&</sup>lt;sup>27</sup> In other words, observations where there was only one customer per firm are dropped.

and during the trading relationship. Summary statistics are presented in Table 7. Once the dataset was cleaned and balanced, 113 observations remained for the supplier credit regressions representing 63 unique firms in the survey. For 50 firms, there are two observations per firm (representing both their oldest and newest suppliers) and for 13 firms, there is only adequate information on one of their suppliers, either the oldest or the newest.

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
DEPENDENT VARIABLES							
Receive Trade Credit (0,1)	0.65	1.00	0.23	0.48	0.00	1.00	113
Amount of Trade Credit Received (%)	36.59	50.00	1018.87	31.92	0.00	100.00	113
LOCK-IN							
Would take a day or less to find alternate supply (0,1)	0.12	0.00	0.10	0.32	0.00	1.00	113
Would take more than a week to find alternate supply (0,1)	0.28	0.00	0.20	0.45	0.00	1.00	113
% Inputs Purchased From Less Than 1 km	16.90	0.00	758.41	27.54	0.00	100.00	63
% Inputs Imported	4.21	0.00	165.49	12.86	0.00	70.00	63
Have Other Suppliers (0,1)	0.73	1.00	0.20	0.44	0.00	1.00	113
INFORMATION/ LOCK-IN							
Duration of Trading Relationship (years)	7.71	5.00	63.52	7.97	0.00	40.00	113
Visit supplier at least once before first sale (0,1)	0.90	1.00	0.09	0.30	0.00	1.00	113
Customer visits supplier at least weekly (0,1)	0.39	0.00	0.24	0.49	0.00	1.00	113
INFORMATION/ NETWORK EFFECTS							
Introduction to Supplier Through Social Network (0,1)	0.33	0.00	0.22	0.47	0.00	1.00	113
Talk at Least Monthly with Other Producers (0,1)	0.68	1.00	0.22	0.47	0.00	1.00	63
Talk at Least Weekly with Other Producers (0,1)	0.56	1.00	0.25	0.50	0.00	1.00	63
ENFORCEMENT							

Table 7: Supplier Credit Summary Statistics

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
Dispute Would Lead to							
Higher Advanced Payment	0.17	0.00	0.15	0.38	0.00	1.00	63
Other Producers Would Find							
Out About Dispute With							
Supplier (0,1)	0.59	1.00	0.25	0.50	0.00	1.00	63
Belief in the Court System							
(0,1)	0.16	0.00	0.14	0.37	0.00	1.00	63
Exporter*Belief in Courts							
$(0,\bar{1})$	0.06	0.00	0.06	0.25	0.00	1.00	63
CONTROLS							
Ln(Employment)	3.34	3.09	1.13	1.06	1.61	6.00	63
Ln(1+age)	2.67	2.64	0.41	0.64	1.10	3.99	63
Bank Credit Access (0,1)	0.33	0.00	0.23	0.48	0.00	1.00	63
Vendors (proportion of							
sample)	0.40	0.00	0.24	0.49	0.00	1.00	63
Exporters (proportion of							
sample)	0.60	1.00	0.24	0.49	0.00	1.00	63

## Supplier Trade Credit Results

Table 8 contains the results of probit estimations of variables that affect the likelihood that the interviewed firms receive trade credit from their suppliers and tobit estimates for the impact of variables on the amount of trade credit received.<sup>28</sup>

The results show that a firm is more likely to receive trade credit and receives more trade credit when suppliers do not visit the firm before the first sale. This result appears counterintuitive, but when a firm does not receive a visit from the supplier it could possibly mean that they already know (and therefore trust) each other. A firm that is visited by the supplier at least once before the first transaction is 27 percent less likely to receive credit, and pays on average 47 percent more of their bill at the time of sale.

<sup>&</sup>lt;sup>28</sup> The standard errors are corrected for the fact that data was collected about two suppliers of the same firm. The data for two suppliers of the same firm is considered "clustered" so that standard errors are calculated under the assumption that errors are independent across firms, but not necessarily within firms, in other words that the observations of the suppliers of the same firm may be correlated.

Firms that visit their suppliers weekly are 17 percent more likely to receive trade credit. These visits may assist the suppliers in gathering information about the reliability of the customer as well as in monitoring informal contracts.

Customer lock-in, i.e. the ability to easily locate alternate suppliers (as measured by the customer buying inputs less than one km away) does not have an effect on the likelihood of being offered trade credit by its supplier or the amount of trade credit received. Similarly, the duration of the trading relationship does not significantly affect the probability of receiving trade credit. Concern that the duration variables would result in bias are unwarranted, since the changes to the coefficient estimates and standard errors caused by dropping the duration variables are almost negligible.

While receiving an introduction through a social network has an expected positive effect on the likelihood of receiving trade credit, the variable is only significant (at the 10 percent level) in the tobit and probit specifications that exclude the duration variables. Exporters are about 24 percent less likely to receive trade credit and allowed to pay about 30 percent less of their bill with delay, although this result is only significant at the 10 percent level. Neither a belief in the courts, nor belief in informal enforcement (as measured here), appears to influence the likelihood of receiving trade credit from one's suppliers.

McMillan and Woodruff (1999) found that older and larger firms on average received less trade credit in Vietnam. Our results for Sialkot show that older firms are less likely to receive trade credit and receive less credit, although this effect is not significant. The coefficient on firm size had different signs in the probit and tobit regressions.

33

If access to other forms of credit serves as a reputation mechanism that induces suppliers to offer trade credit, then this variable should have a positive effect on the likelihood that trade credit is offered. The regressions show that access to formal credit (either from a bank or a credit association) has a negative impact on the likelihood of receiving trade credit but does not affect the amount of trade credit received. This may indicate that firms with access to formal credit are less likely to need trade credit.

	Probit	Tobit	Probit	Tobit					
			(without	(without					
			duration)	duration)					
LOCK-IN									
% Inputs Purchased From Less Than	-0.0011	-0.10	-0.0012	-0.10					
1 km	(-0.50)	(-0.38)	(-0.52)	(-0.38)					
	0.0015	-0.11	0.0011	-0.12					
% Inputs Imported	(0.39)	(-0.24)	(0.29)	(-0.28)					
INFÔRMATION/LOCK-IN									
	-0.0014	0.28							
Duration of Relationship (years)	(-0.13)	(0.23)							
	0.00021	-0.0038							
Duration-squared	(0.67)	(-0.10)							
INFO./NETWORK EFFECTS									
	-0.27	-46.9	-0.27	-46.76					
Visit Supplier Before First Sale	(-2.79)**	(-2.29)*	(-2.72)**	(-2.28)*					
	0.17	11.74	0.18	11.8					
Visit Supplier at Least Weekly	(1.94)+	(0.95)	(1.95)+	(0.93)					
Intro. To Supplier Through Social	0.16	20.95	0.17	21.4					
Network	(1.54)	(1.58)	(1.71)+	(1.65)+					
ENFORCEMENT									
Dispute With Supplier Would Lead	0.14	9.86	0.13	9.79					
To Higher Advanced Payment	(1.13)	(0.48)	(1.04)	(0.47)					
	-0.0087	-1.23	-0.0038	-1.10					
Belief in Court System	(-0.06)	(-0.07)	(-0.03)	(-0.06)					
CONTROLS									
CONTROLS	0.11	10.62	0.13	20.44					
$I_{p(1+\Lambda q_{2})}$	(1.18)	(1.34)	(1.41)	(1.40)					
Lii(1+Age)	0.012	0.80	0.012	0.81					
In(Employment)	(0.18)	(0.10)	(0.18)	(0.01)					
	0.18)	(-0.10)	0.18)	(-0.09)					
Export Dummy	(101)+	(103)+	(1.88)+	(1.02)+					
Receive Bank Credit	$(-1.91)^{+}$	-12.25	-0.26	$(-1.92)^{+}$					
Receive Bank Credit	(-1.93)+	(-0.69)	(-1.88)+	(-0.70)					
Observations	113	113	113	113					
R-Squared	0.25	0.039	0.24	0.038					
$\overline{\mathbf{Z}}^R$ D 1 ( ) A ( ) CL C ( )	0.23	Not	0.24	Not					
<i>I</i> Relative Amount of Information in Pradiction $^{29}$	0.21	annlicable	0.20	applicable					
	20.27	20.21	26.27	upplicable					
Cni-squared	28.27	20.31	26.37	(1, 0, 11)					
	(dot=13)	(dot=13)	(dot=11)	(dot=11)					
Prod>Chi-squared	0.008	0.088	0.006	0.066					
(Kobust z statistics in parentheses, *	(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at								

Table 8: Supplier Trade Credit Results (Main specification) (Clustered errors)

 $\frac{29}{\overline{I}^R}$  or the "relative encount of information in prediction" for models with qualitative dependent

10%)

<sup>&</sup>lt;sup>29</sup>  $\overline{I}^{R}$ , or the "relative amount of information in prediction" for models with qualitative dependent variables was developed by Betancourt and Clague (1981). Put simply, it assesses the amount of additional

An alternate specification of regression equations 1b and 2b is presented in Table 9. In this specification, different survey questions are used to derive alternate variables for "lock-in," "information and network effects" and "community enforcement." The results are fairly similar to the main specification in Table 8 in terms of which categories of variables are significant. The lock-in and community enforcement variables are insignificant in both sets of regressions. The estimates on receiving a visit from the supplier before the first sale are somewhat larger and more significant in the alternate specification. The dummy variable representing that a firm visits his supplier frequently has less significance in the main specification (Table 8) than the substitute network/information variable in the alternate specification (Table 9) representing that the firm talks frequently with other producers.

More interesting are estimates (in Appendix Table 7) when techniques to adjust for the survey sampling technique are applied, taking into account the stratification of the sample and the under-representation of vendors in the sample. The coefficient on lock-in (as measured by the percentage of inputs purchased locally) is larger in absolute value and more significant in survey-adjusted regressions. Also, the coefficients on two of the network variables (introduction through the social network and visiting the supplier weekly) are larger and more significant in the probit specification when the estimation is adjusted for the sampling technique. In the tobit specifications, the impact of a firm being visited before the first sale is somewhat smaller and loses significance with the adjustment for sampling. Access to bank credit also loses significance in the probit

information imparted by the inclusion of explanatory variables to the model (i.e. the introduction of a theory) relative to the amount of information already contained in the sample proportions. It helps to deal with some of the undesirable properties of traditional  $R^2$  measures as they are applied to qualitative dependent variable models, for example that there cannot be a decomposition of total variation and questions about the correct upper-bound for binary-choice statistics.

specifications when adjusted for the sampling method.

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
	0.057	1.68	0.057	1.69
Have Other Supplier of Input	(0.60)	(0.13)	(0.58)	(0.13)
INFORMATION/LOCK-IN				
	0.001	0.52		
Duration of Relationship (years)	(0.10)	(0.45)		
	0.00013	-0.0088		
Duration-squared	(0.42)	(-0.25)		
INFO./NETWORK EFFECTS				
	-0.28	-59.04	-0.28	-56.76
Visit Supplier Before First Sale	(-3.29)**	(-2.93)*	(-3.23)**	(-2.91)**
Talk At Least Weekly to Other	0.30	38.84	0.29	34.47
Producers	(2.17)*	(2.27)*	(2.17)*	(2.27)*
Intro. To Supplier Through	0.069	11.36	0.082	12.26
Social Network	(0.63)	(0.95)	(0.78)	(1.06)
ENFORCEMENT				<u>```</u>
If Manufacturer Cheated	0.043	3.31	0.042	3.35
Supplier, Other Suppliers Find	(0.50)	(0.32)	(0.48)	(0.33)
Out			, , ,	, í
	-0.0013	2.57	-0.004	2.60
Belief in Court System	(-0.01)	(0.15)	(-0.03)	(0.15)
CONTROLS				
	0.059	15.34	0.08	16.69
Ln(1+Age)	(0.62)	(1.13)	(0.86)	(1.27)
	-0.013	-4.08	-0.013	-4.04
Ln(Employment)	(-0.23)	(-0.55)	(-0.23)	(-0.54)
	-0.19	-23.77	-0.2	-24.20
Export Dummy	(-1.54)	(-1.67)+	(-1.56)	(-1.71)+
Receive Bank Credit	-0.14	-2.8	-0.14	-3.2
	(-1.03)	(-0.17)	(-1.02)	(-0.19)
Observations	113	113	113	113
R-Squared	0.26	0.047	0.26	0.046
$\overline{I}^{R}$ Relative Amount of	0.19	Not	0.26	Not
Information in Prediction		applicable		applicable
Chi-squared	26.45	19.91	24.51	18.89
-	(dof=12)	(dof=12)	(dof=10)	(dof=10)
Prob>Chi-squared	0.009	0.069	0.0064	0.042
· · · · · · · · ·				

 Table 9: Supplier Trade Credit Results (Alternate specification) (Clustered errors)

We also estimate a tobit model using a similar specification to McMillan and Woodruff's (1999) specifications for firms in Vietnam. These results can be found in Appendix Table 2. The coefficients with the most similar results are for the duration (1.09 vs. 2 percent) and "having an alternate supplier" (7.88 vs. 7 percent) variables replicating column 3 of McMillan and Woodruff's estimation. For the effect of "introduction through social network," duration-squared, and employment, the coefficients are the same sign, but are different in magnitude.

Appendix Tables 8 and 9 re-estimate the main specifications in Table 8 using different samples. Appendix Table 8 uses a slightly smaller sample where the only observations that are included are those that have two customers per firm.<sup>30</sup> The results are very similar to those in Table 8. The signs are different for some of the lock- in and duration variables, but the estimates are insignificant in all regressions. The only major differences are that the significant coefficient estimates are somewhat larger (in absolute value) and slightly more significant when all firms have two observations. Appendix Table 9 uses only the exporter firms in the sample. Again, the lock- in variables have different signs, but are insignificant in all regressions. The coefficient on the variable representing that the firm was visited by the supplier at least once before the first transaction continues to be significant when only exporters are included, and the coefficient estimate is much larger in the exporter-only regression (-41 percent probability of receiving credit and -63 percent of the bill paid with delay vs. -27 percent and -47 percent respectively).

<sup>&</sup>lt;sup>30</sup> In other words, observations where there was only one customer per firm are dropped.

# VI. Analysis of Joint Action

In this section, we attempt to determine whether firm level characteristics affect the decision of exporting firms to engage in a "joint action" marketing initiative. In other words, we determine which factors contribute to the exporting firms deciding to join together to collectively market their own goods rather than sell their output through a middleman.

Basic probit and logit regression techniques are used to determine how firm-level characteristics affect the decision of an exporting firm to engage in joint action to market their own goods. The dependent variable comes from the following survey question asking about the exporting firms' interest in a hypothetical joint marketing initiative:

If other firms in the cluster were forming a cooperative to sell surgical instruments directly to hospitals rather than selling to surgical instrument companies in the U.S. and Europe, would you join it? (0) No (1) Yes

We hypothesize that the firm characteristics that could potentially influence the proclivity of exporters to engage in a joint action initiative to market their own goods include risk aversion, access to credit (as a source of funds to set up the project), previous experience of the firm with direct marketing, and the value of the firm's current trading relationships with customers. We estimate the following equation using probit and logit methods:

$$P_i = \mathbf{a} + \mathbf{b}E_i + \mathbf{g}R_i + \mathbf{d}D_i + \mathbf{f}Z_i + \mathbf{e}_i$$
<sup>(3)</sup>

where:

*E*: Experience with direct marketing

*R*: Relationship with other firms

*D*: Opportunity cost of joint action

 $\langle \alpha \rangle$ 

#### *Z*: Firm level controls

Previous experience in direct marketing is measured by two dummy variables that the firms have sold products under their own name and have sold some goods directly to hospitals. A prediction about the likely impact of previous experience with marketing is not immediately apparent. On the one hand, firms that have had some marketing experience might be more likely to be interested in expanding their efforts through a larger and broader marketing initiative. However, if they have already had some success marketing on their own, they may not be interested in sharing their knowledge and experience with the rest of the cluster. We will proceed without making a prediction for the signs of these coefficients.

Relationships between firms are measured by a dummy variable that firms speak at least weekly with other producers. Frequent interaction with other firms may positively affect a firm's joint action decision because this interaction may serve to spread information and help the initiative to gain momentum and support among the cluster firms. We predict that this variable will positively influence the decision of firms to participate in joint action.

A firm's decision to participate in a direct marketing scheme should be inversely related to the value of the firm's trading relationship with its current trading partners. This variable is proxied by the duration of the firm's relationship with its oldest customer.

Firms that are more risk averse should be less likely to be interested in a joint action initiative. The proxies used to measure risk aversion are firm size (number of employees) and firm age. The hypothesis is that larger and older firms are less risk

40

averse and therefore will express greater interest in joint action.

We also predict that access to credit should positively affect the decision to

participate, since these firms are more able to fund their participation in the initiative.

	Mean	Median	Std. Dev.	Variance	Min	Max	NOBs
Employment (# of							
Employees)	95.54	45.5	121.45	14750.39	5	585	56
Ln(Employment)	3.89	3.82	1.19	1.41	1.61	6.37	56
Age	18.59	16.5	12.34	152.32	2	53	56
Ln(1+age)	2.75	2.86	0.71	0.50	1.10	3.99	56
Sell Some Products							
Under Own Name							
(0,1)	0.46	0	0.50	0.25	0	1	56
Sell Some Products							
Directly to Hospitals							
(0,1)	0.30	0	0.46	0.22	0	1	56
Would Participate in							
Joint Action (0,1)	0.27	0	0.45	0.20	0	1	56
Duration of Trading							
Relationship with							
Oldest Customer							
(years)	11.55	10	8.64	74.71	1	40	56
Talk at Least Weekly							
with Other Producers							
(0,1)	0.45	0	0.50	0.25	0	1	56
Credit Access (0,1)	0.59	1	0.50	0.25	0	1	56

Table 10: Joint Action Summary Statistics

## Joint Action Results

Probit and logit regressions are estimated for the probability that firms would decide to participate in the hypothetical joint action initiative, using various firm-level characteristics as explanatory variables as described in the previous sub-section. The results of these regressions are presented in Table 11.

The results show that firms with some previous experience in direct marketing, including selling some products under their own name and selling some goods directly to hospitals, have a greater interest in carrying out a joint action with other firms for purposes of marketing. Firms that sell products under their own brand name are 22-23 percent more likely to be interested in joint action, and firms that have already sold some goods directly to hospitals are 29 percent more likely to be interested in a joint marketing initiative.

Firms that have had longer duration relationships with customers tend to be less likely to be interested in joint action. Increasing the duration of a firm's relationship with their oldest customer by one year reduces the likelihood that a firm is interested in a joint marketing initiative by about 6 percent. Increasing the duration by one standard deviation (from 11.55 to 20.19 years) reduces the probability that a firm is interested in joint action by 48 to 51 percent. These results are consistent with the hypothesis that firms with a higher opportunity cost of joint action would be less likely to participate in such initiatives. Since the coefficient on the duration-squared variable is positive, one may be concerned that the impact of duration on the likelihood of carrying out joint action may become positive for some sample points. However, the effect of duration on joint action only becomes positive at 40 ½years and 39 years for probit and logit estimations respectively, and only one firm has a relationship of duration longer than these values.

Having access to credit, either from a bank or through a credit association has a positive but insignificant effect on the likelihood of being interested in direct marketing. Since the cost of such an initiative was not discussed in the questionnaire, it is possible that the firms did not consider the potential cost when answering the questions about joint action.

Risk aversion (as measured by firm size and age) does not appear to affect the

42

decision to participate in a joint marketing initiative. Intra-cluster communication as measured by frequent interactions with other producers also had no significant impact.

	(1)	(2)
	Joint Action	Joint Action
	Probit	Logit
	(Marginal Effects)	(Marginal Effects)
Employment	-0.00074	-0.00077
	(-0.46)	(-0.47)
Employment squared	-0.000004	-0.000003
	(-0.75)	(-0.69)
Age	0.019	0.016
	(1.10)	(0.82)
Age squared	-0.00018	-0.00012
	(-0.52)	(-0.30)
Sell some products under own name	0.22	0.23
	(1.95)+	(1.89)+
Sell some products to hospitals	0.29	0.29
directly	(2.44)*	(2.38)*
Duration of relationship with oldest	-0.066	-0.063
customer (years)	(-3.87)**	(-3.77)**
Duration squared	0.0016	0.0016
	(4.42)**	(4.47)**
Credit Access	0.095	0.089
	(1.15)	(1.07)
Talk at Least Weekly with Other	0.15	0.15
Producers	(1.62)	(1.62)
Observations	56	56
Wald Chi-2(10)	20.10	15.75
Prob>Chi-2	0.03	0.11
Log Likelihood	-21.08	-21.09
$\overline{I}^{R}$ Relative Amount of Information in Prediction <sup>31</sup>	0.27	0.27
Pseudo R-squared	0.35	0.35

Table 11: Joint Action Results (Marginal Effects)

<sup>&</sup>lt;sup>31</sup>  $\overline{I}^{R}$ , or the "relative amount of information in prediction" for models with qualitative dependent variables was developed by Betancourt and Clague (1981). Put simply, it assesses the amount of additional information imparted by the inclusion of explanatory variables to the model (i.e. the introduction of a theory) relative to the amount of information already contained in the sample proportions. It helps to deal with some of the undesirable properties of traditional  $R^2$  measures as they are applied to qualitative dependent variable models, for example that there cannot be a decomposition of total variation and questions about the correct upper-bound for binary-choice statistics.

## **VII.** Conclusions

Several interesting results have been obtained regarding relational contracting as well as the prospects for direct marketing by clustered firms. It was originally speculated that networks, rather than the lock-in of individual customers, would be the predominant form of contract enforcement in a cluster environment. However, similar to McMillan and Woodruff (1999), both types of variables were significant in the regressions of trade credit offered to customers.

Additional results regarding trade credit offered to customers show that firms are more likely to offer trade credit to their customers when firms believe in the effectiveness of formal contract enforcement through the court system. There is also some evidence of lock-in as a tool for contract enforcement; firms give more trade credit (and are more likely to give credit) when relationships are of longer duration. Participation in business networks (that can be used to gather information about reliability or for social sanction) are also effective tools in that firms that obtain information through business networks are more likely to offer trade credit (and offer more trade credit) to their customers.

In the regressions for trade credit received from suppliers, customer lock-in (as measured here) does not appear to have an effect on receiving trade credit. The lack of a measurable impact of customer lock-in may be caused either by a poor measurement of customer lock-in or that it is not an important factor determining trust between clustered firms in Sialkot. The results show that firms are less likely to receive credit when they are visited by suppliers before the first sale, possibly indicating that unknown trading partners are less trusted. Firms that visit their suppliers weekly are 17 percent more likely to receive trade credit. These visits may assist the suppliers to gather information

44

about the reliability of the firms and as well as to monitor informal contracts.

The joint action regression results show that exporters with some previous experience in direct marketing, including selling some products under their own name and selling some goods directly to hospitals, are more interested in carrying out a joint action with other firms to market goods. Firms that have had trading relationships of longer duration with their customers tend to be less interested in such initiatives, most likely due to the fact that longer duration trading relationships are of high (and certain) value.

Industrial clusters provide employment for large numbers of people in developing countries, and have become significant exporters. Case studies highlighting the successes of developing country clusters in these respects have led to enthusiasm on the part of development practitioners about the prospects of clustering as a strategy to promote private sector development and reduce poverty. However, our relational contracting results are qualitatively (and in some cases quantitatively) similar to those obtained in studies of non-clustered firms.<sup>32</sup> Furthermore, social network-based relationships in clusters have been shown to have distortionary effects (as documented by Ilias (2001) and Banerjee and Munshi (2000)). Therefore, policies to promote the development of industrial clusters should consider both the benefits and the drawbacks of clustering, and incorporate the lessons learned from these studies.

<sup>&</sup>lt;sup>32</sup> This is only a tentative conclusion based on a comparison of the coefficient estimates of similar regressions conducted of clustered (Sialkot, this study) and non-clustered firms (Vietnam, McMillan and Woodruff (1999)). We cannot directly compare the magnitudes of coefficients because there was not a joint regression of clustered and non-clustered firms. Conclusive results comparing contract enforcement of clustered versus non-clustered firms would require further study.

## Bibliography

- Baker, G., Gibbons, R., and K. Murphy. "Relational Contracts and the Theory of the Firm," *Quarterly Journal of Economics*, 117(1) (2002), pp. 39 84.
- Banerjee, Abhijit, and Kaivan Munshi, "Networks, Migration, and Investment: Insiders and Outsiders in Tirupur's Production Cluster," mimeo, 2000.
- Betancourt, Roger and Christopher Clague. <u>Capital Utilization: A Theoretical and</u> <u>Empirical Analysis.</u> (Cambridge: Cambridge University Press, 1981.)
- Greif, Avner. "Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies," *Journal of Political Economy*, 102(5), pp. 912 – 950.
- Ilias, Nauman. "Families and Firms: Labor Market Distortion in Sialkot's Surgical Industry," PhD Dissertation, Dept. of Economics, University of Pennsylvania, 2001.
- Johnson, Simon, John McMillan and Christopher Woodruff, "Courts and Relational Contracts," *Journal of Law, Economics and Organization,* Spring 2002 (18), pp. 221-77.
- Kranton, Rachel, "Reciprocal Exchange: A Self-Sustaining System," *American Economic Review*, September 1996, 86(4), pp. 830-51.
- Long, M., Malitz, I., and S. A. Ravid, "Trade Credit, Quality Guarantees, and Product Marketability," *Financial Management*, XXII, 1993, pp. 117-127.
- McMillan, John and Christopher Woodruff, "Interfirm Relationships and Informal Credit in Vietnam," *Quarterly Journal of Economics*, Nov. 1999, pp. 1285-1320.
- North, Douglass. <u>Institutions, Institutional Change, and Economic Performance</u>. (Cambridge: Cambridge University Press,1990).
- Peterson, Mitchell and Raghuram Rajan, "Trade Credit: Theories and Evidence," *Review Of Financial Studies*, Fall 1997(10), pp. 661-692.
- Schmitz, H. and K. Nadvi, "Clustering and Industrialization," *World Development* 27(9) (1999), pp. 1503 1514.
- Small and Medium Enterprise Development Authority (SMEDA), Government of Pakistan, Surgical Instrument Industry of Pakistan: Issues in Export Growth and Development Draft Report, 2001.

- Thompson, Theresa, "Cooperation in Developing Country Industrial Clusters: Marketing in an Age of Globalization," mimeo 2004.
- Woodruff, Christopher, "Contract Enforcement and Trade Liberalization in Mexico's Footwear Industry," *World Development*, Vol. 26, No. 6 (1998), pp. 979-991.

#### Appendix 1: Data Cleaning and Sample Description

#### Data cleaning:

When the interviewer went to the cluster to begin interviewing firms, she found that only about 180 of the 220 exporting firms that were listed by SIMA (the local business association) as surgical instrument manufacturers were actually in operation at the time of the survey. Of the exporter firms in operation, 99 returned the surveys, out of which 76 were actually filled out leading to a response rate of 43 percent among the exporters. The interviewer then met with 47 vendor firms in the villages surrounding Sialkot, where the cottage industry is located.

Data was collected on 123 firms. This meant that there was potentially information on 246 customers and 246 suppliers. However, some of the surveys were incomplete and several observations had to be dropped in order to have a balanced data set.

#### Customer Credit Sample:

Once the dataset was cleaned and balanced, 132 observations remained for the customer credit regressions representing 72 unique firms in the survey. For 60 firms (32 exporters and 28 vendors) there were two observations per firm (representing their oldest and newest customers). For 12 firms (7 exporters and 5 vendors) there was only adequate information on one of their customers. These 12 firms only provided enough information on the variables of interest for one of their customers, and therefore the other customer had to be dropped. For the 7 exporters where there was only sufficient data on one customer, 5 had data on their oldest customer only and 2 had enough data only on their newest customer. For the 5 vendors where there was only sufficient data on one customer, 3 had data on their oldest customer only and 2 had enough data only on their newest customer.

#### Supplier Credit Sample:

Once the dataset was cleaned and balanced, 113 observations remained for the supplier credit regressions representing 63 unique firms in the survey. For 50 firms (31 exporters and 19 vendors) there were two observations per firm (representing their oldest and newest suppliers) and for 13 firms (7 exporters and 6 vendors) there was only adequate information on one of their suppliers. These 13 firms only provided enough information on the variables of interest for one of their suppliers, and therefore the other supplier had to be dropped. For the 7 exporters where there was only data on one supplier, 6 had sufficient data on their oldest supplier only and 1 had enough data only on their newest supplier. For the 6 vendors where there was only data on one supplier, 5 had data on their oldest supplier and 1 had sufficient data only on their newest supplier.

#### Comparison of Customer Credit and Supplier Credit Samples:

Since the number of observations was limited, the samples were cleaned separately for the customer credit regressions and the supplier credit regressions. Comparing the two samples, 90 of the same observations representing 53 of the same firms were included in the two data sets.

	Tobit	Tobit	Tobit	Tobit
	(similar to Col.	(Co1. 1 of	(similar to Col.	(Col. 3 of
	1 of McM-W)	McM-W <sup>33</sup>	3 of McM-W)	McM-W)
LOCK-IN				
Would Take Customer Less than	-3.64		-7.07	
a Week to Find Alternate Supply	(-0.19)		(-0.43)	
Would Take Cust. More Than a	22.26		-5.78	
Month to Find Alt. Supply	(0.75)		(-0.20)	
# Similar Manufacturers w/in 1		-0.7		-1.1
km		(1.66)+		(2.54)*
Most important competitor w/in		-13		-16
1 km		(2.46)*		(2.92)**
INFORMATION/LOCK-IN				
	7.32	8	8.63	7
Duration of Relationship (years)	(1.64)+	(2.96)**	(2.01)*	(2.51)*
	-0.19	-0.5	-0.23	-0.4
Duration-squared	(-0.96)	(2.15)*	(.)	(1.74)+
INFO./NETWORK EFFECTS				
Info. About Customer Through	26.17	20	27.79	10
Business Network	(1.32)	(3.36)**	(1.49)	(1.99)*
Talk To Other Suppliers of				19
Customer At Least Monthly				(2.63)**
Info. About Customer Through	-0.55	4	16.84	-8
Social Network	(-0.02)	(0.60)	(0.67)	(1.34)
CONTROLS				
Price Set By Relationship With			50.62	2
Customer			(1.77)+	(0.53)
				7
Customer is Retailer/Wholesaler				(1.62)
			-20.28	-9
Ln(1+Age)			(-1.47)	(1.76)+
			26.52	2
Ln(Employment)			(1.95)+	(0.98)
Manufacturer Receives Bank			14.38	-2
Credit			(0.44)	(0.36)
Avg. % of Bill Paid With Delay			0.62	40
To Suppliers			(2.25)*	(6.27)**
Observations	132	224	132	224
R-Squared		Not available		Not available
Chi-Squared	8.89	73.5	32.50	134.5
Prob>Chi-Squared	0.18	<0.001	0.0003	<0.001

Appendix Table 1: Regressions on Trade Credit to Customers (Marginal Effects) Specifications similar to McMillan and Woodruff (McM-W) Research in Vietnam Tobit with clustered errors

<sup>&</sup>lt;sup>33</sup> We have converted McMillan and Woodruff's results from decimals to percentages to be more easily comparable to our results, which accounts for the lower degree of accuracy for those results.

	Tobit	Tobit	Tobit	Tobit
	(similar to	(Col. 1 of	(similar to	(Col. 2 of
	Col. 1 of	$McM-W)^{34}$	col. 2 of	McM-W)
	McM-W)		McM-W)	
LOCK-IN				
Would Take Customer Less than	15.55	-11	8.17	-12
a Day to Find Alternate Supply	(0.76)	(1.67)+	(0.45)	(1.74)+
Would Take Customer More	-19.44	0.4	-19.23	0.1
Than a Week to Find Alternate	(-1.34)	(0.07)	(-1.34)	(0.02)
Supply				
INFORMATION/LOCK-IN				
	0.83	3	1.2	2
Duration of Relationship (years)	(0.59)	(1.44)	(0.93)	(0.92)
	-0.00063	-0.16	-0.017	-0.13
Duration-squared	(-0.15)	(1.62)	(-0.44)	(1.37)
Visited Supplier Before First			-31.76	7
Purchase			(-1.58)	(1.19)
Currently Visit Supplier At			18.74	-0.3
Least Weekly			(1.64)	(0.06)
Manufacturer Receives Bank	-26.41	26	-29.76	23
Credit	(-1.56)	(3.79)**	(-1.80)+	(3.56)**
NETWORK EFFECTS				
Introduction To Supplier	22.4	11	20.65	12
Through Social Network	(1.67)+	(1.70)+	(1.53)	(1.89)+
If Manufacturer Cheated			-1.97	14
Supplier, Other Suppliers Find			(-0.16)	(3.19)**
Out				
Observations	113	243	113	243
R-Squared	0.02	Not available	0.03	Not available
Chi-Squared	11.39	45.0	18.27	59.6
Prob>Chi-Squared	0.077	< 0.001	0.032	< 0.001

Appendix 2: Regressions on Trade Credit to Suppliers (Marginal Effects) Specifications similar to McMillan and Woodruff (McM-W) for Research in Vietnam Tobit with clustered errors

<sup>&</sup>lt;sup>34</sup> We have converted McMillan and Woodruff's results from decimals to percentages to be more easily comparable to our results, which accounts for the lower degree of accuracy for those results.

	Tobit (similar	Tobit	Tobit (similar	Tobit
	to Col. 3 of	(Col. 3 of	to Col. 4 of	(Col. 4 of
	McM-W)	McM-W <sup>35</sup>	McM-W)	McM-W)
LOCK-IN				
Would Take Customer Less than a Day			15.56	-11
to Find Alternate Supply			(0.80)	(1.62)
Would Take Customer More Than a			-21.18	-0.2
Week to Find Alternate Supply			(-1.53)	(0.03)
	7.88	7		
Currently Have Alternate Supplier	(0.57)	(1.12)		
INFORMATION/LOCK-IN				
	1.09	2	0.89	3
Duration of Relationship (years)	(0.87)	(0.87)	(0.73)	(1.36)
	-0.015	-0.12	-0.022	-0.14
Duration-squared	(-0.40)	(1.28)	(-0.60)	(1.54)
	-31.88	9	-42.47	7
Visited Supplier Before First Purchase	(-1.62)	(1.51)	(-2.17)*	(1.34)
Currently Visit Supplier At Least	22.61	-2	12.94	-2
Weekly	(2.02)*	(0.31)	(1.07)	(0.39)
	-28.05	22	-25.09	24
Manufacturer Receives Bank Credit	(-1.88)+	(3.46)**	(-1.41)	(3.60)**
NETWORK EFFECTS				
Introduction To Supplier Through	22.09	12	19.02	10
Social Network	(1.56)	(1.79)+	(1.48)	(1.48)
If Manufacturer Cheated Supplier,	-8.54	13	3.19	13
Other Suppliers Find Out	(-0.69)	(3.03)	(0.25)	(3.09)
CONTROLS				
				-39
% Sales Main Product				(3.23)**
			23.68	-6
Ln(1+Age)			(1.74)	(1.13)
			-11.13	-6
Ln(Employment)			(-1.45)	(2.12)*
Observations	113	243	113	243
R-Squared	0.03	Not available	0.04	Not available
Chi-Squared	16.15		20.48	76.1
Prob>Chi-Squared	0.04	< 0.001	0.039	< 0.001

Appendix 2 (continued): Regressions on Trade Credit to Suppliers (Marginal Effects) Using Specifications Similar to McMillan and Woodruff (McM-W) for Research in Vietnam; Standard Tobit (Clustered errors)

<sup>&</sup>lt;sup>35</sup> We have converted McMillan and Woodruff's results from decimals to percentages to be more easily comparable to our results, which accounts for the lower degree of accuracy for those results.

	Probit	Tobit
LOCK-IN	0.001	( 22
Would Take Customer More	-0.091	-6.33
Than a Month to Find Alternate	(-0.77)	(-0.24)
Supply		
INFORMATION/LOCK-IN		
	0.035	9.63
Duration of Relationship (years)	(2.02)*	(2.23)*
	-0.0009	-0.26
Duration-squared	(-1.25)	(-1.43)
INFORMATION/		
NETWORK EFFECTS		
Info. About Customer Through	0.25	41.12
Business Network	(2.68)**	(1.92)+
Info. About Customer Through	0.014	13.11
Social Network	(0.14)	(0.57)
Talk To Other Suppliers of	0.12	23.61
Customer At Least Monthly	(1.07)	(1.02)
ENFORCEMENT		
Businesses Would Refuse to	-0.066	-28.51
Deal With Customer Who	(-0.75)	(-1.61)
Cheated Manufacturer		, ,
	0.27	37.95
Belief in Court System	(2.51)*	(2.00)*
	0.14	55.57
Export Dummy*Belief in Courts	(0.79)	(1.26)
CONTROLS		
	-0.17	-26.92
Ln(1+Age)	(-3.33)**	(-2.06)*
	0.053	16.72
Ln(Employment)	(1.14)	(1.45)
	-0.027	13.34
Receive Bank Credit	(-0.22)	(0.40)
% Trade Credit Received by	0.0046	0.79
Supplier	(4.49)**	(3.04)**
	0.16	49.21
Export Dummy	(1.78)+	(1.78)+
Observations	132	132
Chi-Squared	46.09	33.84
	dof=14	dof=14
Prob>Chi-Squared	< 0.0001	0.0022

# Appendix Table 3: Customer Credit Robustness Check Main Specification – (Clustered errors)

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN			, , , , , , , , , , , , , , , , , , ,	ĺ ĺ
Would Take Customer More	-0.09	-3.11	-0.097	-8.15
Than a Month to Find Alternate	(-0.48)	(-0.15)	(-0.56)	(-0.41)
Supply			,	× ,
INFORMATION/LOCK-IN				
	0.043	5.56		
Duration of Relationship (years)	(1.41)	(2.09)*		
	-0.00068	-0.13		
Duration-squared	(-0.49)	(-1.14)		
INFORMATION/				
NETWORK EFFECTS				
Info. About Customer Through	0.46	38.95	0.43	34.58
Business Network	(3.45)**	(2.94)**	(3.40)**	(2.61)*
Talk To Other Suppliers of	0.52	46.38	0.50	45.96
Customer At Least Monthly	(4.56)**	(2.91)**	(4.14)**	(2.64)**
ENFORCEMENT				
Businesses Would Refuse to	-0.19	-22.69	-0.13	-17.65
Deal With Customer Who	(-1.25)	(-2.22)*	(-0.91)	(-1.72)+
Cheated Manufacturer				
	0.39	32.48	0.37	27.55
Belief in Court System	(3.52)**	(2.86)**	(3.50)**	(2.55)*
CONTROLO				
CONTROLS				
	-0.42	-28.47	-0.25	-14.25
Ln(1+Age)	(-4.43)**	(-3.68)**	(-3.07)**	(-2.22)*
	0.18	21.32	0.15	21.25
Ln(Employment)	(2.20)*	(2.55)*	(1.90)+	(2.51)*
	0.21	40.24	0.18	33.59
Export Dummy	(1.30)	(2.39)*	(1.20)	(1.97)+
Observations	132	132	132	132
F-statistic	4.64	3.35	4.21	2.69
	F(10,61)	F(10,61)	F(8,63)	F(8,63)
Prob>F	0.0001	0.0016	0.0004	0.0131

Appendix Table 4: Regressions on Trade Credit to Customers (Correction for survey sampling) Main Specification

	)	,	1	
	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN			/	,
Would Take Customer More	-0.059	-0.89	-0.078	-8.88
Than a Month to Find Alternate	(-0.50)	(-0.03)	(-0.73)	(-0.34)
Supply	( 0.00)	( 0.05)	( 0.75)	( 0.5 1)
INFORMATION/LOCK-IN				
	0.043	10 90		
Duration of Relationship (years)	(2 24)*	$(2 \ 42)*$		
Durution of Relationship (Jeurs)	-0.001	-0.27		
Duration-squared	(-1.24)	(-1.36)		
INFORMATION/	(1.21)	(1.50)		
NETWORK EFFECTS				
Info About Customer Through	0.31	49.98	0.31	48.8
Business Network	(3.14)**	(7, 12) *	(3.12)**	+0.0 (2 21)*
Talk To Other Suppliers of		26.08		(2.21)
Customer At Least Monthly	0.20	(1, 22)	(2, 32)*	(1.16)
ENEORCEMENT	(2.20)**	(1.22)	(2.32)*	(1.10)
Pugipagag Would Pafuga to	0.057	26.07	0.047	24.06
Deal With Customer Who	(0.03)	-30.97	-0.047	-34.90
Chastad Manufacturar	(-0.70)	(-2.20)"	(-0.00)	(-2.10)*
	0.40	70.44	0.20	71.22
Delief in Count Sustan	U.4U (5.50)**	/8.44	U.39 (5.21)**	/1.52
Beller in Court System	(5.58)**	(3.36)**	(5.31)**	(3.02)**
CONTROLS				
	-0 19	-36 74	-0.082	-9.60
Ln(1+Age)	(-3.43)**	(-2.91)**	(-1.68)+	(-0.88)
2(1.1.80)	0.068	23.53	0.075	26.52
Ln(Employment)	(2.10)*	(2.78)**	(2.51)*	(3.11)**
	0.086	43.43	0.032	28.41
Export Dummy	(0.90)	(1.98)*	(0.33)	(1.36)
Observations	120	120	120	120
R-Squared	0.25	0.062	0.19	0.040
Chi-Squared	38.45	31.82	31.81	23.66
	(dof=10)	(dof=10)	(dof=8)	(dof=8)
Prob>Chi-Squared	<0.0001	0.0004	0.0001	0.0026

Appendix Table 5: Regressions on Trade Credit to Customers (Sample = two observations per firm) Clustered Errors, Main Specification

			-	
	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN			,	,
Would Take Customer More	-0.12	-24.56	-0.11	-24.35
Than a Month to Find Alternate	(-0.92)	(-0.41)	(-0.91)	(-0.43)
Supply	( )			( )
INFORMATION/LOCK-IN				
	0.047	24.02		
Duration of Relationship (years)	(2.08)*	(1.88)+		
	-0.0013	-0.70		
Duration-squared	(-1.46)	(-1.43)		
INFORMATION/				
NETWORK EFFECTS				
Info. About Customer Through	0.13	39.02	0.19	78.60
Business Network	(0.79)	(0.52)	(1.21)	(1.00)
Talk To Other Suppliers of	-0.016	2.02	-0.054	-20.97
Customer At Least Monthly	(-0.12)	(0.03)	(-0.42)	(-0.33)
ENFORCEMENT				
Businesses Would Refuse to	-0.029	-48.63	-0.063	-64.67
Deal With Customer Who	(-0.26)	(-0.83)	(-0.60)	(-1.13)
Cheated Manufacturer				
	0.19	93.08	0.22	99.33
Belief in Court System	(1.24)	(1.07)	(1.45)	(1.07)
CONTROLO				
CONTROLS	0.041	1.00	0.0000	
	-0.061	-1.92	0.0009	29.57
Ln(1+Age)	(-0.82)	(-0.05)	(0.01)	(0.83)
	0.082	43.55	0.086	48.23
Ln(Employment)	(2.11)*	(1.82)+	(2.46)*	(2.13)*
Observations	71	71	71	71
R-Squared	0.13	0.059	0.076	0.037
Chi-Squared	16.48	7.86	10.09	7.00
Prob>Chi-Squared	0.058	0.55	0.18	0.43
	(dof=9)	(dof=9)	(dof=7)	(dof=7)

# Appendix Table 6: Regressions on Trade Credit to Customers (Sample = Exporters only) Clustered Errors, Main Specification

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
% Inputs Purchased From Less	-0.0078	-0.62	-0.0073	-0.61
Than 1 km	(-2.46)*	(-2.19)*	(-2.25)*	(-2.13)*
	0.0020	-0.16	0.0014	-0.15
% Inputs Imported	(0.35)	(-0.35)	(0.27)	(-0.36)
INFORMATION/LOCK-IN				
	0.026	1.94		
Duration of Relationship (years)	(1.334)	(1.45)		
	-0.00050	-0.070		
Duration-squared	(-0.88)	(-1.67)+		
INFORMATION/				
NETWORK EFFECTS				
	-0.23	-29.09	-0.25	-28.52
Visit Supplier Before First Sale	(-1.96)*	(-1.27)	(-2.14)*	(-1.32)
	0.42	7.63	0.4	7.27
Visit Supplier at Least Weekly	(4.30)**	(0.63)	(4.07)**	(0.60)
Intro. To Supplier Through	0.34	16.05	0.35	20.71
Social Network	(3.88)**	(1.47)	(3.86)**	(1.84)+
ENFORCEMENT				
Dispute With Supplier Would	0.21	23.71	0.18	19.99
Lead To Higher Advanced	(1.69)+	(1.04)	(1.36)	(0.86)
Payment				
	0.15	5.58	0.16	7.12
Belief in Court System	(1.08)	(0.28)	(1.16)	(0.37)
CONTROLS				
	-0.042	8.07	0.058	9.46
Ln(1+Age)	(-0.32)	(0.66)	(0.43)	(0.79)
	-0.021	-1.94	-0.038	-2.13
Ln(Employment)	(-0.19)	(-0.17)	(-0.33)	(-0.19)
	-0.2	-19.52	-0.18	-20.3
Export Dummy	(-1.21)	(-1.23)	(-1.11)	(-1.26)
Receive Bank Credit	-0.27	2.12	-0.28	0.17
	(-1.30)	(0.12)	(-1.37)	(0.01)
Observations	113	113	113	113
F-statistic	4.34	1.23	4.21	1.51
	F(13,49)	F(13,49)	F(11,51)	F(11,51)
Prob>F	0.0001	0.29	0.0002	0.16

Appendix Table 7: Regressions on Trade Credit from Suppliers (Correction for survey sampling) Main Specification

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
% Inputs Purchased From Less	0.001	0.030	0.00072	0.021
Than 1 km	(0.43)	(0.09)	(0.30)	(0.07)
	0.0014	-0.24	0.00043	-0.27
% Inputs Imported	(0.31)	(-0.37)	(0.09)	(-0.40)
INFORMATION/LOCK-IN				
Duration of Relationship	-0.011	-0.49		
(years)	(-1.24)	(-0.42)		
	0.00041	0.013		
Duration-squared	(1.58)	(0.36)		
INFORMATION/				
NETWORK EFFECTS				
Visit Supplier Before First	-0.28	-49.88	-0.28	-49.83
Sale	(-2.75)**	(-2.29)*	(-2.69)**	(-2.28)*
	0.26	23.90	0.27	24.17
Visit Supplier at Least Weekly	(2.74)**	(1.68)+	(2.80)**	(1.65)+
Intro. To Supplier Through	0.21	27.80	0.21	27.25
Social Network	(2.07)*	(1.90)+	(2.14)*	(1.91)+
ENFORCEMENT				
Dispute With Supplier Would	0.17	9.52	0.16	9.71
Lead To Higher Advanced	(1.26)	(0.43)	(1.14)	(0.44)
Payment				
	-0.04	0.94	-0.036	0.78
Belief in Court System	(-0.27)	(0.05)	(-0.24)	(0.04)
CONTROLS		1 = 10		1 - 1 -
	0.12	17.68	0.12	17.05
Ln(1+Age)	(1.27)	(1.14)	(1.26)	(1.08)
	-0.0076	-1.38	-0.0084	-28.09
Ln(Employment)	(-0.12)	(-0.14)	(-0.13)	(-1.05)
	-0.17	-28.47	-0.16	-28.09
Export Dummy	(-1.30)	(-1.54)	(-1.23)	(-1.50)
Receive Bank Credit	-0.35	-18.31	-0.33	-17.90
	(-2.56)**	(-0.98)	(-2.38)*	(-0.96)
Observations	100	100	100	100
R-Squared	0.32	0.052	0.31	0.052
Chi-squared	39.38	24.37	31.72	23.09
Prob>Chi-squared	0.0002	0.028	0.0008	0.017
	(dof=13)	(dof=13)	(dof=11)	(dof=11)

Appendix Table 8: Regressions on Trade Credit from Suppliers (Sample = two observations per firm) Clustered Errors, Main Specification

	Probit	Tobit	Probit	Tobit
			(without	(without
			duration)	duration)
LOCK-IN				
% Inputs Purchased From Less	0.0021	0.33	0.0016	0.29
Than 1 km	(0.80)	(0.96)	(0.59)	(0.86)
	0.0019	-0.12	0.0011	-0.21
% Inputs Imported	(0.41)	(-0.26)	(0.23)	(-0.44)
INFORMATION/LOCK-IN				
Duration of Relationship	-0.0061	0.16		
(years)	(-0.45)	(0.11)		
	0.00058	0.018		
Duration-squared	(1.09)	(0.44)		
INFORMATION/				
NETWORK EFFECTS				
Visit Supplier Before First	-0.41	-62.86	-0.4	-62.15
Sale	(-3.52)**	(-2.51)*	(-3.25)**	(-2.50)*
	0.17	20.90	0.18	22.46
Visit Supplier at Least Weekly	(1.16)	(0.91)	(1.16)	(0.97)
Intro. To Supplier Through	-0.03	2.01	0.026	4.94
Social Network	(-0.18)	(0.08)	(0.16)	(0.21)
ENFORCEMENT				
Dispute With Supplier Would	0.0079	-4.61	-0.00079	-4.32
Lead To Higher Advanced	(0.04)	(-0.16)	(-0.01)	(-0.16)
Payment				
	0.24	17.59	0.22	16.49
Belief in Court System	(1.07)	(0.61)	(0.99)	(0.58)
CONTROLS				
	0.18	32.01	0.21	34.53
Ln(1+Age)	(1.43)	(1.53)	(1.74)+	(1.63)
	-0.02	-6.0	-0.013	-5.27
Ln(Employment)	(-0.25)	(-0.54)	(-0.16)	(-0.47)
Receive Bank Credit	-0.29	-21.62	-0.28	-21.78
	(2.17)*	(-1.01)	(-2.06)*	(-1.02)
Observations	69	69	69	69
R-Squared	0.20	0.036	0.17	0.035
Chi-squared	16.26	12.24	11.18	1.022
Prob>Chi-squared	0.18	0.43	0.34	0.42
	(dof=12)	(dof=12)	(dof=10)	(dof=10)

Appendix Table 9: Regressions on Trade Credit from Suppliers (Sample = Exporters only) Clustered Errors, Main Specification

					T-Statistic
		a. 1 1		G. 1 1	(Hypothesis:
	N	Standard	N	Standard	Means are equal;
	Mean	Deviation	Mean	Deviation	degree of freedom
	(included)	(included)	(excluded)	(excluded)	in parentheses)
DEPENDENT VARIABLES					1.(0
	0.55	0.50	0.44	0.50	1.62
Give trade credit	0.55	0.50	0.44	0.50	(212)
Trade credit (%)	35.91	37.99	29.13	38.61	(210)
LOCK-IN					
Would Take Customer Less Than					0.85
a Week to Find Alternate Supply	0.44	0.50	0.38	0.49	(204)
Would Take Customer More					
Than a Month to Find Alternate					-0.20
Supply	0.26	0.44	0.27	0.45	(204)
Maintain inventory of product					-0.42
sold to customer	0.37	0.48	0.40	0.49	(233)
INFORMATION/ LOCK-IN					
					-1.58
Duration of relationship (years)	6.74	6.63	8.38	8.83	(222)
					-1.91
Duration squared	89.05	162.60	147.42	289.36	(222)
INFORMATION / NETWORK					
EFFECTS					
Info. About Customer Through					0.23
Business Network	0.44	0.50	0.42	0.50	(229)
Info. About Customer Through	0.10	0.04	0.10	0.00	0.65
Social Network	0.13	0.34	0.10	0.30	(229)
Talk To Other Suppliers of	0.(2	0.40	0.40	0.40	2.53
Customer At Least Weekly	0.63	0.49	0.40	0.49	(127)
Talk To Other Suppliers of	0.76	0.42	0.7	0.49	1.21
ENEORCEMENT	0.76	0.43	0.67	0.48	(127)
ENFORCEMENT Customer has failed to new after					0.55
delivery	0.22	0.42	0.18	0.30	(125)
Customers Would Find Out	0.22	0.42	0.10	0.59	(123)
About Dispute With Another					2 20
Customer	0.44	0.50	0.26	0.44	(128)
Other producers will refuse to	0.11	0.50	0.20	0.11	(120)
deal with customer who has					1 23
cheated	0.42	0.50	0.31	0.47	(125)
				,	-1.65
Belief in courts*exporter dummy	0.08	0.28	0.18	0.39	(125)
1 7					-1.06
Belief in courts	0.21	0.41	0.29	0.46	(125)
CONTROLS					

Appendix Table 10: Customer Credit Comparison of Regression Sample to Deleted Observations

					T-Statistic
					(Hypothesis:
		Standard		Standard	Means are equal;
	Mean	Deviation	Mean	Deviation	degree of freedom
	(included)	(included)	(excluded)	(excluded)	in parentheses)
					-1.54
Ln(Employment)	3.23	1.06	3.53	1.18	(129)
					-1.20
Ln(1+age)	2.60	0.70	2.76	0.81	(130)
					-2.16
Receive Bank Credit	0.26	0.44	0.46	0.50	(116)
					-1.75
Credit Access	0.31	0.46	0.47	0.50	(115)
Average % Trade Credit Received					0.50
by Supplier	41.53	32.42	38.50	33.31	(120)
Price Set By Relationship with					-1.54
Customer	0.01	0.12	0.07	0.25	(114)
					2.0
Vendors	0.46	0.50	0.29	0.46	(132)
					-2.0
Exporters	0.54	0.50	0.71	0.46	(132)

Appendix Table 11: Supplier Credit Comparison of Regression Sample to Deleted	
Observations	

					T-Statistic
					(Hypothesis:
					Means are
		Standard		Standard	equal; degree
	Mean	Deviation	Mean	Deviation	of freedom in
	(included)	(included)	(excluded)	(excluded)	parentheses)
DEPENDENT VARIABLES					0.05
Receive trade credit	0.65	0.48	0.63	0.49	0.27 (224)
Trade credit (%)	36.59	31.92	42.99	37.87	-1.32 (208)
LOCK-IN					
Would take a day or less to find					0.31
alternate supply	0.12	0.32	0.10	0.30	(219)
Would take more than a week to find alternate supply	0.28	0.45	0.21	0.41	1.20 (219)
% inputs purchased from less					-0.12
than 1 km	16.90	27.54	17.56	30.31	(111)
% inputs imported	4.21	12.86	7.31	19.67	-1.01 (113)
Have Other Suppliers	0.73	0.44	0.72	0.45	0.27 (221)
INFORMATION/ LOCK-IN					
Duration of trading relationship					0.78
(years)	7.71	7.97	6.84	7.74	(204)
					0.49
Duration squared	122.36	247.57	106.11	220.52	(204)
Introduction to Supplier					-0.09
Through Social Network	0.33	0.47	0.33	0.47	(216)
Visit supplier at least once	0.00	0.20	0.05	0.00	-1.24
(before first sale)	0.90	0.30	0.95	0.23	(223)
Customer visite sumplier at least					1 47
weekly	0 39	0.49	0.49	0.50	(224)
INFORMATION/	0.57	0.19	0.19	0.00	(22.1)
NETWORK EFFECTS					
Talk with other producers at					-0.06
least weekly	0.56	0.50	0.56	0.50	(127)
Talk with other producers at					-1.56
least monthly	0.68	0.47	0.80	0.40	(127)
ENFORCEMENT					
If I have a dispute w/ supplier,					0.97
others will find out	0.59	0.50	0.50	0.50	(123)
Dispute w/ supplier would lead	• · -			a :-	-0.75
to higher advance payment	0.17	0.38	0.23	0.42	(122)
Belief in court system	0.16	0.37	0.19	0.40	-0.47 (113)
· · · · · · · · · · · · · · · · · · ·		/			()

					T-Statistic
					(Hypothesis:
					Means are
		Standard		Standard	equal; degree
	Mean	Deviation	Mean	Deviation	of freedom in
	(included)	(included)	(excluded)	(excluded)	parentheses)
					-0.97
Belief in courts*export dummy	0.06	0.25	0.12	0.32	(113)
CONTROLS					0.17
In(Employment)	3 34	1.06	3 37	1 20	-0.17
	5.54	1.00	5.57	1.20	0.12
Ln(1+age)	2.67	0.64	2.66	0.84	(130)
					0.70
Receive bank credit	0.33	0.48	0.27	0.45	(116)
					0.00
Have access to credit	0.33	0.48	0.33	0.48	(115)
					0.19
Vendors	0.40	0.49	0	0.49	(123)
					-0.19
Exporters	0.60	0.49	1	0.49	(123)

					T-Statistic (Hypothesis:
		Standard		Standard	Means are equal;
	Mean	Deviation	Mean	Deviation	degree of freedom in
	(included)	(included)	(excluded)	(excluded)	parentheses)
Ln(Employment)					
					0.46
Ln(1+age)	3.89	1.19	3.74	1.25	(71)
Sell Some Products					-1.06
Under Own Name	0.46	0.50	0.61	0.50	(72)
Sell Some Products					-1.25
Directly to Hospitals	0.30	0.46	0.47	0.51	(71)
Would Participate in					-0.81
Joint Action	0.27	0.45	0.37	0.50	(73)
Duration of Trading					
Relationship with Oldest					-0.84
Customer (years)	11.55	8.64	13.69	7.57	(68)
Talk at Least Weekly with					1.54
Other Producers	0.45	0.50	0.24	0.44	(71)
					1.07
Credit Access	0.59	0.50	0.42	0.51	(66)

Appendix Table 12: Joint Action Comparison of Regression Sample to Deleted Observations

Total	15	11	16	11	37 give trade credit, and 27 receive trade credit.
suppliers	8	1	6	7	$\frac{22}{2}$
Receive from both					
supplier	4	10	8	4	26
Receive from new supplier (only)	1	0	2	0	3
Receive from old supplier (only)	2	0	0	0	2
EXPORTERS (53 firr	ns) Give to old customer (only)	Give to new customer (only)	Give to neither customer	Give to both customers	Total
EXPORTERS (53 firr	ne)				

# Appendix Table 13: Sources and Uses of Trade Credit (95 Firms)<sup>36</sup>

VENDORS (42 firms)	)				
	Give to old	Give to new	Give to		
	customer	customer	neither	Give to both	
	(only)	(only)	customer	customers	Total
Receive from old					
suppliers (only)	3	0	1	0	4
Receive from new					
suppliers (only)	0	0	2	0	2
Receive from neither					
supplier	1	0	2	0	3
Receive from both					
suppliers	3	3	7	20	33
Total	7	3	12	20	Out of 42 vendors, 30 give trade credit and 39 receive trade
Total	7	3	12	20	credit.

<sup>&</sup>lt;sup>36</sup> The sample used to create this table is larger than the samples used in the regressions on trade credit in the paper, since only the trade credit variable was needed. Each of these 95 firms has observations on trade credit given to two customers and received from two suppliers.