ABSTRACT

Title of Dissertation / Thesis:	ESSAYS ON COOPERATION IN DEVELOPING COUNTRY INDUSTRIAL CLUSTERS
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An industrial cluster is a group of firms that are specialized by sector, located in close geographic proximity and consist of mostly small and medium sized enterprises. An introduction to these clusters is provided in Chapter One.

Chapter Two develops a model to examine the conditions under which clustered firms in a less developed country may cooperate in a "joint action" to market their output in a developed country, eliminating the role of an intermediary firm in the developed country. The clustered firms are heterogeneous in expected quality of output and know the quality type of other firms, but the foreign intermediary does not. The intermediary, however, has a lower marketing cost than the clustered firms. The main result of the model is that joint action can occur among high quality type firms, but the low quality firms always use the foreign intermediary to distribute their output.

Chapter Three examines empirically two aspects of collective efficiency, one passive and one active, through the analysis of a survey of the surgical instrument

cluster in Sialkot, Pakistan. First, I test an idea from relational contracting theory that informal relationships can substitute for formal enforcement through the judicial system. Inter-firm trust is measured as the amount of trade credit offered to customers. The results show that suppliers are more likely to offer trade credit when they believe in the effectiveness of formal contract enforcement and when they participate in business networks (proxied by inter-firm communication). Customer lock-in helps to develop inter-firm trust since firms give more credit when relationships are of longer duration. This is because locked-in customers are less able to find alternate suppliers.

Chapter Three also examines the firm-level characteristics that determine the firms' interest in intra-cluster cooperation to market their own goods. The results demonstrate that firms are more likely to be interested in such initiatives once they have already had some direct experience in marketing, and when firms have a lower opportunity cost of leaving their current customers, where opportunity cost is measured by the length of the trading relationship.

ESSAYS ON COOPERATION IN DEVELOPING COUNTRY INDUSTRIAL CLUSTERS

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Chapter 1: Introduction to Industrial Clusters in Developing Countries

1.1 Introduction

An industrial cluster is a group of firms that are specialized by sector, located in close geographic proximity and consists of mostly small and medium sized enterprises. In recent years, clusters of small firms have been viewed optimistically as a source of growth in developing countries. Despite the small size of many of the firms, these clusters make sizeable contributions to developing countries' economies in terms of employment, output, and exports. Therefore clustering is an important aspect of the economies of developing countries and deserves further study.

In the past, there has been some doubt whether small firms could be a potential source of growth in developing countries. A leading undergraduate development textbook is only guardedly optimistic about the potential of small firms in developing countries:

> Small scale industry does indeed serve as a breeding ground for potential entrepreneurs…Some firms have the potential to grow to medium or even large enterprises. It is important, however, not to yield to romanticism. Statistically, very few small firms even survive over long periods of time, let alone grow up to be medium or large enterprises.[1]

While this statement does not preclude the growth of small firms in developing countries, the authors do not seem very confident about their potential. The same textbook cites a positive correlation between GNP per capita and the average size of industrial plants.[2] This statement seems to imply that there is not much place for small firms in a

[1] Gillis, Perkins, Roemer, Snodgrass (1996), pg. 498.

more developed economy. It overlooks the possibility that new types of industrial organization, such as clustering of small firms, can exist in a modern, industrialized economy. While small firms may suffer certain disadvantages, clustering may mitigate some of these difficulties. For instance, the Sinos Valley, Brazil footwear cluster has at least 75 large manufacturers (each with more than 500 employees) that grew from being small firms over the last 25 years.[3] Clearly, clustering is an aspect of small firm dynamics in developing countries that has not received sufficient attention.

Evidence proves that clusters of firms make sizeable contributions to developing countries' economies despite the small size of many of most of the individual firms (see Table 1.1 for more details), and therefore clustering is a topic worthy of inquiry. The subject of this investigation, however, is not the growth potential of clusters, but the potential for clustering to aid or hinder firms in dealing with export markets and the contract enforcement environment.

The Export Environment Faced By Clusters

Many clusters have become major exporters by selling their goods through foreign agents to large firms from developed countries. There has been concern expressed by some authors in the "global commodity chain" literature (to be discussed in more detail in Section 1.5) that developing country firms that produce goods for large multinational firms will be trapped in a subordinate role of low value added production while the multinationals that produce the designs and do the marketing and retailing will reap most

[2] Ibid, pg. 496.

[3] Schmitz (1995), pg. 13.

of the profits. However, since the firms being studied here are geographically clustered, specialized in the same sector, and often have their own business associations, the possibility arises that clustered firms may be able to cooperate in order to break away from the foreign buyers and produce their own designs or do their own marketing. The model in the second chapter will examine the conditions under which clustered firms can cooperate, or undertake a joint action in order to market their own goods directly to consumers.

The Contract Enforcement Environment in Developing Countries

Weak contract enforcement institutions characterize many of the developing countries where industrial clusters are found. In environments where an effective legal system or formal system of contract enforcement is lacking, individuals and firms rely on informal means to enforce agreements, also referred to as relational contracting.[4] The three major methods for informal contract enforcement include: i) dealing only with trusted parties such as friends and family members, ii) contracting repeatedly with the same parties (so that the value of the relationship prevents cheating), and iii) community enforcement (where the threat of sanction by a third party ensures that an agreement is upheld).[5] Depending on the characteristics of a particular geographic area or grouping of agents, one of these methods may be more effective than the others in supporting contract enforcement. For example, since clustered firms all produce similar goods and are geographically concentrated, community enforcement might be a stronger force than

[4] Relational contracting or informal enforcement may not necessarily be a substitute for the judicial system; in fact they might be complements.

[5] Community enforcement requires that information about cheaters is known throughout the community, and that members of the community refuse to trade with known cheaters.

bilateral relationships. If community enforcement is not present, the threat of sanction by an individual supplier in the cluster would most likely be ineffective since there are many other similar suppliers. The third chapter will empirically analyze the factors that support the development of inter-firm trust among clustered firms, where trust is proxied by trade credit offered to customers by suppliers. The data was obtained through a survey of the surgical goods industry located in Sialkot, Pakistan.

Organization of Chapter One

Sections 1.2 and 1.3 of this chapter define industrial clusters and summarize some of their common characteristics as described in the case study literature. Section 1.4 discusses the theorized benefits of clustering, referred to as active and passive collective efficiency. Section 1.5 presents some of the economic literature related to the study of clusters. A brief roadmap (as well as summary results) for the remaining two chapters of the dissertation are described in Section 1.6.

1.2 Defining Clusters

The major characteristics of the industrial model, as clusters are sometimes called, are described in Rabellotti (1995) as:

- Geographically grouped small and medium sized firms which are specialized by sector;
- Forward and backward linkages based on market and non-market exchanges of goods, information, and people;

- Common cultural and social background linking economic agents and creating a behavioral code, sometimes explicit but often implicit;
- Network of public and private local institutions supporting the economic agents acting within the cluster;

For purposes of this chapter, a cluster will be defined as a group of firms located in the same geographic area, such as an industrial district, town, or small region, where there are a significant number of firms specialized in producing inputs for and manufacturing the same type of good. For example, clusters in Sinos Valley (Brazil), Agra (India), and Guadalajara and Leon (Mexico) all produce footwear. Some of the other clusters that have been studied specialize in the production of textiles, leather goods, and surgical instruments. Within a mature cluster, there are some vertically integrated enterprises, but for the most part, production does not generally take place within one firm. Various separate firms carry out the production process, which includes input production, manufacturing, and complementary services. Many clusters, especially the mature ones, have local business associations as well.

1.3 Characteristics of Clusters

Clusters are Widespread in Developing Countries

There are a growing number of case studies detailing the characteristics and growth paths of clusters in developing countries. These case studies provide one with a wealth of information about the functioning of clusters, but more fundamentally they demonstrate the prevalence of clusters across sectors and countries. Among the clusters that have been studied include footwear in Sinos Valley, Brazil, cotton knitwear in

Tiruppur, India, woolen knitwear in Ludhiana, India, garments in Eastlands, Kenya, metal products in Kamukunji, Kenya, vehicle repair in Ziwani, Kenya, fish in Lake Victoria, vehicle repair and metal work in Suame, Ghana, clothing in Western Cape, South Africa, shoes in Guadalajara and Leon, Mexico, footwear in Agra, India, clothing in Gamarra, Peru, textiles, ceramic tiles, and metal engineering in Santa Catarina, Brazil, tanneries in Palar Valley, India, blue jeans in Torreon, Mexico, and surgical instruments in Sialkot, Pakistan.[6]

Economic Importance of Clusters

Clusters produce a significant amount of output, with a great deal of this output bound for the export market. A few key figures give an indication of the economic importance of clusters in developing countries (more information is provided in Table 1.1). Pakistan's Sialkot cluster exported $125 million worth of surgical instruments in 1995-96.[7] Brazil exported 200 million pairs of shoes in 1993, most of which came from the Sinos Valley footwear cluster.[8] In Mexico, the two clusters of Guadalajara and Leon

[6] Two issues of the journal *World Development* [Vol. 23, No. 1 (1995) and Vol. 27, No. 9 (1999)] were dedicated to the study of clusters in developing countries and each contain a number of case studies. For the Sinos Valley, Brazil, see Schmitz (1995) and (1999); for cotton knitwear in Tiruppur, India, see Cawthorne (1995); for woolen knitwear in Ludhiana, India, see Tewari (1999); for garments in Eastlands, Kenya, metal products in Kamukunji, Kenya, vehicle repair in Ziwani, Kenya, fish in Lake Victoria, vehicle repair and metal work in Suame, Ghana, clothing in Western Cape, South Africa, see McCormick (1999); for shoes in Guadalajara and Leon, Mexico, see Rabelloti (1995) and (1999); for footwear in Agra, India, see Knorringa (1999); for clothing in Gamarra, Peru, see Visser (1999); for textiles, ceramic tiles, and metal engineering in Santa Catarina, Brazil, see Meyer-Stamer (1998), for tanneries in Palar Valley, India, see Kennedy (1999); for blue jeans in Torreon, Mexico, see Bair and Gereffi (2001); and for surgical instruments in Sialkot, Pakistan, see Nadvi (1999).

[7] Nadvi (1999), pg. 1611.

[8] Schmitz (1998), pg. 12.

comprised 2900 of the 4500 shoe enterprises in Mexico in 1991.[9] The cluster in Guadalajara alone accounted for 27 percent of the 172.4 million pairs produced in Mexico in 1994.[10] In Tiruppur, India, there were at least 2000 clustered cotton knitwear firms in 1995, and they produced about 70 percent of India's exports of this commodity.[11] In Ludhiana, India, there were 10,000 firms and 200,000 workers producing Rs 241 billion[12] (almost $10 billion in U.S. 1991 dollars) of woolen knitwear in 1991. The Ludhiana cluster contained four-fifths of all woolen knitwear firms in India, producing 90 percent of the country's output of woolen and acrylic knitwear (and 95 percent of the country's exports of this product).[13] In Agra, India, 5000 clustered firms were producing 300,000 pairs of shoes per day in 1991-92.[14] Forty-five percent of India's leather is produced in Palar Valley, where there are at least 600 tanneries in five clusters. Table 1.1 summarizes some of the information regarding the economic significance of the individual clusters.

[9] Rabellotti (1995), pg. 33.

[10] Rabellotti (1999), pg. 1574.

[11] Banerjee and Munshi (2000), pg. 1, 17.

[12] Tewari (1999), pg. 1653.

[13] Tewari (1999), pg. 1652.

[14] Knorringa (1999), pg. 1590.

Table 1.1: Economic Significance of Clusters

Cluster	**Exports**	**Production**	**Employment**
Sialkot, Pakistan (Surgical Instruments)	$125 million of exports in 1995-1996	Most of production exported	300 manufacturers, 2,500 firms total related to surgical instrument industry
Ludhiana, India (Woolen Knitwear)	$121 million in exports in 1996-97	Produced 90% of India's woolen and acrylic knitwear	10,000 firms, 200,000 workers
Tiruppur, India (Cotton Knitwear)	70% of India's cotton knitwear exports	2.5 billion Rupees turnover in 1985	2000 firms in 1995
Agra, India (Footwear)	n.a.	300,000 pairs of shoes per day in 1991-92	5,000 firms and 60,000 employees
Palar Valley, India (Leather Tanning)	Expected exports in 2000-2001 are 80 billion Rupees	n.a.	600 firms
Sinos Valley, Brazil (Footwear)	$1.5 Billion in exports in 1997 (current prices) from Brazil, most from Sinos Valley, in 1990, Brazil accounted for 12.3% of ***world*** leather shoe exports; Sinos Valley exported 70% of output in 1991.	Approximately 142 million pairs of shoes produced in 1991	391 firms and 83,800 workers in 1996 in footwear; 1673 firms and 170,500 workers in cluster (footwear and related industries)
Guadalajara, Mexico (Footwear)	n.a.	Accounted for 27% of the 172.4 million (or about 46.5 million) pairs of shoes produced in Mexico	In 1990, 23% of footwear employment in Mexico in the state of Jalisco, mostly in the city of Guadalajara. In 1993, there were 1,100 firms and 25,000 employees in Guadalajara alone.
Leon, Mexico (Footwear)	n.a.	n.a.	In 1990, 50% of footwear employment in Mexico was in state of Guanajuato, mostly in city of Leon
Gamarra (Lima), Peru (Clothing)	n.a.	In 1993, estimated turnover was $800 million	In 1993, number of firms estimated between 6800 and 8000

Non-Vertically Integrated Production

Various separate firms in the cluster carry out the production process in stages, which includes input production, manufacturing, and complementary services. In general, production of a final good is not carried out in a single, vertically integrated firm. For example, shoe production in the Sinos Valley (Brazil) takes place in stages that are often carried out in different firms, although some firms were vertically integrated.[15] In the Sinos Valley, there are suppliers that produce a variety of goods and services including raw materials, components, machinery, and services such as freelance design and transport. There also was an extensive use of subcontracting in the Sinos Valley, usually to small firms. In Sialkot (Pakistan), in addition to the cluster's core producers, there were various process specialized subcontractors and suppliers of locally manufactured scrap steel.[16] In the Agra (India) footwear cluster, there are many input suppliers that produce different components, such as lasts, tools, leather board, soles, laces, stiffeners, and chemicals.[17] Manufacturers in the footwear clusters of Guadalajara and Leon (Mexico) buy their leather and soles from supplier firms.[18]

Exports Are Vital to Clusters

Clusters often export a great deal of their output. The Indian clusters of Agra and Ludhiana used to export a large proportion of their output to the USSR. Exports to the

[15] Schmitz (1999), pg. 17.

[16] Nadvi (1999), pg. 1610.

[17] Knorriga (1999), pg. 1590.

[18] Rabellotti (1999), pg. 1575.

Soviet Union were arranged through government-to-government contracts, and 50 percent of output from the Ludhiana cluster went there. This export channel collapsed along with the Soviet regime, but the clusters recovered quickly by finding new export markets in Europe and North America. In Ludhiana, exports grew from $32 million in 1991/1992 to $121 million in 1996/1997. Pakistan's Sialkot surgical instrument cluster exports virtually all of its output to North America and Europe. For other data pertaining to cluster exports, refer to Table 1.1.

Common Cultural Background

In many clusters, there is common cultural and social background linking economic agents and creating a behavioral code, sometimes explicit but often implicit. This may help to reduce transaction costs and increase the likelihood of cooperation and transfer of knowledge. The case studies of the Mexican footwear clusters in Guadalajara and Leon found that technological cooperation was most likely to occur among firms that were linked by family ties. These firms would trade technological information and exchange machinery. Informal relationships among the firms in Guadalajara and Leon led to subcontracting orders when there was excess demand, so that firms jointly sold products and recovered credits.[19] Informal contacts were also deemed important in the Brazilian cluster, as information was diffused among friends, family, neighborhood, and church.[20] A common cultural background and long history also characterize the Palar

[19] Rabellotti (1995)

[20] Ibid, pg. 12.

Valley (India) leather tanning cluster. It has been in existence since the 19th century, and is dominated by the local Muslim community.[21]

Business Associations

Many clusters (especially the mature ones) have local business associations. The local trade associations in Guadalajara and in Leon, Mexico (both called Camara del Calzado) promoted the local trade fair, organized the participation of cluster firms in international exhibitions, and sponsored market studies. Sialkot (Pakistan) has three support institutions, the Metal Industries Development Centre, the Sialkot Dry Port Trust, and the Surgical Instrument Manufacturer's Association (SIMA). These business associations are important because they have a role in assisting the cluster firms to cooperate in matters of common interest.

Nature of Relationships in International Markets

For the most part, the design, marketing, and retailing of goods such as those produced by clusters have taken place (and remained) in the developed countries. Cluster firms' goods are sold through various channels, including domestic agents, wholesalers, and foreign agents.[22] In the case of Torreon (Mexico), a textiles cluster that has experienced a significant expansion since the introduction of NAFTA, cluster firms have taken over all parts of the production process *except* design and product development, marketing, and retailing. It is believed that the U.S. "lead firms" view these activities as their core competencies, that there are significant barriers to entry, and that these are the

[21] Kennedy (1999).

[22] Cawthorne (1995), pg. 50.

highest value-added activities of the production process.[23] The small cotton knitwear firms in Tiruppur, India sold their goods to agents. These agents gave the small producers access to larger markets than would be otherwise accessible to them, but at the same time blocked the small firms from having direct access to markets as well as exercising control over prices.[24]

Many of the clusters have ties to large firms in developed countries. Some German international surgical instrument manufacturers subcontract work to the Sialkot cluster firms.[25] After trade liberalization and the loss of the guaranteed Soviet market, many foreign buyers from U.S. and European retail firms came to Ludhiana (India) to purchase wool knitwear.[26] The footwear exports of Guadalajara have also been dominated by U.S. agents.[27]

Shocks to Cluster Exports

In recent years, many clusters have experienced export shocks. In the late 1980s, trade liberalization in Mexico had a dramatic impact on the footwear industry. Imports increased from 200,000 pairs of shoes in 1987 to 107 million pairs in 1991, and domestic production (in all of Mexico) fell from 245.2 to 199.6 million pairs of shoes.[28] The Indian clusters at Tiruppur and Ludhiana had to deal with liberalization of the trade regime

[23] Bair and Gereffi (2001), pg. 1895.

[24] Cawthorne (1995), pg. 50.

[25] Nadvi (1999), pg. 1609.

[26] Tewari (1999), pg. 1654.

[27] Rabellotti (1999), pg. 1578.

[28] Rabellotti (1999), pg. 1571.

beginning in 1991. Average tariffs fell from 142 percent to 40 percent on knitwear within a few years. Trade liberalization also affected Agra's footwear industry. Agra and Ludhiana had an additional challenge in the early 1990s when they lost a large segment of their market consisting of exports to the USSR. Pakistan's Sialkot surgical instrument cluster faced a crisis situation in 1994 when the United States' FDA (Food and Drug Administration) restricted imports of surgical instruments from Pakistan because they did not meet quality assurance standards (including ISO 9000 certification). These quality assurance standards are intended to ensure the implementation of standardized and accountable quality control processes at each stage of the production process, including design, development, manufacturing, and distribution.[29] Since the late 1980s, the Sinos Valley footwear cluster in Brazil has had to deal with changes in the external environment that have involved great challenges for the cluster. One of these challenges has been increased global competition from China for U.S. buyers. In ten years, U.S. footwear imports from China grew 17 times their 1987 levels.[30] At around the same time, U.S. retailers began to place smaller orders to the Sinos Valley firms so that they could maintain smaller inventories. In addition, high inflation in Brazil followed by a currency anchor to the U.S. dollar led to a fall in exporters' receipts.[31]

Cooperation in Clusters

Cooperation is also an important characteristic of firm clusters. To illustrate, in 1994 when the U.S. FDA restricted imports from Pakistan, SIMA, the local business

[29] Nadvi (1999), pg. 1606.

[30] Schmitz (1998), pg. 11.

[31] Schmitz (1998), pg. 11.

association in Sialkot, Pakistan, acquired the services of a U.S. quality assurance consultancy (with the financial assistance of the government) to give other cluster firms the training necessary for obtaining quality assurance certification. By the end of 1997, 208 firms were certified as complying with the quality assurance standards, and 153 more firms were either undergoing training or awaiting certification from the FDA.[32] A major attempt at horizontal cooperation was attempted, but failed in the Sinos Valley, Brazil cluster. An initiative called the "Shoes from Brazil Programme" was implemented to take action on marketing abroad and in Brazil, reorganize production at the firm level, and improve relationships within the supply chain.[33] In the Palar Valley, India, two-thirds of the leather tanneries were operating within four years after the Supreme Court issued its order to halt production due to pollution; 80 percent of the tanneries cooperated to build and operate common effluent (pollution) treatment plants. In Guadalajara, Mexico, the local trade association successfully lobbied the Mexican government for a temporary increase in tariffs when rapid trade liberalization took its toll on the cluster's sales.[34] Also in Guadalajara there is a group of exporting firms that exchanges technical information, machinery, and technicians, and discusses availability of inputs.[35]

[32] Nadvi (1999), pg. 1610.

[33] Schmitz (1998), pg. 31.

[34] Rabellotti (1999), pg. 1579.

[35] Rabellotti (1999) pg. 1579.

1.4 Benefits of Clustering: Passive and Active Collective Efficiency

The notion that small firms could benefit from clustering is not a new idea. Alfred Marshall recognized that the grouping together of firms involved in related activities resulted in positive externalities.[36] These positive externalities include various perceived benefits from clustering, sometimes 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, reduced transaction costs, and the ability for firms to grow in "riskable steps."

Each case study article about clusters presents a slightly different list, but the "passive" benefits of clustering can be summarized as follows. Firms in clusters often benefit from *market access*, referring to the fact that clusters often attract the attention of buyers, which improves the chances for firms to sell their products. As a result of the large number of firms operating in the same geographical area, firms have access to a large *pool of (usually skilled) labor*. *Technological spillovers* may occur because technical information can be easily diffused among producers. Specialization and division of the production process by phases leads to *flexibility* that allows firms to take advantage of different economies of scale afforded at different stages of production. This flexible specialization also leads to higher social welfare when firms face idiosyncratic demand uncertainty, as described by Kranton and Minehart (2000). There is also potential for

[36] As quoted in Schmitz and Nadvi (1999), pg. 1504.

reduced transaction costs within the cluster due to the availability of alternate suppliers, repeated interactions between firms, and ease of conveying information on cheaters. Other perceived benefits of clustering are that it helps firms to grow in "riskable steps."[37] Since clusters consist of manufacturers as well as suppliers dedicated to the production of specialized inputs, a firm starting up within the cluster can start small and focus on a particular stage of the production process or produce a single specialized input for other firms.[38] This significantly reduces start-up costs and lowers barriers to entry from credit constraints.

Active collective efficiency, on the other hand, stems from purposeful cooperation between the firms of the cluster and can be further divided into the sub-categories of horizontal cooperation (also called joint action) and vertical cooperation.[39] Many clusters have business associations whose role it is to support the cluster, and these associations may have a role in fostering cooperation within the cluster. Due to the shocks to exports faced by many of the clusters, there has been a need for upgrading within the clusters.[40] There are three major ways that individual firms or clusters may upgrade, and the firms' capacity to upgrade is often dependent on their ability to cooperate or engage in active collective efficiency.

First, firms may engage in *process upgrading*, which consists of reducing costs either by re-organizing production or by implementing new technology. The second type of upgrading is referred to as *functional upgrading*, leading to a greater involvement of

[37] Schmitz and Nadvi, pg. 1503.

[38] Ibid, pg. 1505.

[39] Ibid, pg. 1504-5.

[40] Ibid, pg. 1507.

manufacturers in the design and marketing process. The last category of upgrading, *product upgrading*, entails producing more sophisticated (higher value-added) goods.

The first type of upgrading, process upgrading, can involve a transformation of firms' relationships with their suppliers, which can also be described as “vertical cooperation.” Upgrading may take the form of introducing new production technologies (such as new machines) or may be a reorganization of production relationships using the same production technology. Whatever forms the upgrading takes, the desired result is generally higher and more reliable quality and shorter delivery times in the processing of orders which often come from foreign buyers.

The second and third type of upgrading may necessitate joint action or "horizontal cooperation" between the firms of the cluster. This is especially true in the case of clusters because most of the firms are too small to make the necessary investments to carry out the activities of product development, marketing, and retailing individually. One must also consider the fact that international buyers are already established members of the market structure. Joint action by the cluster to break into the activities traditionally carried out by foreign buyers is likely to be opposed.

1.5 Literature Review

General Literature

There is a substantial case study literature on firm clusters in developing countries. A long list of these case studies was enumerated in Section 1.3 of the chapter.

The study of clusters is also related to the literature on production networks. Kranton and Minehart have made several contributions to the literature on network industrial structures. Their definition of networks is "manufacturers procure specialized inputs from suppliers that, in turn, sell to several other manufacturers."[41] Kranton and Minehart (2000) present a theoretical model describing the benefits of network relationships in terms of capacity sharing. When firms face large idiosyncratic demand shocks, networks lead to higher social surplus. In this model, manufacturers can choose to be vertically integrated by producing a specialized asset themselves, or they can build a link to a supplier who can sell to many manufacturers. Each supplier can only produce one specialized input, and once manufacturers' demands have been realized, the highest possible gains from trade are obtained. Since manufacturers have uncertain demand for the specialized input, they may regret building capacity to produce their own specialized input if they face a negative demand shock.

Case Studies on Active Collective Efficiency

The majority of the case studies on industrial districts or clusters stress the need for joint action to overcome the new commercial pressures that many of the clusters have faced due to trade liberalization (Mexico, India), quality or environmental standards (Pakistan, Palar Valley India), increased global competition (Brazil), or loss of traditional markets (India).[42]

In her case study of woolen knitwear in Ludhiana, Tewari attributed the recovery of the cluster (after the collapse of the Soviet market) to the cluster's strong presence in

[41] Kranton and Minehart (2000), pg. 1.

[42] Schmitz and Nadvi (1999).

the domestic market. The large and medium sized firms created brands of their own for the domestic market that were of higher quality than those exported to the Soviet Union. This attention to design and quality for the up-scale domestic market made for an easier transition to exporting to the developed nations. In addition, production for the Indian domestic market functioned as an insurance mechanism for firms attempting to enter new export markets. Therefore, according to Tewari's interpretation, the domestic market can play an important role as both a learning opportunity as well as an assured market for its goods (at least until trade liberalization progresses further).

Rabellotti (1995, 1999) examined clusters of shoe producers in Mexico. The first study (1995) compared shoe clusters in Guadalajara and Leon to clustered shoe producers in Italy. She found backward linkages (or relationships between manufacturers and their suppliers) to be stronger in Italy than in Mexico, but found that forward linkages (into marketing and commercialization) were weak in both Mexico and Italy. Her case study also determined that informal relationships took on a greater significance in the Mexican clusters than in the clusters in Italy. In Rabelloti's second study (1999) she focused on the Guadalajara cluster and how inter-firm relationships were affected by trade liberalization. This study found (using subjective survey instruments) that firm performance was positively correlated with vertical and horizontal cooperation. She found that approximately half of firms cooperated with their suppliers in matters such as information exchange, negotiation of payment and delivery conditions, joint product development, quality improvement, and delivery time.[43] On the other hand, there was evidence that vertical cooperation was still lacking in many respects, despite the

[43] Rabellotti, (1999) pg. 1575.

pressures of increased competition in international markets. For example, the survey found that manufacturers continued to have delivery problems with suppliers.

Schmitz (1995, 1999) investigated issues of cooperation in the Brazilian footwear cluster of the Sinos Valley. The first case study documented the history and growth of the cluster from the 1960s to the 1990s. During this period, the cluster grew from a protected infant industry producing for the domestic market into a powerhouse exporter with a substantial share of the world market for shoes.[44] Export agents, especially from the United States, played a large role in the development of the cluster as a major exporter. Cooperation among the firms has ebbed and flowed over the last thirty years. Prior to the 1970s, trust and cooperation founded in a common social identity (German emigrant heritage) was strong. During the 70s and 80s, this cooperation waned as the cluster experienced rapid growth, but then re-emerged in the 1990s. The second study (1999) explored the recent initiatives for cooperation in the Sinos Valley in more detail. Greater cooperation between manufacturers and intermediate input producers improved the quality of goods and decreased delivery times and batch sizes of the footwear in response to the demands of foreign buyers in the U.S. A joint action initiative intended to take action on marketing abroad and in Brazil failed because the five largest exporting firms (which were vertically integrated and had a close relationship with the largest U.S. buyer) defeated the plan by exerting their influence in the shoe manufacturer's association, Abicalcados.[45]

While these case studies provide descriptions of the clusters and their major characteristics, none of them present theoretical models of the interactions that take place

[44] Brazil's exports claimed over 12 percent of the world footwear market, and the Sinos Valley produced the majority of these exports.

[45] Schmitz (1998), pg. 34.

within clusters. Regressions were performed and correlations calculated in some cases, but the samples were generally small and were based on subjective survey instruments. For instance, the survey questions in many cases asked firm owners whether or not cooperation had increased in the cluster. While these case studies offer a wealth of descriptions and historical accounts of the clusters' progress, a theoretical analysis of cluster functioning is necessary in order to aggregate the various experiences of clusters into a single framework and understand them collectively. The purpose of the theoretical section of this study (see Chapter Two) is to provide a theoretical framework through which the process of intra-cluster cooperation can be better understood.

A related area of research is the study of Global Commodity Chains. Global Commodity Chain (GCC) or global value chain analysis[46] takes into account the fact that the design, production, and marketing of products is a chain of activities that do not necessarily occur within the same firm. While this definition refers to a general phenomenon, GCC and global value chain analysis have also been applied to the relationships between clusters and foreign buyers. In some cases, such as the ones examined here, the value chain extends across national borders. Developing country clusters are often part of "buyer-driven commodity chains," as defined by Gereffi. According to him:

> Buyer-driven commodity chains refer to those industries in which large retailers, marketers, and branded manufacturers play the pivotal roles in setting up decentralized production networks in a variety of exporting countries, typically located in the third world. This pattern of trade-led industrialization has become common in labor-intensive, consumer goods industries such as garments, footwear, toys, housewares, consumer electronics and a variety of handicrafts. Production is generally carried out by tiered networks of third world contractors that make finished goods for foreign buyers. The specifications are supplied by the large

[46] Gereffi uses the term "Global Commodity Chain" while Humphrey and Schmitz use the term "global value chain".

> retailers or marketers that order the goods…these companies design and/or market – but do not make – the branded products they order. They are part of a new breed of 'manufacturers without factories' that separate the physical production of goods from the design and marketing stages of the production process.[47]

The implication in the previous quote is that developed country firms "govern" or basically exercise control over the global commodity chain, even in the absence of ownership of the stage firms. The question then arises: Do the buyers (usually from developed countries) control the value chain to an extent that inhibits upgrading of the cluster into the services of marketing and retailing? Some of the authors who have written about industrial clusters in developing countries have expressed concern that the clustered firms producing goods for large multinational firms will become trapped in a subordinate role of low value added production while the multinationals that produce the designs and do the marketing and retailing will take the majority of the profits. These questions will receive greater attention in Chapter Two.

The literature on cluster case studies and the literature on value chain analysis has evolved differently. According to Humphrey and Schmitz (2000), the cluster case studies have focused on interactions within the cluster, such as local level governance and cooperation, while value chain analysis emphasizes links with the outside world and pays less attention to the role of local cooperation between firms. Chapter Two combines elements from both these literatures, presenting a model where links with global buyers influence the decision of the cluster firms to cooperate locally.

[47] Gereffi (1999), pg. 4.

Literature on Transaction Costs, Relational Contracting, and Passive Collective Efficiency

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 in the Tiruppur knitwear cluster. They find that the established producers belonging the Gounders caste, 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. The migrants, with less access to informal credit networks, invest less even though they have higher ability.

Papers by McMillan and Woodruff (1999) and Johnson, McMillan, and Woodruff (2002) empirically test for the existence of relational contracting in countries where third party contract enforcement is either weak or not fully developed, using trade credit as a measure of inter-firm trust. In relational contracting, informal relationships can substitute for enforcement through the court system, as was described in the first section of the chapter. Using Tobit analysis, they found in their (1999) study of Vietnam that the amount of trade credit given to a customer was positively related to customer "lock-in" (the difficulty of the customer finding a new supplier), visits from suppliers, longer duration trading relationships, and participation in business networks. Johnson, McMillan, and Woodruff's (2002) survey of Poland, Slovakia, Romania, Russia, and Ukraine also found support for relational contracting. In addition, the second study showed that confidence in the court system made firms more likely to offer trade credit and lowered switching costs. The effect of courts was strongest at the beginning of a

trading relationship, demonstrating the role of the judiciary in encouraging firms to try new, lower cost suppliers.

Woodruff has also studied clustered firms in the Mexican footwear industry. His 1998 study summarized the results of surveys conducted in Guadalajara and Leon and provided a qualitative analysis of the effect of trade liberalization on contract enforcement in the two clusters. He found that prior to trade liberalization, manufacturers relied on reputation mechanisms rather than the courts to enforce agreements with retailers. Once trade liberalization was underway, manufacturers were powerless to use sanctions to enforce contracts with retailers because the retailers had access to alternate supplies through the world market. Retailers cancelled orders, causing some of the cluster firms to go bankrupt since there was no longer a need for the retailers to maintain a good reputation in the cluster. In this way, trade liberalization weakened relational contracting.

1.6 Roadmap of Chapters Two and Three

The theme that connects the subsequent chapters is cooperation among firms that are clustered. The analysis will focus on two of the benefits from clustering: the ability of firms to cooperate in order to upgrade, and the potential for reduced transaction costs. The first, cooperation for upgrading, is an aspect of "active collective efficiency," while reduced transaction costs would be considered a benefit of "passive collective efficiency." Active collective efficiency, as described earlier, entails purposeful cooperation between firms in the cluster, while passive collective efficiency comprises the benefits that accrue to firms by virtue of being part of a cluster.

Chapter Two will develop a theoretical model of "joint action" among clustered firms. In the context of this model, joint action takes the form of clustered manufacturers sharing the fixed cost of entering into marketing activities in order to directly sell goods to customers in a developed country. Cooperation is needed because the cluster firms are too small to pay the high initial investment cost. One must also consider that the firm from the developed country, who would like to buy goods from the cluster and market them in the developed country, is likely to oppose efforts of the cluster firms to break into activities that it has traditionally carried out. The model will examine the conditions under which clustered firms from a less developed country (that are heterogeneous in expected quality of output) can cooperate, or undertake a joint action in order to eliminate a foreign company from a developed country acting as an intermediary between the clustered manufacturers and the final market for the goods.

The theoretical model in Chapter Two will prove that joint action can potentially occur among high quality firms, but never with the participation of the low quality firms. The low quality firms always sell their goods to the foreign intermediary that in turn markets their output in the developed country. 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. Joint action is more likely to take place in larger clusters, when the probability of producing high quality by the high quality firms and the final market price of the good are high, and when the marketing cost is low. All clustered firms can potentially benefit from the prospect of joint action even if it does not actually take place, and regardless of the proportions of high and low quality firms. Joint action is

inefficient due to the fixed cost that the clustered firms must pay to break into the final goods market (which does not have to be paid by the established developed country firm).

In Chapter Three, we use the empirical analysis of a survey conducted of the surgical instrument cluster in Sialkot, Pakistan to examine one aspect each of passive and active collective efficiency. In the first part, we study the transaction costs that the clustered firms encounter in their dealings with customers and suppliers, which is one aspect of passive collective efficiency. In the second part, we determine which firm and cluster characteristics contribute to firms' interest in intra-cluster cooperation for functional upgrading (a form of active collective efficiency) to market their own goods.

The first part of Chapter Three will examine aspects of relational contracting in the context of a cluster and in an institutional environment where third party enforcement is weak. We will utilize the survey instrument developed by McMillan and Woodruff (1999) in their study of Vietnam to study mechanisms of contract enforcement in Pakistan's surgical instrument cluster to see under what conditions relational contracting can occur in a cluster.[48] One of McMillan and Woodruff's results in Vietnam was that firms are more likely to trust customers (and therefore offer trade credit) the more difficult it is for that customer to find an alternate supplier, in other words when there is "lock-in." Since clustered manufacturers have numerous alternate suppliers of intermediate inputs, we hypothesize that information sharing and network effects are more likely to be significant determinants of trust and contract enforcement than customer lock-in when firms are clustered.

[48] This survey instrument was used in McMillan and Woodruff, "Interfirm Relationships and Informal Credit in Vietnam," Quarterly Journal of Economics (1999) and Johnson, McMillan and Woodruff, "Courts and Relational Contracts" Journal of Law, Economics and Organization (2002).

The empirical results in the first part of Chapter Three show that firms are more likely to offer trade credit to their customers when firms believe that the judicial system can enforce contracts. In contrast to what we initially hypothesized about clusters, customer lock-in plays a role in developing inter-firm trust, since trade credit is positively associated with trading relationships of longer duration. Firms are also more likely to offer trade credit to customers when they participate in, and obtain information through business networks. These networks can be used both for information gathering about customers and for community enforcement of informal contracts. On the other hand, if a firm is visited by a supplier before the first trade, it is less likely to receive trade credit. A visit from the supplier before the first sale may indicate that the firm's manager is unknown to the supplier and therefore not fully trusted.

The second part of Chapter Three attempts to determine whether firm level characteristics affect the decision of exporting firms to engage in a joint initiative to market their own goods. According to the theoretical model developed in Chapter Two, an important determinant of whether this "joint action" occurs is the opportunity cost of cooperative marketing, where the opportunity cost is measured as the price that the middleman is willing to pay for the cluster's goods. We use simple probit and logit regressions to determine how firm characteristics affect the decision of a firm to participate in a joint marketing initiative. The dependent variable was based on questions in the survey about the exporting firms' interest in engaging in a hypothetical joint marketing initiative.

The regressions in the second part of Chapter Three on joint action for the cluster to market their own goods show that when firms have already had some

direct experience in marketing (for example, selling products under their own brand name and selling directly to hospitals), they view joint marketing initiatives more favorably. Relationships with customers of longer duration tend to dampen firms' interest in joint action. This is because the opportunity cost of joint marketing is greater, due to the high value current trading relationships.

Chapter 2: Cooperation in Developing Country Industrial Clusters: Marketing in an Age of Globalization

2.1 Introduction

In recent years, there has been an increase in interest in clusters of small firms in developing countries. A cluster is defined as a group of firms specialized by sector, located in close geographic proximity, and comprised of mostly small and medium sized enterprises.[49] Many clusters have become major exporters by selling their goods through foreign agents to large firms from developed countries who then market the goods to consumers in developed countries. These clusters merit greater attention in view of the fact that, despite their small size, they make sizeable contributions to developing countries' economies in terms of employment, output, and exports.[50]

The benefits to firms from clustering are sometimes referred to as "collective efficiency." Passive collective efficiency refers to benefits accruing to a firm by virtue of being in a cluster.[51] Active collective efficiency, on the other hand, stems from

[49] 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.

[50] 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 45 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 percent 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)).

[51] The perceived benefits of passive collective efficiency include access to credit, market access, access to a large pool of skilled labor, technological spillovers, flexible specialization, and reduced transaction costs.

purposeful cooperation between firms to upgrade the cluster's production by streamlining production processes, producing higher value-added goods, or entering into design and marketing activities.[52]

This chapter focuses on one aspect of active collective efficiency and develops a model to examine the conditions under which clustered firms in a less developed country may cooperate to carry out a "joint action" initiative to market their output in a developed country, rather than sell it through a middleman. The joint action initiative eliminates the role of an intermediary firm in the developed country. Cooperation among the clustered firms is necessary since they are too small individually to make the investments required to carry out a successful marketing campaign. The firms in the cluster are modeled as heterogeneous in expected quality of output. There are two types of firms, high and low quality, and the high quality firms have a greater probability of producing high quality output than the low quality firms. In the model, clustered firms know the quality type of other firms, but the foreign intermediary does not. The foreign intermediary, however, has a lower marketing cost than the clustered firms. The main result of the model is that joint action can occur among high quality firms, but the low quality firms always use the foreign intermediary to distribute their output. In the equilibrium where the high quality firms carry out the joint marketing initiative, the cluster firms receive a larger share of the smaller total producer surplus.

Organization of Chapter Two

Section 2.2 of this chapter discusses some of the economic literature related to the

[52] Schmitz and Nadvi (1999), pg. 1504.

study of clusters and presents two case studies pertinent to the discussion of joint action. Section 2.3 introduces the model's fundamentals and assumptions. Section 2.4 describes how the model is solved. In Section 2.5, equilibrium refinements are introduced and several propositions are derived. The welfare implications of joint action are briefly discussed in Section 2.6, and conclusions are presented in Section 2.7.

2.2 Literature and Case Studies

Since we present a model of a large multinational firm potentially buying goods from a cluster consisting of many heterogeneous producers, the adverse selection framework provides a useful starting point.[53] In this context, we assume that the cluster maintains a local information advantage about the probability with which each firm in the cluster produces high quality output. However, our model differs somewhat from the standard model of adverse selection where there is typically a competitive market with many buyers, because our model features a monopsonist purchaser of goods.[54]

Most models of vertical control in the industrial organization literature assume that an upstream firm (a manufacturer) exerts control over downstream firms (wholesalers or retailers) through vertical restraints, such as franchise fees or resale-price maintenance.[55] The upstream firm's bargaining power is derived from its ability to set a

[53] Information asymmetry about quality was first formalized by Akerlof (1970) in his seminal work on market for "lemons." Since then, adverse selection has been applied to a variety of economic problems, particularly in the study of credit and insurance markets (Stiglitz and Weiss (1981), Rothschild and Stiglitz (1976)).

[54] Barriers to entry due to language, culture, government restrictions, information or other fixed costs may restrict the number of developed country firms operating in the developing country and purchasing from the cluster. Such barriers to entry or economies of scale make the competitive consumer market consistent with profits being made by the developed country retailer.

[55] See Rey and Tirole (1986a) and (1986b).

"take it or leave it" price. In our model, the direction of control is reversed, and the downstream firm, a large multinational retailer from a developed country, exerts control over upstream firms, who are small clustered manufacturers in a less developed country.[56]

There are also various studies that have focused on the benefits of clustering. The literature on economic geography has focused on the process of agglomeration, where low transport costs and economies of scale can lead to geographic concentration of manufacturing in equilibrium.[57] A substantial case study literature on clusters in developing countries has stressed the role of inter-firm cooperation to overcome problems that clustered exporters have collectively encountered.[58] In addition, some have suggested that clustered firms may be able to cooperate in order to "break out" of the relationship with foreign buyers and carry out their own design and marketing in order to gain a greater share of producer surplus.[59,60] The industrial clusters in the Sinos Valley (Brazil) and Sialkot (Pakistan) have both attempted joint action initiatives, with mixed results:

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[56] In addition, our model simplifies the final goods market by assuming a fixed price in the retail market, eliminating the externalities caused by double (price) marginalization that typically lead to contraction of consumer demand in vertical control models (Spengler (1950)).The assumption of a fixed price in the consumer market can be justified in the context of this model. For the goods that clusters typically produce (such as shoes and textiles), the consumer market is generally highly competitive.

[57] See Krugman (1991) and Krugman and Venables (1995).

[58] Problems that clusters have collectively experienced have been due to trade liberalization (Mexico, India), quality or environmental standards (Pakistan, Palar Valley India), increased global competition (Brazil), or loss of traditional markets (India).

[59] See Humphrey and Schmitz (2000), Kaplinsky (2000), Schmitz (1999).

[60] A related area of research, called Global Commodity Chain (GCC) analysis, documents "buyer-driven commodity chains" where multinationals in developed countries design and market goods produced in third world factories (Gereffi (1994)).

Sinos Valley, Brazil[61]*:* As of 1991, the Sinos Valley shoe cluster (Brazil) consisted of more than 1,800 firms and 153,000 employees, which included shoe manufacturers, suppliers, marketing firms, and other specialized service firms. Since the late 1980s, the cluster has been faced with increased competition from China for U.S. buyers. The "Shoes from Brazil Programme," a major joint action initiative to improve marketing abroad, failed because the largest five exporting firms (that were vertically integrated and had a close relationship with the largest U.S. buyer) opposed the plan and undermined it by exerting their influence in the shoe manufacturer's association, Abicalcados.

Sialkot, Pakistan[62]*:* A cluster of firms consisting of approximately 220 producers and 1500 subcontractors in Pakistan produce surgical instruments mainly for foreign markets in the United States and Western Europe. The cluster exported $124 million worth of goods in 2000-2001.[63] Since doctors and hospitals in the U.S. often purchase disposable surgical instrument as “kits,” or packages of surgical instruments that are sterilized and specialized for use in particular medical procedures, a new joint action initiative has been proposed including a plan for these kits to be produced locally and sold directly to hospitals, rather than through a third party. This is precisely the type of joint action that this chapter wishes to examine.

While many studies have focused on the benefits of clustering, others, such as Ilias (2001) and Banerjee and Munshi (2000), have pointed out the distortionary effects of social network-based relationships in clusters.[64] Although industrial clusters in

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[61] Schmitz (1995), (1998).

[62] Nadvi (1999).

[63] SMEDA (2001), pg. 13.

[64] Ilias (2001) focuses on the role of family labor in the Sialkot surgical instrument cluster and the

developing countries have generated interest as an instrument for promoting employment and growth in poor countries, these studies highlight the need to consider both their advantages and drawbacks.

Firm-level characteristics that determine clustered firms' interest in intra-cluster cooperation are empirically examined in Chapter Three, using the responses of firms in the Sialkot surgical instrument cluster about a hypothetical "joint action" initiative to market their own goods. The results demonstrate that firms are more likely to be interested in such initiatives when: i) they have already had some direct experience in marketing, and ii) firms have a lower opportunity cost of leaving their current customers, where opportunity cost is measured by the length of the trading relationship.

2.3 Features of the Model

The "joint action" model presented in this chapter incorporates two key assumptions. First, the cluster firms (or LDC firms) maintain a local information advantage about the probability of the individual cluster firms producing high quality. Given that many clusters consist of hundreds of producers, this is a reasonable assumption. Second, the developed country firm has an established marketing and distribution network through which it can sell the cluster's output, but it does not have

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distortionary effects of the decision to use family versus non-family labor. He concludes that there exists 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.

manufacturing capacity of its own.[65] We consider a model where the cluster firms must decide between selling their output to the developed country firm (or DC firm) or marketing their goods themselves, where the DC firm has a cost advantage in marketing. Production capacity, consumer demand, and consumer prices are fixed.[66]

Information Structure and Timing of the Model

There will be two types of firms in the cluster, type A or "high quality" firms and type B or "low quality" firms. The numbers of high quality and low quality firms in the cluster are fixed and predetermined. High quality firms have a higher probability of producing high quality goods than the low quality firms. Quality of the output is important since only high quality goods can be sold to consumers. Each LDC firm has perfect information about its type as well as the type and output quality of all other firms in the cluster. The DC firm only knows N_A and N_B, the numbers of high and low quality firms respectively that exist in the cluster. It cannot distinguish the quality type of individual firms and only observes the quality of goods after they have been purchased from the cluster.

The model takes place in three periods. In the first period, the DC firm announces a price, p, that it is willing to pay for the goods from the cluster, and will buy one unit

[65] In the case of Torreon (Mexico) a textiles cluster that has experienced a significant expansion since the introduction of NAFTA, cluster firms have taken over all parts of the production process *except* design and product development, marketing, and retailing (Bair and Gereffi (2001)). Almost 100 percent of Sialkot's (Pakistan) surgical instruments exported to Europe and North America as subcontracting work for large firms or sold through agents in the U.S. Towards the late 1980s, about half of Sinos Valley's (Brazil) shoe production was exported, mostly through American export agents.

[66] In equilibrium, the least expected profit that a cluster firm can receive is zero, the same that it would earn if it did not produce. Since the firms are risk neutral, it is harmless to assume that each cluster firm always produces one unit (full capacity).

from each LDC firm that is willing to sell to it at that price.[67] Each cluster firm's production capacity is one unit of the good. Since the DC firm cannot observe the quality of the goods until after they have purchased them from the cluster, it must offer the same price for the goods of all LDC firms, regardless of the LDC firm's type. In the second period, each LDC firm simultaneously decides to participate in a joint action initiative by paying a share of the total joint action cost, M, or to sell to the DC firm at the price announced in the first period. The cost of joint action, M, is known by all participants. Firms participating in the joint action initiative sell their goods directly to consumers in the developed country market.[68] In the final period, production takes place in the cluster and each LDC firm sells its output according to its decision in the second period, either to the DC firm (who then sell the goods to consumers in its home market) or directly to consumers in the developed country through the joint action initiative.[69] In the developed country, high quality goods are sold to consumers (either by the DC firm or the LDC firms who market their own goods) at a price R per unit and low quality goods cannot be sold.[70] Information about the unit cost of production, c, and the price paid by consumers

[67] The DC firm exercises a degree of vertical control over the cluster firms since it offers them a "take it or leave it" price at which it is willing to purchase the cluster's output. There is evidence that this structure reflects the relations between clustered firms and their customers. A case study of the Sinos Valley described how there used to be an auction system of taking orders by the foreign buyers (Schmitz (1999)).

[68] It is possible that some cluster firms engage in joint action while at the same time others sell their goods to the DC firm. Only those firms participating in the joint action pay a portion of the joint action cost.

[69] Since no strategic action takes place in the third period, we can incorporate the payoff functions into the second period so that we effectively have a two-period game.

[70] The reader may note that with this ordering of the stages, the DC firm commits to a price before production takes place in the cluster. If production took place first, then only the firms that produced low quality output would want to sell to the DC firm, leading to market failure similar to the result obtained in Akerlof's (1970) lemons model. In addition, the DC firm announces its price before the cluster firms make a decision about joint action so that the DC firm does not have an opportunity to respond to the cluster's decision for or against joint action. If the DC firm were given the opportunity to respond with a counter-offer price (if, for instance the cluster decided to carry out joint action), the results would be very similar to those obtained in the present model.

of high quality goods, *R*, is publicly known. Each cluster firm that sells to the DC firm receives *p*, regardless of the quality of its output. On the other hand, a cluster firm that markets its output through the joint action receives *R* only if its output is high quality.

The Less Developed Country (LDC)/Cluster Firms

The cluster consists of *N* firms. Each firm in the cluster (also referred to as an LDC firm) produces the same good, and has a production capacity of one unit of the good. Firms are risk neutral and maximize expected profit. There are two types of firms, *A* and *B*, and they have uncertain quality of output. Each type of firm can produce two levels of quality, *V*. Type A or "high quality" firms produce low quality, V^{LOW}, with probability θ_A, and type B or "low quality" firms produce low quality with probability θ_B where $\theta_A < \theta_B$.[71] The number of high quality and low quality firms are fixed before any action takes place in the model. Let $j = 1, \ldots, N_A$ denote the high quality firms and $k = 1, \ldots, N_B$ denote the low quality firms where $N_A + N_B = N$. Then $\alpha = N_A/N$ is the proportion of high quality firms, and $1 - \alpha = N_B/N$ is the proportion of low quality firms in the cluster. Each cluster firm knows its type and the types of all other firms in the cluster. All LDC firms face the same unit cost of production, *c*.

In the second stage, the cluster firms simultaneously choose either to sell their goods either to a monopsonist buyer from a developed country (the DC firm) at a price, *p*, or pay a fixed cost, *M*, to engage in "joint action" and market the goods themselves as a cooperative, eliminating the DC firm as the middle-man.[72] The action space is therefore

[71] Type A firms will also be referred to as "high quality firms" and type B as "low quality firms." We can set $V^{LOW}=0$ without loss of generality.

$s_i \in \{0, 1\}$ for each cluster firm $i=1, \ldots, N$, where 0 denotes that the LDC firm sells to the DC firm and 1 signifies that the firm participates in the joint action initiative. Let the type A firms' choice of action in the second stage, given p announced by the DC firm, be defined as $s_j(p)$ for $j = 1, \ldots, N_A$ and type B firms' strategies as $s_k(p)$ for $k = 1, \ldots, N_B$. The collective decisions of the cluster generate $\lambda(p)$, the proportion of all cluster firms that participate in joint action in response to p. Then, $\lambda(p) = \frac{1}{N}\left[\sum_{j=1}^{N_A} s_j(p) + \sum_{k=1}^{N_B} s_k(p)\right]$.

$\lambda(p)$ can also be expressed as $\alpha\,\lambda_A(p) + (1-\alpha)\,\lambda_B(p)$ where $\lambda_A(p)$ and $\lambda_B(p)$ are the proportions of type A and type B cluster firms participating in joint action respectively.

The cost of joint action is modeled as a fixed cost because it represents the large up-front investments required to set up a distribution network and marketing campaign. Equal division of this cost among the participating cluster firms is appealing from a "fairness" perspective since each firm markets one unit of the good.[73] Each cluster firm is too small to pay the cost of developing a marketing and distribution network itself so that $R(1-\theta_A) - M - c \leq 0$; in other words, it is never profitable for a single cluster firm to market its output alone. We assume that the unit cost of production, c, is always positive, and represents the costs of raw materials and labor.[74]

Since cluster firms are risk neutral, they maximize their utility by maximizing

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[72] While it is theoretically possible for there to be multiple joint action initiatives taking place simultaneously, we will only allow a single joint action to occur. This assumption simplifies analysis of the model and is the most efficient given the strong economies of scale derived from the high fixed cost, M, of joint action.

[73] Equal division of M also simplifies the solution of the model. However, even if there were an unequal division of the cost between the high and low quality firms, it would not change the main results of the model such that the DC firm would still always purchase the output of low quality firms in equilibrium.

[74] We assume that it is always efficient for all firms to produce so that $R(1-\theta_B) - c > 0$.

expected profit. Profit maximization takes place by weighing the benefits of joint action against the opportunity cost of selling to the DC firm. Each LDC firm would earn $\Pi_i^{LDC} = p - c$, where *i=A,B* by selling to the DC firm, and by engaging in joint action, each firm in expectation would earn $\mathrm{E}\,\Pi_i^{LDC} = R(1-\theta_i) - c - \frac{M}{N\lambda(p)}$ for *i=A,B*. Since cluster firms receive the actual price at which their output is sold, then with probability θ_i each cluster firm receives $R - c - \frac{M}{N\lambda(p)}$ and with probability *(1-* θ_i *)* receives $-c - \frac{M}{N\lambda(p)}$ since low quality goods cannot be sold.[75] If a firm receives the same expected payoff from joint action as selling to the DC firm, we assume that it sells to the DC firm, even though cluster firms are risk neutral.

In order to focus on the most interesting cases, we will limit most of the analysis to cases where joint action is potentially profitable for all cluster firms, so that $R(1-\theta_B) - \frac{M}{N} \geq c$ (Assumption A). Later we consider cases where Assumption A fails but joint action is still potentially profitable for type A firms.[76]

The Developed Country (DC) Firm

The developed country firm (DC firm) has no manufacturing capacity of its own, and is strictly specialized in the marketing and retailing of goods. If an LDC firm sells its

[75] Recall that there is perfect information among the cluster firms about the output quality of each firm.

[76] Note that Assumption A (that joint action is potentially profitable for all firms) is not a subset of cases where joint action is potentially profitable for type A firms. It can be the case that $R(1-\theta_B) - \frac{M}{N} \geq c$ even though it is not possible for type A firms alone to carry out a joint action initiative, for example when α is small so that $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha}$.

one unit of output to the DC firm at the announced price, *p*, the DC firm sells it (if it is high quality) in its home country final goods market at a price *R*, effectively acting as a middleman between the cluster and the consumers. The announced price $p \in [0, \infty)$ is assumed to be a continuous variable.

The quality of output produced by the cluster matters for the DC firm if it is buying goods from the cluster since only high quality goods can be sold to consumers. The DC firm maximizes its expected profit subject to the constraint that the LDC firms are willing to sell their products at the announced price. We assume that the DC firm, as an established player, does not have to pay a marketing cost, *M*. This captures the idea that it has already built a distribution/marketing network.[77] The expected proportion of high quality goods that the DC firm purchases from the cluster depends on which LDC cluster firms sell to the DC firm at the announced price.[78] The DC firm's problem is:

$$\max_{p} E\Pi^{DC} = N\left[R\left[\alpha(1-\lambda_A(p))(1-\theta_A) + (1-\alpha)(1-\lambda_B(p))(1-\theta_B)\right] - p(1-\lambda(p))\right]$$

After the DC firm announces *p*, all cluster firms simultaneously decide to sell to the DC firm or carry out the joint action initiative. The DC firm's choice of *p* can be expressed as a function of $\lambda(p)$ since the DC firm does not know the quality type of individual firms and therefore only takes into consideration the expected number of high quality goods that it buys from the cluster. For a given *p*, the DC firm receives higher

[77] The same results of the model would be obtained if instead we supposed that the DC firm has to pay a marketing cost, *M'*, as long as $M' < M$. This is because the results of the model depend on the fact the DC firm has a cost advantage in marketing and distribution. It is reasonable to assume that the DC firm's marketing cost would be lower than what the cluster firms pay because it likely has some advantages in its home market, such as better information on local market conditions, preferential tax treatment, government subsidies, or economies of scale in marketing if it markets goods procured from producers other than the cluster.

[78] Note that while the DC firm cannot observe the type of individual cluster firms, in equilibrium it will be able to determine which type of cluster firm will sell to it.

expected profits from type A firms due to their higher expected output quality. At the same time, the type of cluster firm that sells to the DC firm may also depend on the announced price.

First Best Outcome

We define efficiency in terms of the joint profits of the DC firm and the cluster firms. The efficient or first best outcome is maximizes the total surplus, as elaborated in Proposition 1.

Proposition 1: It is always efficient for the DC firm to market the high quality goods of both high (type A) and low (type B) quality firms.

Given the assumptions on the cost structure, it is efficient for all cluster firms to produce. Production capacity, consumer demand, and consumer prices are fixed. If the LDC firms (or a sub-set) market their own goods, they must pay an entry cost, *M*, to build a distribution network. The DC firm already has a network through which it can sell the cluster's goods, and does not need to pay the entry cost, making upstream foreclosure more efficient (see also Appendix A for a proof).[79] Global welfare is higher when the DC firm markets all of the cluster's output. However, as will be discussed later, joint action also affects the division of surplus between the DC firm and the cluster. We will also see how a reduction in efficiency is not necessary in order for the cluster firms to share in the total surplus, since the threat of joint action may be sufficient for the cluster firms to receive the same expected profits as when joint action actually occurs.

[79] Upstream foreclosure is the restriction of buyers' (in this case, the consumers in the developed country) access to other suppliers (the clustered manufacturers). Tirole (1988) noted that fixed costs of production might lead to downstream foreclosure due to efficiency considerations (pg. 193).

2.4 Solving the Model

We now solve this two-stage model where in period one, the DC firm announces the price at which it will buy goods from the cluster and in period two, the cluster firms decide to sell to the DC firm or engage in joint action. In the second stage, the cluster firms simultaneously decide whether to engage in joint action or sell to the DC firm at the price *p* that is announced by the DC firm in the first stage. Each possible *p* that the DC firm may announce in the first stage leads to a unique second stage subgame. The model is a dynamic game of imperfect information. However, since there is no signaling stage and no opportunity for the DC firms to update its beliefs about the types of cluster firms, we can proceed to solve the game by backwards induction.

Solving the Second Stage

We restrict the model to the consideration of pure strategies.[80]

Lemma 1: For any announced price, p such that $p \geq c$, there exists at least one pure strategy second stage equilibrium where all cluster firms sell to the DC firm.

To see why Lemma 1 holds, recall that the model assumes that no single cluster firm can make positive profits from marketing goods alone. Therefore, if all cluster firms sell to the DC firm, there is no incentive for a single firm in the

[80] We should note that the second stage of the game is supermodular even though we will not exploit this characteristic of the game. Supermodular games were first described by Topkis (1979) and economic applications were developed by Vives (1990) and Milgrom and Roberts (1990). In this class of games, players' strategies are strategic complements. In our model, the payoff to selecting "do joint action" is increasing in the number of LDC firms choosing to participate in the joint action initiative (in other words, the actions exhibit strategic complementarities) because the fixed cost of marketing their own goods is divided equally among all firms participating in the joint action initiative.

cluster to deviate from that strategy since it would receive negative profits from doing so (see Appendix A, proof of Lemma 1).

Lemma 2: For any announced price, p such that $p \geq c$, the second stage game has at most three equilibria. These are: i) all cluster firms sell to the DC firm; ii) all cluster firms participate in the joint action initiative; and iii) type A firms carry out the joint action initiative and type B firms sell to the DC firm.

To see why Lemma 2 holds, we begin by noting: i) in any continuation equilibrium, all firms of certain quality type will have the same strategy, and ii) joint action cannot take place without the participation of type A firms (see Appendix A, Lemmas 2a and 2b for proofs).[81] Given these restrictions, the three possible equilibria of the second stage of the game are those presented in Lemma 2. The existence of the continuation equilibria depend on the parameter values *R, M, N, c,* θ_A, and θ_B in addition to the price, *p*, announced by the DC firm in the first stage.[82] The first continuation equilibrium, "all sell to the DC firm", was discussed in Lemma 1.

The outcome in which all firms carry out joint action is always an equilibrium of the second stage game provided that the announced price, *p*, is below a certain threshold. Formally, "all do joint action" is a continuation equilibrium for all parameter values and for all *p* such that $p < R(1-\theta_B) - \frac{M}{N}$. Any firm that deviates from the "do joint action"

[81] That all type A firms follow the same strategy and all type B firms follow the same strategy follows from the assumptions that only pure strategies are played, that benefits to joint action are increasing in the number of participating firms, and that all cluster firms of a certain type have the same profit function. Joint action cannot take place without the participation of type A firms because for any strategy where it is profitable for type B firms to carry out joint action, then it is also profitable for all type A firms to participate in the joint action since $R(1-\theta_A) > R(1-\theta_B)$ and the cost of joint action is shared equally.

[82] All three continuation equilibria do not exist for all parameter values. The possible second stage equilibria for various parameter values are given in Appendix C.

strategy would earn lower expected profits (see Appendix A, Lemma 2c).

A third continuation equilibrium exists for some parameter values and for p in the range $R(1-\theta_A)-\frac{M}{N\alpha} > p \geq R(1-\theta_B)-\frac{M}{N\alpha+1}$.[83] In this case, a separating equilibrium is obtained where type A firms engage in joint action and type B firms sell to the DC firm.[84] The first part of the condition says that it is profitable for type A firms to carry out a joint action initiative (with all type A firms participating). The second part of the condition ensures that "sell to the DC firm" is a best response for type B firms; in other words if all type B firms sell to the DC firm, there is no incentive for an individual type B firm to join type A firms in carrying out joint action.[85]

Since there are multiple equilibria in the second stage of the game for many values of the announced price p that may be offered in the first stage, we will have to specify a selection of a continuation equilibrium for each p. How this second stage equilibrium is chosen will be dealt with in more detail in Section 2.5 of the chapter through the introduction of a cooperative equilibrium refinement. For now, however, we derive results for the first stage that are obtained for any selection.

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[83] Note that the second part of the condition requires that θ_A and θ_B are not too similar in magnitude.

[84] For some parameter values, i.e. for $R(1-\theta_B)-\frac{M}{N\alpha+1} > R(1-\theta_A)-\frac{M}{N\alpha}$, the third continuation equilibrium does not exist.

[85] When $R(1-\theta_A)-\frac{M}{N\alpha} > p \geq R(1-\theta_B)-\frac{M}{N\alpha+1}$, it may even be more profitable (in expectation) for type B firms to participate in the joint action initiative along with the type A firms if all type B firms were to participate. Even so, it is still a continuation equilibrium for type B firms to sell to the DC firm.

Solving the First Stage

Now, we move to the first stage to find a solution to the whole game. The DC firm always has a single best response (in the first period solved by backwards induction) which is determined by the cluster firms' strategies and the parameter values of the particular game. Given that all firms of the same type have the same strategy, $\lambda(p)$ (the proportion of all cluster firms that participate in joint action) summarizes the payoff relevant information for the DC firm.

In equilibrium, the DC firm knows which continuation equilibrium will be realized at each price it might announce in the first stage.[86] The DC firm maximizes its profits by offering the lowest price necessary to buy goods from the LDC firms, given the strategy profiles of the cluster firms. In this way, the DC firm's choice of *p* in the first stage depends on the anticipated second stage equilibrium corresponding to each *p*.

The multiplicity of second stage equilibria, combined with the assumption that the announced price is a continuous variable, implies that there is a continuum of equilibria in this game. Despite this multiplicity, and without placing any restrictions on the selection of equilibria, we can derive Proposition 2 regarding the ability of type B firms to engage in joint action.

Proposition 2: The DC firm always prevents the participation of type B firms in joint action. That is, there does not exist a subgame perfect Nash equilibrium where type B firms participate in a joint action initiative.

[86] A semi-pooling equilibrium cannot exist where only some of the firms of a certain type sell to the DC firm. Suppose that some type A firms sell to the DC firm while the rest carry out the joint action. Then the DC firm could raise the announced price by a small amount "ε" and buy from all type A firms. The same argument applies to type B firms.

Intuitively, the DC firm will always prevent the participation of type B firms in joint action due to the cost advantage that the DC firm maintains since it does not have to pay a fixed cost to build a marketing/distribution network.[87] The DC firm offers a high enough price to purchase the output of type B firms because the DC firm can always make positive profits from re-selling type B firms' goods in the developed country's consumer market.[88] The price that the DC firm needs to pay to procure the goods of type B firms is less than (or at most equal to) the price needed to buy the goods of type A firms, due to type B firms' lower probability of producing high quality goods.[89]

2.5 Application of Equilibrium Refinements

Given that there are multiple equilibria, we examine possible refinements that may be used to select an equilibrium of the second stage game, which will allow us to solve for a unique equilibrium of the two-stage game. The idea of applying a cooperative refinement is appealing because the objective of this model is to determine the conditions under which intra-cluster cooperation can be successful. This leads us to consider Aumann's strong equilibrium (1959) and Bernheim, Peleg and Whinston's (1987)

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[87] The result is robust even if type B firms had to only pay a nominal marketing fee, for example any $\varepsilon > 0$, because the DC firm would still have a cost advantage since it does not have to pay any marketing cost.

[88] The DC firm receives expected revenues of $R(1-\theta_B)$ from each type B firm that it buys from, and the most that the DC firm would have to pay to buy goods only from type B firms is $p = R(1-\theta_B) - \frac{M}{N}$. The DC firm's strategy to offer a higher purchase price to the cluster firms in order to deter entry into the retail sector is similar in spirit to the limit pricing model where a firm charges a sufficiently low price to consumers deter entry of other firms.

[89] The expected profit from joint action is always lower for type B firms than for type A firms because of their lower probability of producing high quality goods, since cluster firms participating in joint action receive *R* only if they produce high quality.

coalition-proof equilibrium.[90]

Aumann's strong equilibrium (1959) and Bernheim, Peleg and Whinston's (1987) coalition-proof equilibrium propose that an equilibrium be chosen such that no subset of players can jointly deviate in a way that increases the payoffs of all members. Since this includes the grand coalition of all players, the selected equilibrium is the unique, payoff dominant equilibrium. While they are slightly different concepts, both lead to the same result in the joint action model.[91] We proceed with the coalition-proof equilibrium, since it is a slightly weaker concept than Aumann's strong equilibrium.

Equilibrium Selection in the Second Stage

Our first result is that the coalition proof equilibrium results in a unique continuation equilibrium.

Lemma 3: ***For each price, p, the coalition-proof equilibrium refinement results in a unique second stage equilibrium. The selected equilibrium is payoff dominant for the cluster firms.***

The coalition-proof equilibrium refinement ensures that the payoff dominant

[90] Other possible equilibrium refinements include focal points (Schelling (1960)), the maximin strategy (Von Neumann and Morgenstern (1953)), correlated equilibria (Aumann (1974) and Myerson (1986)), and the global games approach (Carlsson and van Damme (1993) and Morris and Shin (2002)). Of these, the global games approach may be of interest for this game because it has been applied to games characterized by multiple equilibria caused by self-fulfilling beliefs, such as speculative currency attacks and bank runs. An extension of the joint action model may incorporate the global games approach since the actions "do joint action" are strategic complements for the cluster firms, possibly causing them to have self-fulfilling beliefs about whether or not joint action will occur.

[91] Aumann's strong equilibrium is a slightly stronger refinement. In Bernheim, Peleg and Whinston's coalition-proof equilibrium, once a sub-set of players has deviated, they are allowed to deviate again. (This second potential deviation is not permitted in Aumann's strong equilibrium.) The "strong equilibrium" and the "coalition-proof equilibrium" give equivalent results in this model because if it is more profitable for the cluster firms to carry out joint action than to sell to the DC firm, then there is no incentive to deviate and sell to the DC firm.

equilibrium is chosen in the second stage.[92] The selection of the continuation equilibrium depends on the announced price, since the coalition-proof equilibrium refinement uses a comparison of the announced price to the expected joint action return and selects the action leading to the highest expected payoff. In this way, we know which continuation equilibrium will be selected (and which cluster firms will sell to the DC firm) for a given announced price.

The proportion of firms selling to the DC firm increases monotonically with the announced price, since type A firms have a higher expected return to joint action than type B firms. If the DC firm announces a low price (i.e. a price that is less than the payoff any cluster firm would receive from joint action with all firms participating), then the cluster firms cooperatively market their output. If the DC firm announce a price greater than what type B firms would earn from joint action (with all firms participating) but less than type A firms' payoff from joint action (with type A firms only), the third continuation equilibrium is selected.[93] If the DC firm announces a price that is higher than the payoff from joint action, then the DC firm markets all of the cluster's output.[94,95]

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[92] Recall that the three possible continuation equilibria are: i) all cluster firms sell to the DC firm; ii) all cluster firms participate in a joint action initiative; and iii) type A firms carry out the joint action initiative and type B firms sell to the DC firm.

[93] Recall from the earlier discussion of the second stage that the third continuation equilibrium does not exist for all parameter values. We will discuss the implications of non-existence of the third equilibrium shortly.

[94] The payoff from joint action that the DC firm would exceed in order to purchase all of the cluster's output depends on the parameter values. If $R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N}$ so that there is no possibility of a separating equilibrium where type B firms sell to the DC firm and type A carry out joint action, then the highest price the DC firm must pay to procure all of the cluster's output is $p = R(1-\theta_B)-\frac{M}{N}$. If, on the other hand $R(1-\theta_B)-\frac{M}{N} < R(1-\theta_A)-\frac{M}{N\alpha}$, the DC firm must pay $p = R(1-\theta_A)-\frac{M}{N\alpha}$ to buy from all cluster firms.

Solving the First Stage

Given the selection of the second stage equilibrium defined by the coalition-proof equilibrium, the DC firm must offer the LDC firms a price equal to what they would earn from joint action if it wishes to procure the cluster's output.

The DC firm's expected profits are decreasing in the price that it offers to the cluster and increasing in the type of LDC firm that is willing to sell to it at a given price. In the first stage, the DC firm chooses a price to maximize profits given this tradeoff, by tailoring the announced price accordingly in the first stage.

The following two propositions give a full characterization of the game for different values of the game parameters R, M, N, θ_A, and θ_B (see also Appendix B). We assume for Propositions 3 and 4 that Assumption A holds. In order to make the analysis more tractable, we will divide the game parameters into two regions. In Region I, $R(1-\theta_A) - \frac{M}{N\alpha} \leq R(1-\theta_B) - \frac{M}{N}$, so that there cannot be a separating equilibrium where the DC firm buys from type B firms only. This can happen, for example, when the proportion of high quality firms in the cluster, α, is very small so that joint action with the participation of only type A firms is not profitable. All other parameter values fall into Region II, so that $R(1-\theta_B) - \frac{M}{N} < R(1-\theta_A) - \frac{M}{N\alpha}$.

Proposition 3: For all game parameters in Region I, there exists a unique subgame

[95] Another way to state these results is as follows. Whenever the continuation equilibrium, "all do joint action" exists, it is payoff dominant (and therefore chosen). "All sell to DC firm" is only selected if it is the only continuation equilibrium. If the parameter values and announced price are such that only the first and third continuation equilibria exist, the third is chosen so that type A firms carry out joint action and type B firms sell to the DC firm.

perfect Nash equilibrium where the DC firm offers p= $R(1-\theta_B)-\frac{M}{N}$ ***and markets all of the cluster's output.***

Since there is no *p* that leads to the third continuation equilibrium, the DC firm can effectively choose to buy from all or none of the cluster firms. Its profit maximizing strategy is to announce the minimum price necessary to purchase the cluster's output.[96]

In Region II, on the other hand, the DC firm can effectively choose to buy from all cluster firms, from type B only, or from none of the cluster firms, depending on the announced price.[97] In order to procure the higher average quality goods from type A firms, the DC firm must pay the highest price ($p= R(1-\theta_A)-\frac{M}{N\alpha}$) to all cluster firms to compensate for the higher opportunity cost of the type A firms. The DC firm's choice of *p* in Region II requires further specification of the parameter values, as formalized in Proposition 4.

Proposition 4: For game parameters in Region II and $\frac{M}{NR(\theta_B-\theta_A)}<\frac{1}{3}$, ***the coalition-proof equilibrium refinement results in a unique subgame perfect Nash equilibrium where for*** $\alpha\in(\alpha_1,\alpha_2)$ ***the high quality firms market their own goods and***

[96] If the DC firm offers $p< R(1-\theta_B)-\frac{M}{N}$, all firms carry out joint action, and if $p\geq R(1-\theta_B)-\frac{M}{N}$, all cluster firms sell to the DC firm.

[97] If the DC firm offers $p< R(1-\theta_B)-\frac{M}{N}$, all firms carry out joint action. If $R(1-\theta_B)-\frac{M}{N}\leq p< R(1-\theta_A)-\frac{M}{N\alpha}$, type B firms sell to the DC firm and type A firms carry out joint action. If $p\geq R(1-\theta_A)-\frac{M}{N\alpha}$, all cluster firms sell to the DC firm.

the DC firm procures the goods of the low quality firms at price $p = R(1-\theta_B) - \frac{M}{N}$**.**[98]

For all other game parameters in Region II, that is, for i) $\frac{M}{NR(\theta_B - \theta_A)} \geq \frac{1}{3}$ ***or ii)*** $\frac{M}{NR(\theta_B - \theta_A)} < \frac{1}{3}$ ***and*** $\alpha \notin (\alpha_1, \alpha_2)$**, the DC firm buys all of the cluster's output at** $p = R(1-\theta_A) - \frac{M}{N\alpha}$**.**

The DC firm faces a price-quality trade-off because it can either announce a low price and buy only from type B firms or it can offer a high price and procure all of the cluster's goods. The intuition underlying Proposition 4 is that for some parameter values, the losses accruing to the DC firm as a result of paying the high price (required to procure type A's output) to type B firms is not made up by the higher expected quality from type A firms. Therefore, the DC firm does not always market the goods of type A firms, even when it can earn positive profits from doing so.[99]

In the next sub-section, we see how small changes in the parameter values

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[98] $\alpha_{1,2} = \frac{1}{2} \pm \frac{\sqrt{\left[R(\theta_B-\theta_A)+\frac{M}{N}\right]^2 - 4\left(\frac{M}{N}\right)\left[R(\theta_B-\theta_A)+\frac{M}{N}\right]}}{2\left[R(\theta_B-\theta_A)+\frac{M}{N}\right]}$. Note that since $\alpha_1 < \frac{1}{2}$, the high quality firms do not need to be in the majority for them to carry out a joint action initiative.

[99] Within Region II, a sub-region exists where the DC firm would receive negative profits if it paid type A firms what they would earn from joint action. Call this Region III. It exists for game parameters such that $R(1-\alpha)(\theta_B-\theta_A) - \frac{M}{N\alpha} > 0$. In Region III, the DC firm only markets the goods of type B firms. We can re-write the condition for Region III to exist as: $\frac{M}{NR(\theta_B-\theta_A)} < \frac{1}{4}$ and $\alpha \in (\alpha_3, \alpha_4)$, where $\alpha_{3,4} = \frac{1}{2} \pm \sqrt{\frac{[R(\theta_B-\theta_A)]^2 - 4\left(\frac{M}{N}\right)[R(\theta_B-\theta_A)]}{2[R(\theta_B-\theta_A)]}}$. Since the interval $\alpha \in (\alpha_1, \alpha_2)$ from Proposition 4 defining when the DC firm chooses to buy only the goods of type B firms is larger than the interval $\alpha \in (\alpha_3, \alpha_4)$, we can infer that the DC firm does not market type A's goods for all parameters where it can earn positive profits.

alter the equilibrium strategies in the game, using the solution given in Proposition 4. This will tell us under what conditions joint action can occur.

Comparative Statics for Proposition 4

We now analyze how the values of α (described in Proposition 4) depend on the exogenous parameter values *R*, *N*, or $(1-\theta_A)$, *M*, and $(1-\theta_B)$.[100] Increasing *R*, *N*, or $(1-\theta_A)$ or decreasing *M* or $(1-\theta_B)$ relaxes the equilibrium constraint so that joint action takes place with the participation of type A firms for more values of α.[101] Since the realization of joint action reduces total surplus, then changes in the parameters leading to joint action can be associated with a reduction in efficiency.

Increasing the probability of producing high quality by type A firms $(1-\theta_A)$ or increasing the retail margin, *R*, increases both the benefits and costs to the DC firm of buying from all cluster firms. However, the net effect is that changes in either make type A firms less desirable to the DC firm as suppliers. Even though buying from type A firms raises the average quality of the goods that the DC firm purchases, the DC firm pays a higher price not just to the type A firms, but to all cluster firms due its inability to distinguish type A and B firms ex ante. In other words, the information effect (negative)

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[100] Technically, α (the proportion of high quality firms) cannot take every value between 0 and 1, since the size of the cluster, *N*, is finite. However, if the cluster is large, then we can effectively treat α as a continuous variable.

[101] In other words, for parameter values such that the DC firm is indifferent between buying from all cluster firms (announcing $p = R(1-\theta_A) - \frac{M}{N\alpha}$) and buying only type B's output (announcing $p = R(1-\theta_B) - \frac{M}{N}$), the DC firm offers the lower price and buys from type B firms only if there is an increase in *R*, *N*, or $(1-\theta_A)$, or a decrease in *M* or $(1-\theta_B)$. The DC firm is indifferent when $\frac{M}{NR(\theta_B-\theta_A)} < \frac{1}{3}$ and $\alpha = \alpha_1$ or $\alpha = \alpha_2$. We assume that the DC firm offers the higher price and buys from all firms at indifference points.

dominates the productivity effect (positive) through the impact on equilibrium prices.

Changes in *M* and *N* affect the per firm cost of joint action. Since each type A firm has to pay at least $\frac{M}{N\alpha}$ to carry out a joint action initiative, then changes in *M* or *N* that reduce the required contribution per firm for joint action (such as increasing the number of firms, *N*, and/or reducing the total cost of joint action, *M*), increases the potential benefits of joint action to type A firms and therefore raises the price that the DC firm would have to pay all firms if it decided to buy from both firm types.

Ceteris paribus, a decrease in $(1-\theta_B)$, the probability that type B firms produce high quality, reduces the price that the DC firm has to pay to type B firms if it buys only from them. At the same time it makes the high price demanded by the type A firms less palatable since the DC firm must also pay the higher price to type B firms in return for lower expected quality.

Relaxing Assumption A

Next, we briefly explore the possibility of joint action occurring when Assumption A fails, so that it is potentially profitable for type A firms to carry out joint action alone, but is not profitable for type B firms to participate in a joint action initiative even with the participation of all firms. That is, we consider parameters such that $R(1-\theta_B)-\frac{M}{N}<c$, but $R(1-\theta_A)-\frac{M}{N\alpha}\geq c$. Similar to the discussion for Proposition 4, the DC firm has to pay a higher price to all cluster firms to compensate for the higher opportunity cost of type A firms in order to buy from all cluster firms rather than type B firms only. Proposition 5 specifies the parameter values for which the DC firm chooses

to buy from all cluster firms or from the low quality firms only.

Proposition 5: When joint action is potentially profitable only for the high quality firms, then for values of game parameters s.t. $\frac{M}{N[R(1-\theta_A)-c]} < \frac{1}{4}$ ***the coalition-proof equilibrium refinement results in a unique subgame perfect Nash equilibrium where for*** $\alpha \in (\alpha_5, \alpha_6)$ ***the high quality firms market their own goods and the DC firm procures the goods of the low quality firms at price p=c.***[102] ***For all other game parameters, that is, for i)*** $\frac{M}{N[R(1-\theta_A)-c]} \geq \frac{1}{4}$***; or ii)*** $\frac{M}{N[R(1-\theta_A)-c]} < \frac{1}{4}$ ***and*** $\alpha \notin (\alpha_5, \alpha_6)$***, the DC firm buys all of the cluster's output at price p=*** $R(1-\theta_A) - \frac{M}{N\alpha}$**.**

The intuition is very similar to that described under Proposition 4, since the DC firm again faces a price-quality trade-off because it can either announce a low price and buy only from type B firms or it can offer a high price and procure all of the cluster's goods. The major difference from the results in Proposition 4 is that since type B firms would not participate in a joint action initiative under any conditions when Assumption A fails, the DC firm only has to pay the unit cost of production, *c*, in order to secure the output of type B firms.

Comparative Statics for Proposition 5

We now analyze how the values of α (described in Proposition 5) depend on the exogenous parameter values *R*, *N*, or $(1-\theta_A)$, *M*, and $(1-\theta_B)$. Increasing *R*, *N*, or

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[102] $\alpha_{5,6} = \frac{1}{2} \pm \frac{\sqrt{[R(1-\theta_A)-c]^2 - 4\left(\frac{M}{N}\right)[R(1-\theta_A)-c]}}{2[R(1-\theta_A)-c]}$. Note that since $\alpha_5 < \frac{1}{2}$, the high quality firms do not need to be in the majority for them to carry out a joint action initiative.

$(1-\theta_A)$ or decreasing M or $(1-\theta_B)$ relaxes the equilibrium constraint so that joint action takes place with the participation of type A firms for more values of α.[103] These conditions are similar to those discussed in the comparative statics section of Proposition 4 (where Assumption A held), except that $(1-\theta_B)$ is replaced here with the unit cost, *c*. The intuition for changes in *R*, *N*, $(1-\theta_A)$, and *M* is identical to the discussion accompanying Proposition 4. A small reduction in the unit production cost, *c*, to the extent that it does not make joint action potentially profitable for type B firms, would cause the DC firm to allow type A joint action by reducing the price that the DC firm pays type B firms if it only buys from them.[104] Since the realization of joint action reduces total surplus, then changes in the parameters leading to joint action can be associated with a reduction in efficiency.

2.6 Welfare Analysis

In this section, we discuss the welfare implications of joint action. Efficiency requires that the DC firm markets the goods of all cluster firms, as demonstrated in Proposition 1. In this section, we return to Assumption A so that joint action is

[103] For parameter values such that the DC firm is indifferent between buying from all cluster firms and only buying from type B firms, the DC firm will offer the lower price and only buy from type B firms if there is an increase in *R*, *N*, or $(1-\theta_A)$, or a decrease in *M* or *c*. The DC firm is indifferent between buying from all cluster firms and only buying from type B firms when $\frac{M}{N[R(1-\theta_A)-c]} < \frac{1}{4}$ and $\alpha = \alpha_5$ or $\alpha = \alpha_6$. We assume that the DC firm offers the higher price and buys from all firms at indifference points.

[104] Under Assumption A, the price that the DC firm pays type B firms (if it only buys from them) depends on their joint action payoff (which depends on $(1-\theta_B)$). However, when Assumption A fails so that joint action would yield negative profits for type B firms, the DC firm only pays them *c* for their output if it only buys from type B.

potentially profitable for all cluster firms.

Here, we determine changes in welfare by comparing what the cluster firms earn when the coalition-proof equilibrium is applied to the joint action model versus what the cluster firms earn when participation in joint action is not an option, i.e. examining the altered game where choosing joint action is not part of the cluster firms' action space. In order to do this, we establish the equilibrium of the game where there is no possibility of joint action in Proposition 6.

Proposition 6: In the game where joint action is not a member of the cluster firms' action space, there exists a unique subgame perfect Nash equilibrium where the DC firm offers p=c and markets all of the cluster's output.

If joint action is not part of the cluster firms' action space, then they can choose to produce and sell to the DC firm or not produce. We assume that a cluster firm will sell to the DC firm when it is indifferent between selling to the DC firm and not producing. Since the cluster firms have no alternative avenue through which it can sell its goods, the DC firm only needs to offer a price equal to the unit cost of production, *c*, in order to purchase all of the cluster's output. In this equilibrium, the DC firm receives the entire expected surplus, or $E\Pi^{DC} = NR[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)]-Nc$ and the cluster firms receive zero profits. The division of profits obtained in the game without joint action is equivalent to the profits received by each firm in the original joint action model if the parameter values were such that joint action was not profitable for any coalition of cluster firms, in other words $R(1-\theta_A)-\frac{M}{N}-c<0$. In Corollary 1, we compare this outcome to that obtained under Assumption A and the application of the coalition-proof equilibrium refinement.

Corollary 1: Under Assumption A, the coalition-proof equilibrium refinement results in weakly higher expected profits for all cluster firms than if joint action was not possible.

The cluster firms are always better off simply whenever the option of joint action exists as a potentially profitable alternative to selling their goods to the DC firm and the coalition-proof equilibrium refinement is applied to select equilibrium strategies in the second stage, even though type B firms never engage in joint action and type A firms only carry out joint action for limited values of the game parameters. The intuition is simple; under the coalition-proof equilibrium refinement, the cluster firms carry out joint action if the announced price is less than the joint action payoff. The threat of joint action leads the DC firm to offer a price equal to the joint action payoff, leading to a redistribution of surplus compared to the game where joint action is not in the cluster firms' action space.

In Region II, each type A firm earns expected profits of $R(1-\theta_A)-\frac{M}{N\alpha}-c$, the payoff from joint action with the participation of type A firms, regardless of whether joint action takes place or not. However, type A firms only receive $R(1-\theta_B)-\frac{M}{N}-c$ in Region I. Type B earn $R(1-\theta_B)-\frac{M}{N}-c$, the payoff from joint action with the participation of all firms in Region I. In Region II type B firms can earn as much as $R(1-\theta_A)-\frac{M}{N\alpha}-c$ if the DC firm offers the price necessary to stop type A firms from carrying out joint action. Otherwise, they receive the same payoff as Region I (also see Appendix D).

It is not necessary that global surplus be reduced for the cluster firms to receive a higher share of the profits. In Region I and for some parameter values in Region II (such that the DC firm purchases all of the cluster's output - see Proposition 4), the first best outcome is achieved and the cluster firms receive a larger share of the surplus than the game where joint action is not part of the action space.[105] For parameter values in Region II such that type A firms carry out joint action, the cluster firms also receive a higher surplus than if joint action were not possible, but with an efficiency cost such that total surplus is reduced.

If Assumption A fails, but joint action is still potentially profitable for type A firms, then only type A firms benefit from the possibility of joint action when comparing the outcome of the joint action model to the profits obtained in the model where joint action is not in the cluster firms' action space. In this case, type B firms would earn zero profits. Similar to the results under Assumption A, efficiency may or may not be affected by the possibility of joint action. For parameter values such that the DC firm purchases all of the cluster's output (see Proposition 5), the first best outcome is achieved, but for parameter values such that joint action takes place, total surplus is reduced. See Appendix D for details of the welfare implications when Assumption A fails.

2.7 Conclusions

The model has provided several results relating to joint action and the viability of breaking into the functions of marketing by a cluster of small firms when the final goods

[105] This result assumes that the coalition-proof equilibrium refinement is applied and Assumption A holds.

market is dominated by an established multinational firm. We have proved that joint marketing by the cluster may exclude low quality producers, and that it cannot take place without the participation of high quality firms. In this sense, successful joint action initiatives may be associated with high quality output. This may shed some light on the failure of joint action in the Sinos Valley (Brazil), where the largest firms with close ties to U.S. multinationals opposed the initiative.[106] In order to bypass the middle-man, firms in industrial clusters may need to focus on improving the quality of their output. However, even without venturing into marketing, clustered firms may still be able to increase their profits through improvements in product quality.

We have also seen that even in a model where joint marketing is inefficient, cluster firms can benefit when joint action exists as a potentially profitable alternative to selling to the DC firm (compared to the outcome when joint action is not part of the firms' action space). It is not necessary for joint marketing to take place for the cluster to receive a share a total surplus, since the DC firm may preempt joint action through the price it offers. On the other hand, there are parameter values for which the DC firm is not willing to offer the cluster firms the equivalent of their joint action profits, and joint action (the inefficient outcome) occurs. Under these circumstances, a trade-off may exist between efficiency and the cluster's welfare.

Extensions and Future Research

We use the predictions of the comparative static exercises to expand on ideas for further research. Recall that under Assumption A, increasing R, N, or $(1-\theta_A)$ or

[106] The largest firms in the Sinos Valley are more vertically integrated, which is correlated with having greater control over quality. See Schmitz (1999) for details.

decreasing M or $(1-\theta_B)$ relaxes the equilibrium constraint so that joint action takes place among the high quality firms for more values of α. The propensity of clusters to undertake joint action might change over time due to changes in these parameter values.

The high quality firms may therefore increase their chances of a successful joint action through the adoption of technologies that reduce the probability of low quality output.[107] Also, new technologies (such as the internet) leading to an exogenous decrease in the cost of marketing, *M,* may make it more likely that clusters market their output without a middleman.

Since, according to the existing model, increasing the size of the cluster (*N*) has beneficial effects by way of decreasing the per firm cost of a joint action initiative, existing firms should not erect barriers to entry. This assumes, however, that the fixed cost *(M)* of joint action does not increase with the size of the cluster. If instead the cost of joint action rises with the size of the cluster (for example, due to free-riding), this issue may require further investigation.

Future research may attempt to incorporate some of the ideas above, in addition to considering how results would change if as mentioned previously, the Global Games approach is applied as an equilibrium selection device in place of the coalition-proof equilibrium refinement.

[107] Increasing the probability of producing high quality output by type A firms, under the coalition-proof equilibrium refinement, would increase the price that the DC firm must pay to all cluster firms if it procures all of the cluster's output. Even though buying from type A firms raises the average quality of the goods that the DC firm purchases, the DC firm pays a higher price not just to the type A firms, but to all cluster firms due its inability to distinguish type A and B firms ex ante. If the probability of producing high quality by type B firms does not increase at the same rate as for type A firms, then paying this higher price for the output of the type B firms becomes unattractive to the DC firm. The losses accruing to the DC firm as a result of paying the high price (required to procure type A's output) to type B firms would not made up by the higher expected quality from type A firms and the DC firm would choose to buy from type B firms only, allowing joint action taking place among type A firms.

Chapter 3: Intra-Cluster Cooperation and Relational Contracting in Pakistan's Surgical Instrument Cluster: An Empirical Study

3.1 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.[108] 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.[109] 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 transaction 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

[108] 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 percent 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)).

[109] 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.

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.[110] Cooperation is necessary because the individual firms are too small to carry out such a project.

This chapter empirically examines the nature of cooperative relationships formed 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

[110] Schmitz and Nadvi (1999), pg. 1504.

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.[111]

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

[111] North (1990), pg. 54.

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".[112] The methods of informal enforcement have been laid out in the New Institutional Economics literature and consist of the agents' ability to sanction individuals who have reneged on their agreements without relying on the legal system.[113]

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.[114] 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

[112] See Baker, Gibbons, and Murphy (2002).

[113] See Macauley (1963), North (1990), Greif (1994), Kranton (1996). 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 exchange. 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.

[114] 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.

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 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 was presented in Chapter Two, which developed a theoretical model of "joint action" for clustered firms to market their own goods. It examined 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.[115] The model proved that joint action can occur among high quality type firms, but not with the participation of low quality firms. The model also showed that joint action is more likely to take place when i) the size of the cluster, the

[115] There were two types of firms in the cluster: type A or "high quality" and type B or "low quality".

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 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 transaction 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.

1) 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 through business networks are more likely to offer trade credit and allow 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 Chapter Three

This chapter is presented in seven sections. In Section 3.1, the introduction, we have defined and summarized the study. Section 3.2 discusses some of the empirical literature related to clusters. In Section 3.3, the surgical instrument cluster of Sialkot

(Pakistan) is introduced, along with the survey methodology and the estimation strategy for the relational contracting regressions. Sections 3.4 and 3.5 present the results of the relational contracting regressions for trade credit offered to customers and trade credit received from suppliers. Section 3.6 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 3.7.

3.2 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 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.[116]

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.[117] Woodruff's (1998) case study of a shoe-producing cluster in Mexico

[116] 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.

[117] 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

demonstrated the importance of community sanctions for contract enforcement in a cluster.[118] This chapter extends the empirical literature on clusters to include results on relational contracting to enforce contracts.

3.3 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 3.1), 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.[119] For the most part, the U.S. imports Sialkot's disposable (single-use) instruments, and Europe imports re-useable instruments.[120] In addition to surgical instruments, the 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.[121] The firms of the cluster manufacture approximately 10,000 different types of disposable and re-useable surgical

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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.

[118] 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.

[119] SMEDA (2001), pg 16.

[120] SMEDA (2001), pg. 17.

[121] SMEDA (2001), pg. 13.

instruments.[122]

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.[123] Except for the largest manufacturers, production of a final good is not generally carried out in a single, vertically integrated firm.

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).

Table 3.1: Surgical Instrument Firms in Pakistan
(from '95-'96 Census of Manufacturing)

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

The cluster has a long and interesting history. Local blacksmiths began producing surgical instruments around the start of the 20th century at the request of the American Mission Hospital in Sialkot. In the 1930s, the cluster began exporting regionally to

[122] SMEDA (2001), pg. 21.

[123] SMEDA (2001), pg. 39.

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."[124]

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 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.[125,126] 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

[124] SMEDA (2001), pg. 9 and pg. 52.

[125] SMEDA (2001), pg. 49.

[126] Imported steel is used for the re-usable instruments.

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 3.2.

Table 3.2: Survey Sample (All firms surveyed)

	Number of firms	% of sample	Average employment (# of workers)	Average age of firms (years)
Exporters	76	62%	91.8	19.9
Vendors	47	38%	15.4	11.7
All Firms	123		61.9	16.7

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.[127] 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

[127] The survey was carried out in Spring 2002.

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.[128]

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 3.3). 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 3.3). 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

[128] As can be seen in Table F13, 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.)

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.

Table 3.3: Variation in Ages and Duration of Relationships in Sample[129]

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

[129] 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.

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:

$$P_i = \alpha + \beta R_i + \gamma B_i + \delta S_i + \phi Z_i + \varepsilon_i \quad (1a)$$

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:

$$P_i = \alpha + \beta R_i + \gamma B_i + \delta S_i + \phi Z_i + \varepsilon_i \quad (1b)$$

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:

$$TC_i^* = \alpha + \beta R_i + \gamma B_i + \delta S_i + \phi Z_i + \varepsilon_i \quad (2a)$$

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:

$$TC_i^* = \alpha + \beta R_i + \gamma B_i + \delta S_i + \phi Z_i + \varepsilon_i \quad (2b)$$

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[130], 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* $0 < TC_i^* < 1$

$TC_i = 0$ *for* $TC_i^* \leq 0$

$TC_i = 1$ *for* $TC_i^* \geq 1$

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"

[130] 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.

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 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 3.4 and 3.7 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, 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.

3.4 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 3.4. 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.

Table 3.4: Customer Credit Summary Statistics

	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
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	0.22	0.00	0.18	0.42	0.00	1.00	72

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
(0,1)							
Customers Would Find Out About Dispute With 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 (0,1)	0.42	0.00	0.25	0.50	0.00	1.00	72
Belief in the Court System (0,1)	0.21	0.00	0.17	0.41	0.00	1.00	72
Export Dummy*Belief in Courts (0,1)	0.08	0.00	0.08	0.28	0.00	1.00	72
CONTROLS							
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 Customer (0,1)	0.01	0.00	0.01	0.12	0.00	1.00	72

Customer Trade Credit Results

Table 3.5 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.[131]

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,

[131] 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.

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 3.5.

Obtaining information about customers through a business network appears to 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).

Table 3.5: Regressions on Trade Credit to Customers, Marginal Effects, Probit and Tobit, Main specification, Clustered errors

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

[132] $\bar{I}^R$, 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 3.6. 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 3.5 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 Table F1 (in Appendix F). 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.

Table 3.6: Regressions on Trade Credit to Customers, Marginal Effects, Probit and Tobit, Alternate Specification, Clustered errors

	Probit	Tobit	Probit (without duration)	Tobit (without duration)
LOCK-IN				
Would Take Customer Less than a Week to Find Alternate Supply	0.12 (1.36)	14.18 (0.91)	0.11 (1.22)	14.26 (0.87)
Would Take Customer More Than a Month to Find Alternate Supply	-0.042 (-0.34)	1.32 (0.05)	-0.051 (-0.45)	-3.29 (-0.12)
INFORMATION/LOCK-IN				
Duration of Relationship (years)	0.034 (1.94)+	**8.82** **(2.07)***		
Duration-squared	-0.001 (-1.13)	-0.22 (-1.20)		
INFORMATION/ NETWORK EFFECTS				
Info. About Customer Through Business Network	**0.24** **(2.39)***	**41.22** **(1.96)***	**0.25** **(2.58)****	**43.83** **(2.02)***
Talk To Other Suppliers of Customer At Least Weekly	**0.20** **(2.54)****	28.30 (1.54)	**0.20** **(2.58)****	27.72 (1.47)
ENFORCEMENT				
Customers Would Find Out About Dispute With Another Customer	-0.073 (-0.90)	-17.42 (-1.06)	-0.073 (-0.92)	-15.96 (-0.98)
Belief in Court System	**0.29** **(3.16)****	**49.21** **(2.13)***	**0.30** **(3.49)****	**48.43** **(2.09)***
CONTROLS				
Ln(1+Age)	**-0.16** **(-2.85)****	-21.57 (-1.65)+	-0.079 (-1.62)	-2.07 (-0.18)
Ln(Employment)	0.068 (1.65)+	19.89 (1.95)+	0.068 (1.78)+	**21.71** **(2.23)***
Export Dummy	0.13 (1.35)	**46.87** **(2.04)***	0.099 (1.06)	38.95 (1.69)+
Observations	132	132	132	132
R-Squared	0.21	0.044	0.17	0.03
$\bar{I}^R$ Relative Amount of Information in Prediction	0.30	Not applicable	0.23	Not applicable
Chi-Squared	36.58 (dof=11)	26.12 (dof=11)	33.45 (dof=9)	17.86 (dof=9)
Prob>Chi-Squared	0.0001	0.006	0.0001	0.037

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Robustness

Additional regressions (Table F3, in Appendix F) 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.[133] 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.[134] Trade credit may also be a price discrimination mechanism.[135] 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 Table F3 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

[133] See Long, Malitz, and Ravid (1993), Deloof and Jegers (1996).

[134] See Peterson and Rajan (1997).

[135] See Petersen and Rajan (1997). 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.

Table F4 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.[136] 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 Table F4 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 estimates that only

[136] Similar to the results contained in the main text (Tables 3.5 and 3.6), the standard errors in Table F4 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".

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.

Tables F5 and F6 re-estimate the main specifications in Table 3.5 using different samples. Table F5 uses a slightly smaller sample where the only observations that are included are those that have two customers per firm.[137] The results are very similar to those in Table 3.5, except that some coefficient estimates are slightly larger (in absolute value) and somewhat more significant. Table F6 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.

3.5 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

[137] In other words, observations where there was only one customer per firm are dropped.

survey also included questions on visits by customers and suppliers before the first sale and during the trading relationship. Summary statistics are presented in Table 3.7. 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.

Table 3.7: Supplier Credit Summary Statistics

	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

	Mean	Median	Variance	Std. Dev.	Min	Max	NOBs
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							
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 (0,1)	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 3.8 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.[138]

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

[138] 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.

to receive credit, and pays on average 47 percent more of their bill at the time of sale. 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.

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.

Table 3.8: Supplier Trade Credit Results, Main specification, Clustered errors

	Probit	Tobit	Probit (without duration)	Tobit (without duration)
LOCK-IN				
% Inputs Purchased From Less Than 1 km	-0.0011 (-0.50)	-0.10 (-0.38)	-0.0012 (-0.52)	-0.10 (-0.38)
% Inputs Imported	0.0015 (0.39)	-0.11 (-0.24)	0.0011 (0.29)	-0.12 (-0.28)
INFORMATION/LOCK-IN				
Duration of Relationship (years)	-0.0014 (-0.13)	0.28 (0.23)		
Duration-squared	0.00021 (0.67)	-0.0038 (-0.10)		
INFO./NETWORK EFFECTS				
Visit Supplier Before First Sale	**-0.27** **(-2.79)****	**-46.9** **(-2.29)***	**-0.27** **(-2.72)****	**-46.76** **(-2.28)***
Visit Supplier at Least Weekly	0.17 (1.94)+	11.74 (0.95)	0.18 (1.95)+	11.8 (0.93)
Intro. To Supplier Through Social Network	0.16 (1.54)	20.95 (1.58)	0.17 (1.71)+	21.4 (1.65)+
ENFORCEMENT				
Dispute With Supplier Would Lead To Higher Advanced Payment	0.14 (1.13)	9.86 (0.48)	0.13 (1.04)	9.79 (0.47)
Belief in Court System	-0.0087 (-0.06)	-1.23 (-0.07)	-0.0038 (-0.03)	-1.10 (-0.06)
CONTROLS				
Ln(1+Age)	0.11 (1.18)	19.62 (1.34)	0.13 (1.41)	20.44 (1.40)
Ln(Employment)	0.012 (0.18)	-0.89 (-0.10)	0.012 (0.18)	-0.81 (-0.09)
Export Dummy	-0.24 (-1.91)+	-30.84 (-1.93)+	-0.24 (-1.88)+	-30.96 (-1.92)+
Receive Bank Credit	-0.27 (-1.93)+	-12.25 (-0.69)	-0.26 (-1.88)+	-12.42 (-0.70)
Observations	113	113	113	113
R-Squared	0.25	0.039	0.24	0.038
$\bar{I}^R$ Relative Amount of Information in Prediction[139]	0.21	Not applicable	0.20	Not applicable
Chi-squared	28.27 (dof=13)	20.31 (dof=13)	26.37 (dof=11)	 (dof=11)
Prob>Chi-squared	0.008	0.088	0.006	0.066

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

[139] $\bar{I}^R$, 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 3.9. 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 3.8 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 3.8) than the substitute network/information variable in the alternate specification (Table 3.9) representing that the firm talks frequently with other producers.

More interesting are estimates (Table F7, in Appendix F) 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

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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.

Table 3.9: Supplier Trade Credit Results, Alternate specification, Clustered errors

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

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 Table F2 (in Appendix F). 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.

Tables F8 and F9 re-estimate the main specifications in Table 3.8 using different samples. Table F8 uses a slightly smaller sample where the only observations that are included are those that have two customers per firm.[140] The results are very similar to those in Table 3.8. 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. Table F9 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).

[140] In other words, observations where there was only one customer per firm are dropped.

3.6 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:

$$P_i = \alpha + \beta E_i + \gamma R_i + \delta D_i + \phi Z_i + \varepsilon_i \quad (3)$$

where:

E: Experience with direct marketing

R: Relationship with other firms

D: Opportunity cost of joint action

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 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.

Table 3.10: Joint Action Summary Statistics

	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

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 3.11.

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 ½ years 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 decision to participate in a joint marketing initiative. Intra-cluster communication as measured by frequent interactions with other producers also had no significant impact.

Table 3.11: Joint Action Results, Marginal Effects

	(1)	(2)
	Joint Action Probit (Marginal Effects)	Joint Action Logit (Marginal Effects)
Employment	-0.00074 (-0.46)	-0.00077 (-0.47)
Employment squared	-0.000004 (-0.75)	-0.000003 (-0.69)
Age	0.019 (1.10)	0.016 (0.82)
Age squared	-0.00018 (-0.52)	-0.00012 (-0.30)
Sell some products under own name	0.22 (1.95)+	0.23 (1.89)+
Sell some products to hospitals directly	**0.29** **(2.44)***	**0.29** **(2.38)***
Duration of relationship with oldest customer (years)	**-0.066** **(-3.87)****	**-0.063** **(-3.77)****
Duration squared	**0.0016** **(4.42)****	**0.0016** **(4.47)****
Credit Access	0.095 (1.15)	0.089 (1.07)
Talk at Least Weekly with Other Producers	0.15 (1.62)	0.15 (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
$\bar{I}^R$ Relative Amount of Information in Prediction[141]	0.27	0.27
Pseudo R-squared	0.35	0.35

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

3.7 Conclusions

Several interesting results have been obtained regarding relational contracting as

[141] $\bar{I}^R$, 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.

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. Since firms give more trade credit (and are more likely to give credit) when relationships are of longer duration, there is some evidence of lock-in as a tool for contract enforcement. Business networks, that may be used to gather information about the reliability of customers or for social sanction, are also found to be significant determinants of inter-firm trust; firms that obtain information through business networks are more likely to offer trade credit (and offer more trade credit) to their customers. Finally, we found that firms are more likely to offer trade credit and to offer more trade credit to their customers when firms believe that the court system can help to enforce contracts.

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. On the other hand, regular contact between firms and suppliers appear to reinforce inter-firm trust, since firms that visit their suppliers weekly are 17 percent more likely to receive trade credit.

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. On average, firms with a long trading relationship with its oldest customer tend to express less interest in joint marketing agreements, 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.[142] 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.

[142] 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.

Appendices

Appendix A: Proofs for Chapter Two

Proof of Proposition 1: ***It is always efficient for the DC firm to market the high quality goods of both high and low quality firms.***

If the LDC firms (or a sub-set) decide to market their own goods, the cluster must pay an entry cost, *M*, in order to build a distribution network. (The manner in which the entry cost is divided among the firms is irrelevant). Therefore, the total expected surplus of the goods produced and marketed by the cluster firms is
$NR[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)]-Nc-M$.

The DC firm already has a distribution network through which it can sell the cluster's goods, and the entry cost does not need to be paid. The total expected surplus of the goods produced by the cluster that can be earned by selling the goods through the DC firm is simply $NR[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)]-Nc$.
Therefore, total expected surplus is reduced when the clustered firms decide to market their own goods.

Lemma 1: ***For any announced price, p such that $p \geq c$, there exists at least one pure strategy second stage equilibrium, where all cluster firms to sell to the DC firm.***

Proof:
For type A firms: Suppose that for a given $p = p^* \geq c$, *N-1* of the cluster firms decide to sell to the DC firm. For the remaining firm, firm *i*, (suppose it is type A), it is a best response to also sell to the DC firm. By selling to the DC firm, it earns $\Pi_{Ai}^{LDC} = p^* - c \geq 0$.
By deciding to market its output alone, it would earn $E\Pi_{Ai}^{LDC} = R(1-\theta_A) - M - c < 0$.
For type B firms: Similar arguments prove the proposition for type B firms.

Lemma 2a: ***In any continuation equilibrium, all type A firms will follow the same strategy, and all type B firms will follow the same strategy.***

Proof: Proof is by contradiction. Consider two type B firms *i* and *j* that might be following different strategies. Suppose that type B firm *i* follows a strategy such that if the announced price $p=p^*$ then firm *i* sells to the DC firm. For type B firm *j*, if $p=p^*$ then the firm engages in joint action.

If firm *j*'s strategy is a best response, it must be that $R(1-\theta_B) - \frac{M}{N\gamma} \geq p^*$ where γ is the

proportion of all cluster firms participating in joint action when $p=p^*$.[143] If this is true, then firm *i*'s strategy is not a best response to the other LDC firms' strategies because *i*'s payoff from following the strategy when $p=p^*$ is $\Pi_{Bi}^{LDC} = p^* - c$ which is strictly lower than *i*'s payoff from deviating from the strategy by engaging in joint action and earning $\Pi_{Bi}^{LDC} = R(1-\theta_B) - \frac{M}{N\gamma+1}$.

If, instead $R(1-\theta_B) - \frac{M}{N\gamma} < p^*$, then firm *j*'s strategy is not a best response, and it will join firm *i* in selling to the DC firm.

Therefore firm *i* must follow the same strategy as firm *j* in equilibrium. The argument can be extended to consider any three type B firms that have different strategies and so on up to $N(1-\alpha)$ type B firms. Therefore, all type B firms will follow the same strategy. Similar arguments prove the proposition for type A firms.

*Lemma 2b****: There does not exist a set of continuation equilibrium strategies such that type B firms participate in the joint action and type A firms sell to the DC firm.***

Proof: Proof is by contradiction. Suppose that a type A firm *i* follows a strategy where if the announced price $p=p^*$ then firm *i* sells to the DC firm. For a type B firm *j*, if $p=p^*$ then the firm engages in joint action. For firm *j*'s strategy to be a best response, it must be that $R(1-\theta_B) - \frac{M}{N\gamma} \geq p^*$ where γ is the proportion of all cluster firms participating in joint action when $p=p^*$.[144] If this is true, then firm *i*'s strategy is not a best response to the other LDC firms' strategies because *i*'s payoff from following the strategy when $p=p^*$ is $\Pi_{Ai}^{LDC} = p^* - c$ which is strictly lower than *i*'s payoff from deviating from the strategy by engaging in joint action and earning $E\Pi_{Ai}^{LDC} = R(1-\theta_A) - \frac{M}{N\gamma+1}$. Therefore, there does not exist a set of strategies in equilibrium such that type B firms can engage in joint action while type A firms sell to the DC firm.

Lemma 2c: ***Given Assumption A, for any given p*** $< R(1-\theta_B) - \frac{M}{N}$ ***(in other words, p is less than the expected profit from joint action for type B firms when all firms participate), there exists a pure strategy continuation equilibrium where all cluster firms engage in joint action.***

If $p^* < R(1-\theta_B) - \frac{M}{N}$ and all cluster firms participate in joint action, type B firms earn

[143] If no firms other than *j* are participating in joint action, let $N\gamma$ =1.

[144] If no firms other than *j* are participating in joint action, let $N\gamma$ =1.

$\mathrm{E}\,\Pi_{Bi}^{LDC} = R(1-\theta_B) - \frac{M}{N}$ - c and type A firms earn $\mathrm{E}\,\Pi_{Ai}^{LDC} = R(1-\theta_A) - \frac{M}{N}$ - c. A cluster firm (type A or B) that deviates and sells to the DC firm will earn $\Pi_i^{LDC} = p^*$ - c which is lower than the payoff to joint action.

Appendix B: Nash Equilibria of the Game for Various Parameter Values When the Coalition-Proof Equilibrium Refinement is Applied to the Second Stage

a. Case 1: Joint action is potentially profitable for type A firms only

Case 1: $R(1-\theta_B)-\frac{M}{N} < c$ and $c < R(1-\theta_A)-\frac{M}{N\alpha}$

The DC firm can always buy from only the type B firms at a price $p=c$ since joint action would never yield positive profits for them under these parameter values.

If the coalition-proof equilibrium refinement is applied, then type A firms adopt the strategy that they will carry out joint action for any announced price $p < R(1-\theta_A)-\frac{M}{N\alpha}$. Whether or not offering a higher price to the type A firms is profitable for the DC firm depends on all the parameter values. Since the DC firm cannot distinguish between type A and type B firms, the DC firm would have to offer the higher price ($p = R(1-\theta_A)-\frac{M}{N\alpha}$) to all the cluster firms, not just type A firms.

Given $E\Pi^{DC}_{Buy\,Bonly} = N(1-\alpha)\left[R(1-\theta_B)-c\right]$ and

$$E\Pi^{DC}_{Buy\,A\&B} = NR\left[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)\right]-N\left[R(1-\theta_A)-\frac{M}{N\alpha}\right]=$$

$NR(1-\alpha)(\theta_A-\theta_B)+\frac{M}{\alpha}$, $E\Pi^{DC}_{Buy\,A\&B} > E\Pi^{DC}_{Buy\,Bonly}$ requires that

$-NR(1-\alpha)(1-\theta_A)+\frac{M}{\alpha}+N(1-\alpha)c > 0$.

Given the roots of $E\Pi^{DC}_{Buy\,A\&B}$ - $E\Pi^{DC}_{Buy\,Bonly}$ =0, then for $\frac{M}{N[R(1-\theta_A)-c]} > \frac{1}{4}$, no real roots exist, so that $E\Pi^{DC}_{Buy\,A\&B} > E\Pi^{DC}_{Buy\,Bonly}$ for all α. And for $\frac{M}{N[R(1-\theta_A)-c]} < \frac{1}{4}$, $E\Pi^{DC}_{Buy\,A\&B} > E\Pi^{DC}_{Buy\,Bonly}$ for $\alpha \in (\alpha_5, \alpha_6)$.[145]

Summary of results for case 1:
Type B firms sell their goods to the DC firm since joint action would not yield positive profits. If the coalition-proof equilibrium refinement is applied, and

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[145] $\alpha_{5,6} = \frac{1}{2} \pm \frac{\sqrt{1-4\frac{M}{N[R(1-\theta_A)-c]}}}{2}$

$\frac{M}{N[R(1-\theta_A)-c]} \leq 1/4$, then a pure strategy subgame perfect Nash equilibrium exists such that for all $\alpha \in (\alpha_5, \alpha_6)$ the DC buys goods from type B firms at $p=c$ and type A firms carry out a joint action marketing initiative.
If the coalition-proof equilibrium refinement is applied, and either i) $\frac{M}{N[R(1-\theta_A)-c]} \leq 1/4$ where $\alpha \notin (\alpha_5, \alpha_6)$ or ii) $\frac{M}{N[R(1-\theta_A)-c]} > 1/4$, then a pure strategy subgame perfect Nash equilibrium exists such that the DC firm buys from all cluster firms at a price $p = R(1-\theta_A) - \frac{M}{N\alpha}$.

b. Cases 2 – 15: Joint action is potentially profitable for both types of cluster firms, but it is not possible for the DC firm to only buy from type B firms

Cases 2 - 15:

$R(1-\theta_B) - \frac{M}{N} > c$, $R(1-\alpha)(\theta_B - \theta_A) - \frac{M}{N\alpha} \leq 0$, and $R(1-\theta_A) - \frac{M}{N\alpha} < R(1-\theta_B) - \frac{M}{N}$

In cases 2-15, the DC firm can only buy from all or none of the cluster firms since $R(1-\theta_A) - \frac{M}{N\alpha} < R(1-\theta_B) - \frac{M}{N}$.
Since the DC firm receives positive profits by buying and reselling the cluster's output, the DC firm will always buy from all of the cluster firms in this case.

If the coalition-proof equilibrium refinement is applied, then the DC firm would earn $E\Pi^{DC} = NR[\alpha(1-\theta_A) + (1-\alpha)(1-\theta_B)] - N\left[R(1-\theta_B) - \frac{M}{N}\right]$ by offering $p = R(1-\theta_B) - \frac{M}{N}$ and would earn zero profits if it offers $p < R(1-\theta_B) - \frac{M}{N}$.

Summary of results for cases 2 – 15:
If the coalition-proof equilibrium refinement is applied, then a pure strategy subgame perfect Nash equilibrium exists such that the DC firm buys from all cluster firms and pays $p = R(1-\theta_B) - \frac{M}{N}$ to all cluster firms.

c. Cases 16 – 21: Joint action is potentially profitable for both types of cluster firms, and it is possible for the DC firm to either buy from all cluster firms or buy only from type B firms

For cases 16 - 21:

$R(1-\theta_B)-\frac{M}{N}>c$, $R(1-\alpha)(\theta_B-\theta_A)-\frac{M}{N\alpha}\le 0$, and

$R(1-\theta_B)-\frac{M}{N}<R(1-\theta_A)-\frac{M}{N\alpha}$

In cases 16-21, the DC firm can effectively buy from all cluster firms, type B only, or from none of the cluster firms, depending on the price that it announces. The DC firm will always buy from at least the type B firms because it makes positive profits by buying and marketing the output of type B firms. It will be shown that there will be some instances where the DC firm could make positive profits procuring the whole cluster's output, but chooses to buy from type B firms only.

If the coalition-proof equilibrium refinement is applied, the DC firm can buy the whole cluster's output by offering $p=R(1-\theta_A)-\frac{M}{N\alpha}$ to all firms, or it buy only from type B firms by offering $p=R(1-\theta_B)-\frac{M}{N}$ as long as $E\Pi^{DC}_{Buy\,A\&B}>E\Pi^{DC}_{Buy\,Bonly}$. Recall that if the DC firm is buying all of the cluster's output, it must pay the same price to all firms since it cannot distinguish the quality type of individual cluster firms.

Given $E\Pi^{DC}_{Buy\,Bonly}=N(1-\alpha)\left[R(1-\theta_B)-\left[R(1-\theta_B)-\frac{M}{N}\right]\right]=M(1-\alpha)$ and

$E\Pi^{DC}_{Buy\,A\&B}=N(1-\alpha)(\theta_B-\theta_A)+\frac{M}{\alpha}$, $E\Pi^{DC}_{Buy\,A\&B}>E\Pi^{DC}_{Buy\,Bonly}$ requires that

$N\left[-R(1-\alpha)(\theta_B-\theta_A)+\frac{M}{N\alpha}-\frac{M(1-\alpha)}{N}\right]>0$. However, the DC firm can profitably buy from type A (and therefore the entire cluster) whenever $-R(1-\alpha)(\theta_B-\theta_A)+\frac{M}{N\alpha}\ge 0$. Therefore, the condition allowing for DC to make positive profits by buying all of the cluster's output is not sufficient for the DC firm to want to do so.

When the difference between the benefit that the DC firm receives by buying from both firms ($R[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)]$) and the price that the DC firm has to pay in order to procure the output of type A firms ($p=R(1-\theta_A)-\frac{M}{N\alpha}$) is sufficiently small, such that $R[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)]-\left[R(1-\theta_A)-\frac{M}{N\alpha}\right]<\frac{M(1-\alpha)}{N}$, then the DC firm will choose to only buy the type B firms' output, even though it can make positive profits by

procuring and marketing all of the cluster's output.

Given the roots of $E\Pi^{DC}_{Buy\,A\&B} - E\Pi^{DC}_{Buy\,Bonly} = 0$, then for $\frac{M}{NR(\theta_B - \theta_A)} > \frac{1}{3}$, no real roots exist, and $E\Pi^{DC}_{Buy\,A\&B} > E\Pi^{DC}_{Buy\,Bonly}$ for all α[146]. And for $\frac{M}{NR(\theta_B - \theta_A)} < \frac{1}{3}$, the DC firm will choose to only buy the type B firms' output for $\alpha \in (\alpha_1, \alpha_2)$.

Summary of results for cases 16 - 21:

If the coalition-proof equilibrium refinement is applied, then for parameter values such that $\frac{M}{NR(\theta_B - \theta_A)} > \frac{1}{3}$, or for $\frac{M}{NR(\theta_B - \theta_A)} < \frac{1}{3}$ where for $\alpha \notin (\alpha_1, \alpha_2)$ a pure strategy subgame perfect Nash equilibrium exists such that the cluster firms sell their goods to the DC firm at a price $p = R(1-\theta_A) - \frac{M}{N\alpha}$. For all other parameter values such that $\frac{M}{NR(\theta_B - \theta_A)} < \frac{1}{3}$ where for $\alpha \in (\alpha_1, \alpha_2)$ a pure strategy subgame perfect Nash equilibrium exists such that the type B firms sell their goods to the DC firm at a price $p = R(1-\theta_B) - \frac{M}{N}$ and type A firms will market their own goods.

d. Cases 22 – 27: Joint action is potentially profitable for all firms, but the DC firm would earn negative profits if it were to offer type A firms what they would earn from joint action

For cases 22 - 27:

$R(1-\theta_B) - \frac{M}{N} > c$, $R(1-\alpha)(\theta_B - \theta_A) - \frac{M}{N\alpha} > 0$

In cases 22 – 27, the DC firm would earn negative profits if it were to offer $p = R(1-\theta_A) - \frac{M}{N\alpha}$, i.e. what type A firms what they would earn from joint action.

However, in order to have positive profits, the DC firm must at least buy from the type B firms. If the coalition-proof equilibrium refinement is applied, the DC firm buys from

[146] $\alpha_{1,2} = \frac{1}{2} \pm \frac{\sqrt{\left[R(\theta_2 - \theta_A) + \frac{M}{N}\right]^2 - 4\left(\frac{M}{N}\right)\left[R(\theta_B - \theta_A) + \frac{M}{N}\right]}}{2\left[R(\theta_B - \theta_A) + \frac{M}{N}\right]}$

type B firms at a price $p = R(1-\theta_B) - \frac{M}{N}$.

If the coalition-proof equilibrium refinement is applied, then the DC firm will only make positive profits if it purchases goods from the type B firms. Buying from the type B firms, the DC firm would earn

$E\Pi^{DC} = N(1-\alpha)R[\alpha(1-\theta_A) + (1-\alpha)(1-\theta_B)] - N(1-\alpha)\left[R(1-\theta_B) - \frac{M}{N}\right]$ by offering

$p = R(1-\theta_B) - \frac{M}{N}$ and would earn zero profits if it offers $p < R(1-\theta_B) - \frac{M}{N}$.

Summary of results for cases 22 - 27:
If the coalition-proof equilibrium refinement is applied, then a pure strategy subgame perfect Nash equilibrium exists such that the type A firms carry out a joint action initiative and the DC firm markets the goods of the type B firms at price

$p = R(1-\theta_B) - \frac{M}{N}$.

Appendix C: Continuation Equilibria of the Second Stage for Various Parameter Values, Taking *p* as Given

a. Case 1: Joint action is potentially profitable for type A firms only

For Case 1: $R(1-\theta_B)-\frac{M}{N} < c$ **and** $c < R(1-\theta_A)-\frac{M}{N\alpha}$

For $c \le p < R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation (or second stage) equilibria, taking *p* as given. In the first, type B firms sell to the DC firm and type A firms engage in joint action. In the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_A)-\frac{M}{N\alpha}$, there is one continuation equilibrium where all cluster firms to sell to the DC firm.

b. and c. Cases 2 – 15 and 16 - 21: Joint action is potentially profitable for both types of cluster firms

b. For Cases 2 – 15, the following hold: $R(1-\theta_B)-\frac{M}{N} > c$ **,**

$R(1-\alpha)(\theta_B-\theta_A)-\frac{M}{N\alpha} \le 0$ **, and** $R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N}$**.**

2. For $R(1-\theta_B)-\frac{M}{N\alpha+1} < c < R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N(1-\alpha)}$ we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$, there are three continuation equilibria. In the first, all cluster firms sell to the DC firm. In the second, all cluster firms carry out joint action. In the third continuation equilibrium, type A firms carry out a joint action initiative while type B firms sell to the DC firm. For $p \ge R(1-\theta_B)-\frac{M}{N}$, there is one continuation equilibrium where all cluster firms to sell to the DC firm.

3. For $c < R(1-\theta_B)-\frac{M}{N\alpha+1} < R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N(1-\alpha)}$ we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N\alpha+1}$ there are two continuation equilibria. In the first, all cluster firms sell to the DC firm. In the second, all cluster firms carry out a joint action

initiative. For $R(1-\theta_B)-\frac{M}{N\alpha+1} \le p < R(1-\theta_B)-\frac{M}{N}$, there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm. In the second, all cluster firms carry out a joint action initiative. In the third continuation equilibrium, type A firms carry out a joint action initiative while type B firms sell to the DC firm. For $p \ge R(1-\theta_B)-\frac{M}{N}$, there is one continuation equilibrium where all cluster firms to sell to the DC firm.

4. For $c < R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N\alpha+1} < R(1-\theta_B)-\frac{M}{N(1-\alpha)}$, we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm. For $p \ge R(1-\theta_B)-\frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

5. For $R(1-\theta_A)-\frac{M}{N\alpha} < c < R(1-\theta_B)-\frac{M}{N(1-\alpha)}$ we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm. For $p \ge R(1-\theta_B)-\frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

6. For $R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N(1-\alpha)} < c < R(1-\theta_A)-\frac{M}{N(1-\alpha)+1}$ we have the following equilibria in the second stage, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm. For $p \ge R(1-\theta_B)-\frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

7. For $R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N(1-\alpha)} < R(1-\theta_A)-\frac{M}{N(1-\alpha)+1} < c$, we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B) - \frac{M}{N}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

8. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N(1-\alpha)} > R(1-\theta_B) - \frac{M}{N\alpha+1} > c$ we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B) - \frac{M}{N\alpha+1}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha+1} \le p < R(1-\theta_A) - \frac{M}{N\alpha}$, there are three possible pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. In the third continuation equilibrium, type A firms carry out a joint action initiative while the type B firms sell to the DC firm.

For $R(1-\theta_A) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$, there are two continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm.

For $p = R(1-\theta_B) - \frac{M}{N}$ there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

9. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N(1-\alpha)} > c > R(1-\theta_B) - \frac{M}{N\alpha+1}$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_A) - \frac{M}{N\alpha}$ there are three pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action, and in the second, all cluster firms sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action and in the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

10. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > c > R(1-\theta_B) - \frac{M}{N(1-\alpha)} > R(1-\theta_B) - \frac{M}{N\alpha+1}$

then we have the following equilibria in the second stage of the game, taking *p* as given. For $c \le p < R(1-\theta_A) - \frac{M}{N\alpha}$ there are three pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action, and in the second, all cluster firms sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action and in the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

11. For $R(1-\theta_B) - \frac{M}{N} > c > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N(1-\alpha)} > R(1-\theta_B) - \frac{M}{N\alpha+1}$ we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B) - \frac{M}{N}$ there are two continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm.

For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell their goods to the DC firm.

12. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N\alpha+1} > R(1-\theta_B) - \frac{M}{N(1-\alpha)} > c$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B) - \frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm.

For $R(1-\theta_B) - \frac{M}{N\alpha+1} \le p < R(1-\theta_A) - \frac{M}{N\alpha}$ there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm.

For $R(1-\theta_B) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action and in the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

13. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N\alpha+1} > c > R(1-\theta_B) - \frac{M}{N(1-\alpha)}$

then we have the following equilibria in the second stage of the game, taking p as given. For $c \le p < R(1-\theta_B) - \frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha+1} \le p < R(1-\theta_A) - \frac{M}{N\alpha}$ there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action and in the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

14. For $R(1-\theta_B) - \frac{M}{N} > R(1-\theta_A) - \frac{M}{N\alpha} > c > R(1-\theta_B) - \frac{M}{N\alpha+1} > R(1-\theta_B) - \frac{M}{N(1-\alpha)}$ then we have the following equilibria in the second stage, taking p as given.

For $c \le p < R(1-\theta_A) - \frac{M}{N\alpha}$, there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second, all sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha} \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms to engage in joint action, and in the second, all cluster firms sell to the DC firm.

For $p \ge R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

15. For $R(1-\theta_B) - \frac{M}{N} > c > R(1-\theta_A) - \frac{M}{N\alpha} > R(1-\theta_B) - \frac{M}{N\alpha+1} > R(1-\theta_B) - \frac{M}{N(1-\alpha)}$ then we have the following equilibria in the second stage of the game, taking p as given.

For $c \le p < R(1-\theta_B) - \frac{M}{N}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second all cluster firms sell to the DC firm. For $p = R(1-\theta_B) - \frac{M}{N}$, there is one continuation equilibrium where all cluster firms sell to the DC firm.

c. For cases 16 – 21, the following hold: $R(1-\theta_B)-\frac{M}{N}>c$**,**

$R(1-\alpha)(\theta_B-\theta_A)-\frac{M}{N\alpha}\le 0$**, and** $R(1-\theta_B)-\frac{M}{N}<R(1-\theta_A)-\frac{M}{N\alpha}$

16. For $R(1-\theta_A)-\frac{M}{N\alpha}>R(1-\theta_B)-\frac{M}{N}>R(1-\theta_B)-\frac{M}{N\alpha+1}>R(1-\theta_B)-\frac{M}{N(1-\alpha)}>c$ then we have the following equilibria in the second stage of the game, taking *p* as given. For $c\le p<R(1-\theta_B)-\frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second all cluster firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N\alpha+1}\le p<R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second all cluster firms sell to the DC firm. In the third continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm.

For $R(1-\theta_B)-\frac{M}{N}\le p<R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation equilibria. In the first, type B firms sell to the DC firm and type A firms carry out a joint action initiative. In the second continuation equilibrium, all cluster firms to sell to the DC firm. For $p\ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

17. For $R(1-\theta_A)-\frac{M}{N\alpha}>R(1-\theta_B)-\frac{M}{N}>R(1-\theta_B)-\frac{M}{N\alpha+1}>c>R(1-\theta_B)-\frac{M}{N(1-\alpha)}$ then we have the following equilibria in the second stage of the game, taking *p* as given. For $c\le p<R(1-\theta_B)-\frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second all cluster firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N\alpha+1}\le p<R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second all cluster firms sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N}\le p<R(1-\theta_A)-\frac{M}{N\alpha}$ there are two pure strategy continuation equilibria. In the first, type A firms carry out joint action while type B firms sell to the DC firm, and in the second equilibrium all cluster firms sell to the DC firm. For $p\ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

18. For $R(1-\theta_A)-\frac{M}{N\alpha} > R(1-\theta_B)-\frac{M}{N} > c > R(1-\theta_B)-\frac{M}{N\alpha+1} > R(1-\theta_B)-\frac{M}{N(1-\alpha)}$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action, and in the second all cluster firms sell to the DC firm. In the third pure strategy continuation equilibrium, type A firms carry out a joint action initiative and type B firms sell to the DC firm.

For $R(1-\theta_B)-\frac{M}{N} \le p < R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation. In the first, type B firms sell to the DC firm and type A firms carry out a joint action initiative. In the second continuation equilibrium, all cluster firms to sell to the DC firm.

For $p \ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

19. For $R(1-\theta_A)-\frac{M}{N\alpha} > R(1-\theta_B)-\frac{M}{N} > R(1-\theta_B)-\frac{M}{N(1-\alpha)} > R(1-\theta_B)-\frac{M}{N\alpha+1} > c$ then we have the following equilibria in the second stage, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N\alpha+1}$, there are two pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm and in the second, all cluster firms carry out joint action. For $R(1-\theta_B)-\frac{M}{N\alpha+1} \le p < R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm, and in the second, all cluster firms carry out joint action. In the third, type A firms carry out joint action and type B firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N} \le p < R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation equilibria. In the first, type B firms sell to the DC firm and type A engage in joint action and in the second, all cluster firms sell to the DC firm. For $p \ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

20. For $R(1-\theta_A)-\frac{M}{N\alpha} > R(1-\theta_B)-\frac{M}{N} > R(1-\theta_B)-\frac{M}{N(1-\alpha)} > c > R(1-\theta_B)-\frac{M}{N\alpha+1}$ then we have the following equilibria in the second stage, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm, and in the second, all cluster firms carry out joint action. In the third, type A firms carry out joint action and type B firms sell to the

DC firm. For $R(1-\theta_B)-\frac{M}{N} \le p < R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation equilibria. In the first, type B firms sell to the DC firm and type A engage in joint action and in the second, all cluster firms sell to the DC firm.

For $p \ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

21. For $R(1-\theta_A)-\frac{M}{N\alpha} > R(1-\theta_B)-\frac{M}{N} > c > R(1-\theta_B)-\frac{M}{N(1-\alpha)} > R(1-\theta_B)-\frac{M}{N\alpha+1}$ then we have the following equilibria in the second stage, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm and in the second, all cluster firms carry out joint action. In the third, type A firms carry out joint action and type B firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N} \le p < R(1-\theta_A)-\frac{M}{N\alpha}$, there are two pure strategy continuation equilibria. In the first, type B firms sell to the DC firm and type A engage in joint action, and in the second, all cluster firms sell to the DC firm.

For $p \ge R(1-\theta_A)-\frac{M}{N\alpha}$ there is one continuation equilibrium where all cluster firms sell to the DC firm.

d. Cases 22 – 27: Joint action is potentially profitable for all firms, but the DC firm would earn negative profits if it were to offer type A firms what they would earn from joint action

For Cases 22 – 27, the following hold: $R(1-\theta_B)-\frac{M}{N} > c$ **and**

$R(1-\alpha)(\theta_B-\theta_A)-\frac{M}{N\alpha} > 0$. The second inequality tells us that DC firm would earn negative profits if it were to offer type A firms $p = R(1-\theta_A)-\frac{M}{N\alpha}$

22. For $R(1-\theta_B)-\frac{M}{N(1-\alpha)} > R(1-\theta_B)-\frac{M}{N\alpha+1} > c$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms carry out joint action and in the second, all cluster firms sell to the

DC firm. For $R(1-\theta_B)-\frac{M}{N\alpha+1} \le p < R(1-\theta_B)-\frac{M}{N}$, there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm and in the second, all cluster firms carry out joint action. In the third continuation equilibrium, type A firms carry out joint action and type B firms sell to the DC firm. For $p= R(1-\theta_B)-\frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, type A firms carry out joint action and type B firms sell to the DC firm and in the second, all cluster firms sell to the DC firm.

23. For $R(1-\theta_B)-\frac{M}{N(1-\alpha)} > c > R(1-\theta_B)-\frac{M}{N\alpha+1}$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm and in the second, all cluster firms carry out joint action. In the third, type A firms carry out joint action and type B firms sell to the DC firm. For $p= R(1-\theta_B)-\frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, type A firms carry out joint action and type B firms sell to the DC firm and in the second, all cluster firms sell to the DC firm.

24. For $c > R(1-\theta_B)-\frac{M}{N(1-\alpha)} > R(1-\theta_B)-\frac{M}{N\alpha+1}$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_A)-\frac{M}{N}$ there are three pure strategy continuation equilibria. In the first, type B firms sell to the DC firm and type A firms engage in joint action. In the second continuation equilibrium, all cluster firms engage in joint action. In the third, all cluster firms sell to the DC firm. For $p = R(1-\theta_A)-\frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, all cluster firms sell to the DC firm and in the second, type B firms sell their goods to the DC firm and type A firms engage in joint action.

25. For $R(1-\theta_B)-\frac{M}{N\alpha+1} > R(1-\theta_B)-\frac{M}{N(1-\alpha)} > c$, then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \le p < R(1-\theta_B)-\frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second, all cluster firms sell to the DC firm. For $R(1-\theta_B)-\frac{M}{N\alpha+1} \le p < R(1-\theta_A)-\frac{M}{N}$, there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action. In the second,

type B firms sell to the DC firm and type A firms engage in joint action. In the third, all cluster firms sell to the DC firm. For $p = R(1-\theta_A) - \frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, type B firms sell their goods to the DC firm and type A firms engage in joint action and in the second, all cluster firms sell to the DC firm.

26. For $R(1-\theta_B) - \frac{M}{N\alpha+1} > c > R(1-\theta_B) - \frac{M}{N(1-\alpha)}$, then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \leq p < R(1-\theta_B) - \frac{M}{N\alpha+1}$ there are two pure strategy continuation equilibria. In the first, all cluster firms engage in joint action and in the second all cluster firms sell to the DC firm. For $R(1-\theta_B) - \frac{M}{N\alpha+1} \leq p < R(1-\theta_A) - \frac{M}{N}$, there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action. In the second, type B firms sell to the DC firm and type A firms engage in joint action. In the third, all cluster firms sell to the DC firm. For $p = R(1-\theta_A) - \frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, type B firms sell their goods to the DC firm and type A firms engage in joint action, and in the second, all cluster firms sell to the DC firm.

27. For $c > R(1-\theta_B) - \frac{M}{N\alpha+1} > R(1-\theta_B) - \frac{M}{N(1-\alpha)}$ then we have the following equilibria in the second stage of the game, taking *p* as given.

For $c \leq p < R(1-\theta_A) - \frac{M}{N}$, there are three pure strategy continuation equilibria. In the first, all cluster firms engage in joint action. In the second, type B firms sell to the DC firm and type A firms engage in joint action. In the third, all cluster firms sell to the DC firm. For $p = R(1-\theta_A) - \frac{M}{N}$, there are two pure strategy continuation equilibria. In the first, type B firms sell their goods to the DC firm and type A firms engage in joint action, and in the second, all cluster firms sell to the DC firm.

Appendix D: Welfare Implications of Joint Action

a. Case 1: Joint action is potentially profitable for type A firms only

Case 1: $R(1-\theta_B)-\frac{M}{N} < c$ and $c < R(1-\theta_A)-\frac{M}{N\alpha}$

If the coalition-proof equilibrium refinement is applied and $\frac{M}{N[R(1-\theta_A)-c]} \leq 1/4$, then for all $\alpha \in (\alpha_5, \alpha_6)$, then type B firms receive $p=c$ selling to the DC firm, and type A firms earn $R(1-\theta_A)-\frac{M}{N\alpha}$ - c in expected profits. In this case, type B firms receive the same level of welfare as when there is no possibility of joint action, type A firms are better off, and the DC firm is worse off.

$E\Pi_A^{LDC} = R(1-\theta_A)-\frac{M}{N\alpha}$ - c

$\Pi_B^{LDC} = 0$

$E\Pi^{DC} = N(1-\alpha)[R(1-\theta_B)-c]$

If the coalition-proof equilibrium refinement is applied and either i) $\alpha_z \leq 1/4$ where $\alpha \notin (\alpha_5, \alpha_6)$ or ii) $\frac{M}{N[R(1-\theta_A)-c]} > 1/4$, the DC firm buys from all cluster firms at a price $p = R(1-\theta_A)-\frac{M}{N\alpha}$. In this case, all cluster firms are better off, and the DC firm is worse off than if there were no possibility of joint action.

$E\Pi_i^{LDC} = R(1-\theta_A)-\frac{M}{N\alpha}$ - c for $i=A,B$

$E\Pi^{DC} = NR[\alpha(1-\theta_A)+(1-\alpha)(1-\theta_B)] - N\left[R(1-\theta_A)-\frac{M}{N\alpha}\right]$

b. Cases 2 – 15: Joint action is potentially profitable for both types of cluster firms, but it is not possible for the DC firm to only buy from type B firms

Cases 2 - 15:

$R(1-\theta_B)-\frac{M}{N} > c$, $R(1-\alpha)(\theta_B-\theta_A)-\frac{M}{N\alpha} \leq 0$, and $R(1-\theta_A)-\frac{M}{N\alpha} < R(1-\theta_B)-\frac{M}{N}$

Even if the coalition-proof equilibrium refinement is applied, the DC firm procures the goods of all cluster firms, paying $p = R(1-\theta_B) - \frac{M}{N}$ for their goods. In this case, the LDC firms are better off (and the DC firm is worse off) as a result of the opportunity for joint action. The firms receive:

$\Pi_i^{LDC} = R(1-\theta_B) - \frac{M}{N} - c$ where $i=A,B$; and

$E\Pi^{DC} = NR[\alpha(1-\theta_A) + (1-\alpha)(1-\theta_B)] - N\left[R(1-\theta_B) - \frac{M}{N}\right]$

c. Cases 16 – 21: Joint action is potentially profitable for both types of cluster firms, and it is possible for the DC firm to buy from all cluster firms or only buy from type B firms

For cases 16 - 21:

$R(1-\theta_B) - \frac{M}{N} > c$, $R(1-\alpha)(\theta_B - \theta_A) - \frac{M}{N\alpha} \leq 0$, and

$R(1-\theta_B) - \frac{M}{N} < R(1-\theta_A) - \frac{M}{N\alpha}$

If the coalition-proof equilibrium refinement is applied, for parameter values such that $\frac{M}{NR(\theta_B - \theta_A)} > \frac{1}{3}$, then no joint action takes place, and the DC firm pays $p = R(1-\theta_A) - \frac{M}{N\alpha}$ to all LDC firms for their goods. In this case, the LDC firms are better off (and the DC firm is worse off) as a result of the opportunity for joint action. The firms receive:

$\Pi_i^{LDC} = R(1-\theta_A) - \frac{M}{N\alpha} - c$ where $i=A,B$; and

$E\Pi^{DC} = NR[\alpha(1-\theta_A) + (1-\alpha)(1-\theta_B)] - N\left[R(1-\theta_A) - \frac{M}{N\alpha}\right]$

Even though no joint action occurs, the cluster firms are better off and the DC firm is worse off than if there were no joint action option.

If the coalition-proof equilibrium refinement is applied, for parameter values such that $\frac{M}{NR(\theta_B - \theta_A)} < \frac{1}{3}$, then joint action happens with type A participation for $\alpha \in (\alpha_1, \alpha_2)$. The cluster firms are better off than if there were no possibility of joint action, and the DC firm is worse off.

$E\Pi_A^{LDC} = R(1-\theta_A) - \frac{M}{N\alpha} - c$

$\Pi_B^{LDC} = R(1-\theta_B) - \frac{M}{N} - c$

$E\Pi^{DC} = N(1-\alpha)R(1-\theta_B) - N(1-\alpha)\left[R(1-\theta_B) - \frac{M}{N}\right]$. Even though no joint action occurs, the cluster firms are better off and the DC firm is worse off than if there were no joint action option.

d. Cases 22 – 27: Joint action is potentially profitable for all firms, but the DC firm would earn negative profits if it were to offer type A firms what they would earn from joint action

For cases 22 - 27:

$R(1-\theta_B) - \frac{M}{N} > c$, $R(1-\alpha)(\theta_B - \theta_A) - \frac{M}{N\alpha} > 0$

If the coalition-proof equilibrium refinement is applied, then joint action takes place with the participation of type A firms and the DC firm buys the output of the type B firms at $p = R(1-\theta_B) - \frac{M}{N}$. The cluster firms are better off than if there were no possibility of joint action, and the DC firm is worse off.

$E\Pi_A^{LDC} = R(1-\theta_A) - \frac{M}{N\alpha} - c$

$\Pi_B^{LDC} = R(1-\theta_B) - \frac{M}{N} - c$

$E\Pi^{DC} = N(1-\alpha)R(1-\theta_B) - N(1-\alpha)\left[R(1-\theta_B) - \frac{M}{N}\right]$.

Appendix E: Data Cleaning and Description of Sample for Chapter Three

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.

Appendix F: Additional Regression and Data Tables

Table F1: Regressions on Trade Credit to Customers, Marginal Effects, Specifications similar to McMillan and Woodruff for Research in Vietnam, Tobit with clustered errors

	Tobit (sim. to Col. 1 of McM-W)	Tobit (Co1. 1 of McM-W)[147]	Tobit (sim. to Col. 3 of McM-W)	Tobit (Col. 3 of McM-W)
LOCK-IN				
Would Take Customer Less than a Week to Find Alternate Supply	-3.64 (-0.19)		-7.07 (-0.43)	
Would Take Cust. More Than a Month to Find Alt. Supply	22.26 (0.75)		-5.78 (-0.20)	
# Similar Manufacturers w/in 1 km		-0.7 (1.66)+		**-1.1 (2.54)***
Most important competitor w/in 1 km		**-13 (2.46)***		**-16 (2.92)****
INFORMATION/LOCK-IN				
Duration of Relationship (years)	7.32 (1.64)+	**8 (2.96)****	**8.63 (2.01)***	**7 (2.51)***
Duration-squared	-0.19 (-0.96)	**-0.5 (2.15)***	-0.23 (.)	-0.4 (1.74)+
INFO./NETWORK EFFECTS				
Info. About Customer Through Business Network	26.17 (1.32)	**20 (3.36)****	27.79 (1.49)	**10 (1.99)***
Talk To Other Suppliers of Customer At Least Monthly				**19 (2.63)****
Info. About Customer Through Social Network	-0.55 (-0.02)	4 (0.60)	16.84 (0.67)	-8 (1.34)
CONTROLS				
Price Set By Relationship With Customer			50.62 (1.77)+	2 (0.53)
Customer is Retailer/Wholesaler				7 (1.62)
Ln(1+Age)			-20.28 (-1.47)	-9 (1.76)+
Ln(Employment)			26.52 (1.95)+	2 (0.98)
Manufacturer Receives Bank Credit			14.38 (0.44)	-2 (0.36)
Avg. % of Bill Paid With Delay To Suppliers			**0.62 (2.25)***	**40 (6.27)****
Observations	132	224	132	224
Chi-Squared	8.89	73.5	32.50	134.5
Prob>Chi-Squared	0.18	<0.001	0.0003	<0.001

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

[147] 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.

Table F2: Regressions on Trade Credit to Suppliers, Marginal Effects, Specifications similar to McMillan and Woodruff for Research in Vietnam, Tobit with clustered errors

	Tobit (similar to Col. 1 of McM-W)	Tobit (Col. 1 of McM-W)[148]	Tobit (similar to col. 2 of McM-W)	Tobit (Col. 2 of McM-W)
LOCK-IN				
Would Take Customer Less than a Day to Find Alternate Supply	15.55 (0.76)	-11 (1.67)+	8.17 (0.45)	-12 (1.74)+
Would Take Customer More Than a Week to Find Alternate Supply	-19.44 (-1.34)	0.4 (0.07)	-19.23 (-1.34)	0.1 (0.02)
INFORMATION/LOCK-IN				
Duration of Relationship (years)	0.83 (0.59)	3 (1.44)	1.2 (0.93)	2 (0.92)
Duration-squared	-0.00063 (-0.15)	-0.16 (1.62)	-0.017 (-0.44)	-0.13 (1.37)
Visited Supplier Before First Purchase			-31.76 (-1.58)	7 (1.19)
Currently Visit Supplier At Least Weekly			18.74 (1.64)	-0.3 (0.06)
Manufacturer Receives Bank Credit	-26.41 (-1.56)	**26** **(3.79)****	-29.76 (-1.80)+	**23** **(3.56)****
NETWORK EFFECTS				
Introduction To Supplier Through Social Network	22.4 (1.67)+	11 (1.70)+	20.65 (1.53)	12 (1.89)+
If Manufacturer Cheated Supplier, Other Suppliers Find Out			-1.97 (-0.16)	**14** **(3.19)****
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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

[148] 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.

Table F2 (continued): Regressions on Trade Credit to Suppliers, Marginal Effects, Specifications similar to McMillan and Woodruff for Research in Vietnam, Tobit with clustered errors

	Tobit (similar to Col. 3 of McM-W)	Tobit (Col. 3 of McM-W)[149]	Tobit (similar to Col. 4 of McM-W)	Tobit (Col. 4 of McM-W)
LOCK-IN				
Would Take Customer Less than a Day to Find Alternate Supply			15.56 (0.80)	-11 (1.62)
Would Take Customer More Than a Week to Find Alternate Supply			-21.18 (-1.53)	-0.2 (0.03)
Currently Have Alternate Supplier	7.88 (0.57)	7 (1.12)		
INFORMATION/LOCK-IN				
Duration of Relationship (years)	1.09 (0.87)	2 (0.87)	0.89 (0.73)	3 (1.36)
Duration-squared	-0.015 (-0.40)	-0.12 (1.28)	-0.022 (-0.60)	-0.14 (1.54)
Visited Supplier Before First Purchase	-31.88 (-1.62)	9 (1.51)	**-42.47** **(-2.17)***	7 (1.34)
Currently Visit Supplier At Least Weekly	**22.61** **(2.02)***	-2 (0.31)	12.94 (1.07)	-2 (0.39)
Manufacturer Receives Bank Credit	-28.05 (-1.88)+	**22** **(3.46)****	-25.09 (-1.41)	**24** **(3.60)****
NETWORK EFFECTS				
Introduction To Supplier Through Social Network	22.09 (1.56)	12 (1.79)+	19.02 (1.48)	10 (1.48)
If Manufacturer Cheated Supplier, Other Suppliers Find Out	-8.54 (-0.69)	13 (3.03)	3.19 (0.25)	13 (3.09)
CONTROLS				
% Sales Main Product				**-39** **(3.23)****
Ln(1+Age)			23.68 (1.74)	-6 (1.13)
Ln(Employment)			-11.13 (-1.45)	**-6** **(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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

[149] 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.

Table F3: Customer Credit Robustness Check, Marginal Effects, Main Specification, Clustered errors

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F4: Regressions on Trade Credit to Customers, Marginal Effects, Correction for survey sampling, Main Specification

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

(Robust T-statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F5: Regressions on Trade Credit to Customers, Marginal Effects, Sample has two observations per firm, Clustered Errors, Main Specification

	Probit	Tobit	Probit (without duration)	Tobit (without duration)
LOCK-IN				
Would Take Customer More Than a Month to Find Alternate Supply	-0.059 (-0.50)	-0.89 (-0.03)	-0.078 (-0.73)	-8.88 (-0.34)
INFORMATION/LOCK-IN				
Duration of Relationship (years)	**0.043** **(2.24)***	**10.90** **(2.42)***		
Duration-squared	-0.001 (-1.24)	-0.27 (-1.36)		
INFORMATION/ NETWORK EFFECTS				
Info. About Customer Through Business Network	**0.31** **(3.14)****	**49.98** **(2.42)***	**0.31** **(3.12)****	**48.8** **(2.21)***
Talk To Other Suppliers of Customer At Least Monthly	**0.20** **(2.26)***	26.98 (1.22)	**0.20** **(2.32)***	24.83 (1.16)
ENFORCEMENT				
Businesses Would Refuse to Deal With Customer Who Cheated Manufacturer	-0.057 (-0.70)	**-36.97** **(-2.26)***	-0.047 (-0.60)	**-34.96** **(-2.16)***
Belief in Court System	**0.40** **(5.58)****	**78.44** **(3.36)****	**0.39** **(5.31)****	**71.32** **(3.02)****
CONTROLS				
Ln(1+Age)	**-0.19** **(-3.43)****	**-36.74** **(-2.91)****	-0.082 (-1.68)+	-9.60 (-0.88)
Ln(Employment)	**0.068** **(2.10)***	**23.53** **(2.78)****	**0.075** **(2.51)***	**26.52** **(3.11)****
Export Dummy	0.086 (0.90)	**43.43** **(1.98)***	0.032 (0.33)	28.41 (1.36)
Observations	120	120	120	120
R-Squared	0.25	0.062	0.19	0.040
Chi-Squared	38.45 (dof=10)	31.82 (dof=10)	31.81 (dof=8)	23.66 (dof=8)
Prob>Chi-Squared	<0.0001	0.0004	0.0001	0.0026

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F6: Regressions on Trade Credit to Customers, Marginal Effects, Exporters Only Sample, Clustered Errors, Main Specification

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F7: Regressions on Trade Credit from Suppliers, Marginal Effects, Correction for survey sampling Main Specification

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

(Robust T-statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F8: Regressions on Trade Credit from Suppliers, Marginal Effects, Sample has two observations per firm, Clustered Errors, Main Specification

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F9: Regressions on Trade Credit from Suppliers, Marginal Effects, Exporters Only Sample, Clustered Errors, Main Specification

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

(Robust z statistics in parentheses, **significant at 1%, *significant at 5%, +significant at 10%)

Table F10: Customer Credit Comparison of Regression Sample to Deleted Observations

	Mean (included)	Standard Deviation (included)	Mean (excluded)	Standard Deviation (excluded)	T-Statistic (Hypothesis: Means are equal; degree of freedom in parentheses)
DEPENDENT VARIABLES					
Give trade credit	0.55	0.50	0.44	0.50	1.62 (212)
Trade credit (%)	35.91	37.99	29.13	38.61	1.25 (210)
LOCK-IN					
Would Take Customer Less Than a Week to Find Alternate Supply	0.44	0.50	0.38	0.49	0.85 (204)
Would Take Customer More Than a Month to Find Alternate Supply	0.26	0.44	0.27	0.45	-0.20 (204)
Maintain inventory of product sold to customer	0.37	0.48	0.40	0.49	-0.42 (233)
INFORMATION/ LOCK-IN					
Duration of relationship (years)	6.74	6.63	8.38	8.83	-1.58 (222)
Duration squared	89.05	162.60	147.42	289.36	-1.91 (222)
INFORMATION / NETWORK EFFECTS					
Info. About Customer Through Business Network	0.44	0.50	0.42	0.50	0.23 (229)
Info. About Customer Through Social Network	0.13	0.34	0.10	0.30	0.65 (229)
Talk To Other Suppliers of Customer At Least Weekly	0.63	0.49	0.40	0.49	2.53 (127)
Talk To Other Suppliers of Customer At Least Monthly	0.76	0.43	0.67	0.48	1.21 (127)
ENFORCEMENT					
Customer has failed to pay after delivery	0.22	0.42	0.18	0.39	0.55 (125)
Customers Would Find Out About Dispute With Another Customer	0.44	0.50	0.26	0.44	2.20 (128)
Other producers will refuse to deal with customer who has cheated	0.42	0.50	0.31	0.47	1.23 (125)
Belief in courts*exporter dummy	0.08	0.28	0.18	0.39	-1.65 (125)
Belief in courts	0.21	0.41	0.29	0.46	-1.06 (125)

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

Table F11: Supplier Credit Comparison of Regression Sample to Deleted Observations

	Mean (included)	Standard Deviation (included)	Mean (excluded)	Standard Deviation (excluded)	T-Statistic (Hypothesis: Means are equal; degree of freedom in parentheses)
DEPENDENT VARIABLES					
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 alternate supply	0.12	0.32	0.10	0.30	0.31 (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 than 1 km	16.90	27.54	17.56	30.31	-0.12 (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 (years)	7.71	7.97	6.84	7.74	0.78 (204)
Duration squared	122.36	247.57	106.11	220.52	0.49 (204)
Introduction to Supplier Through Social Network	0.33	0.47	0.33	0.47	-0.09 (216)
Visit supplier at least once (before first sale)	0.90	0.30	0.95	0.23	-1.24 (223)
Customer visits supplier at least weekly	0.39	0.49	0.49	0.50	-1.47 (224)
INFORMATION/ NETWORK EFFECTS					
Talk with other producers at least weekly	0.56	0.50	0.56	0.50	-0.06 (127)
Talk with other producers at least monthly	0.68	0.47	0.80	0.40	-1.56 (127)
ENFORCEMENT					
If I have a dispute w/ supplier, others will find out	0.59	0.50	0.50	0.50	0.97 (123)
Dispute w/ supplier would lead to higher advance payment	0.17	0.38	0.23	0.42	-0.75 (122)
Belief in court system	0.16	0.37	0.19	0.40	-0.47 (113)
Belief in courts*export dummy	0.06	0.25	0.12	0.32	-0.97

	Mean (included)	Standard Deviation (included)	Mean (excluded)	Standard Deviation (excluded)	T-Statistic (Hypothesis: Means are equal; degree of freedom in parentheses)
					(113)
CONTROLS					
Ln(Employment)	3.34	1.06	3.37	1.20	-0.17 (129)
Ln(1+age)	2.67	0.64	2.66	0.84	0.12 (130)
Receive bank credit	0.33	0.48	0.27	0.45	0.70 (116)
Have access to credit	0.33	0.48	0.33	0.48	0.00 (115)
Vendors	0.40	0.49	0	0.49	0.19 (123)
Exporters	0.60	0.49	1	0.49	-0.19 (123)

Table F12: Joint Action Comparison of Regression Sample to Deleted Observations

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

Table F13: Sources and Uses of Trade Credit[150]

EXPORTERS (53 firms)					
	Give to old customer (only)	Give to new customer (only)	Give to neither customer	Give to both customers	Total
Receive from old supplier (only)	2	0	0	0	**2**
Receive from new supplier (only)	1	0	2	0	**3**
Receive from neither supplier	4	10	8	4	**26**
Receive from both suppliers	8	1	6	7	**22**
Total	**15**	**11**	**16**	**11**	Out of 53 exporters, 37 give trade credit, and 27 receive trade credit.

VENDORS (42 firms)					
	Give to old customer (only)	Give to new customer (only)	Give to neither customer	Give to both 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 credit.

[150] The sample used to create this table is larger than the samples used in the regressions on trade credit in Chapter Three, 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.

Table F14: Correlation Coefficients for Customer Credit Variables

	Vendor Dummy	*Exporter Dummy*	*LnEmp*	*Ln(1+age)*	*Duration*	*Dur-Sq*	*Business Network for Info*	*Social Network for Info*
Vendor Dummy	1.00							
Exporter Dummy	-1.00	1.00						
LnEmp	-0.52	0.52	1.00					
Ln(1+age)	-0.25	0.25	0.29	1.00				
Duration	-0.04	0.04	0.12	0.48	1.00			
Dur-Sq	-0.10	0.10	0.14	0.44	0.94	1.00		
Business Network for Info	0.50	-0.50	-0.30	-0.19	0.00	-0.01	1.00	
Social Network for Info	-0.13	0.13	-0.06	-0.04	0.00	0.02	-0.02	1.00
Trade Credit (0/1)	0.13	-0.13	0.06	-0.11	0.14	0.09	0.24	-0.02
TradeCredit %	-0.12	0.12	0.28	0.08	0.24	0.19	0.07	0.00
Lockin-less than 1 week alt. Supp	0.57	-0.57	-0.38	-0.25	-0.08	-0.12	0.37	0.08
Lockin-more than 1 month alt. Supp	-0.48	0.48	0.53	0.27	0.12	0.17	-0.42	-0.02
Cust Find Out About Dispute	0.16	-0.16	-0.15	0.08	0.02	-0.03	0.08	0.19
Bus Refuse to Deal w/ Cheating Cust	-0.15	0.15	0.19	-0.03	-0.07	-0.10	-0.11	0.08
*Court*Exporter*	-0.28	0.28	0.33	0.17	0.07	0.04	-0.10	0.05
Belief in Courts	0.13	-0.13	0.11	0.10	0.03	-0.02	-0.03	-0.03

	Vendor Dummy	*Exporter Dummy*	*LnEmp*	*Ln(1+age)*	*Duration*	*Dur-Sq*	*Business Network for Info*	*Social Network for Info*
Avg Trade Credit from Supplier	0.27	-0.27	0.01	0.03	0.06	0.07	0.09	-0.13
Talk Weekly w/Other Firms	0.24	-0.24	-0.03	0.01	0.07	0.07	0.12	0.10
Talk Monthly w/Other Firms	0.11	-0.11	0.00	-0.02	0.03	0.06	-0.03	0.03
Bank Credit	-0.54	0.54	0.52	0.18	0.10	0.17	-0.30	-0.17
CreditAccess	-0.60	0.60	0.55	0.12	0.07	0.16	-0.37	0.05
Price Set Relationship w/Cust	-0.11	0.11	0.05	0.07	-0.05	-0.04	0.02	-0.05

	Trade Credit (0/1)	*TradeCredit %*	*Lockin-less than 1 week alt. Supp*	*Lockin-more than 1 month alt. Supp*	*Cust Find Out About Dispute*	*Bus Refuse to Deal w/ Cheating Cust*	*Court* Exporter*	*Belief in Courts*
Trade Credit (0/1)	1.00							
TradeCredit %	0.84	1.00						
Lockin-less than 1 week alt. Supp	0.17	-0.05	1.00					
Lockin-more than 1 month alt. Supp	-0.13	0.07	-0.51	1.00				

	Trade Credit (0/1)	*TradeCredit %*	*Lockin-less than 1 week alt. Supp*	*Lockin-more than 1 month alt. Supp*	*Cust Find Out About Dispute*	*Bus Refuse to Deal w/ Cheating Cust*	*Court* Exporter*	*Belief in Courts*
Cust Find Out About Dispute	-0.07	-0.10	0.00	-0.09	1.00			
Bus Refuse to Deal w/ Cheating Cust	0.03	-0.04	-0.13	0.13	0.57	1.00		
*Court*Exporter*	0.11	0.22	-0.15	0.26	-0.06	0.18	1.00	
Belief in Courts	0.23	0.18	-0.10	0.00	0.18	0.29	0.59	1.00
Avg Trade Credit from Supplier	0.33	0.16	0.22	-0.06	-0.09	0.03	-0.24	0.05
Talk Weekly w/Other Firms	0.25	0.10	0.23	-0.14	-0.02	0.06	-0.18	0.10
Talk Monthly w/Other Firms	0.13	0.05	0.04	-0.16	-0.12	-0.08	-0.31	-0.06
Bank Credit	-0.08	0.12	-0.33	0.38	-0.32	0.07	0.14	-0.08
CreditAccess	-0.09	0.13	-0.33	0.45	-0.26	0.12	0.23	-0.04
Price Set Relationship w/Cust	-0.01	0.05	-0.11	-0.07	0.14	0.14	-0.04	-0.06

	Avg Trade Credit from Supplier	*Talk Weekly w/Other Firms*	*Talk Monthly w/Other Firms*	*Bank Credit*	*CreditAccess*	*Price Set Relationship w/Cust*
Avg Trade Credit from Supplier	1.00					
Talk Weekly w/Other Firms	0.53	1.00				
Talk Monthly w/Other Firms	0.30	0.70	1.00			
Bank Credit	-0.13	-0.37	-0.21	1.00		
CreditAccess	-0.15	-0.28	-0.15	0.89	1.00	
Price Set Relationship w/Cust	-0.15	-0.17	-0.24	0.21	0.19	1.00

Table F15: Correlation Coefficients for Supplier Credit Variables

	Vendor Dummy	*Exporter Dummy*	*LnEmp*	*Ln(1+age)*	*Duration*	*Dur-sq*	*Bus Network Intro*	*Social Network Intro*
Vendor Dummy	1.00							
Exporter Dummy	-1.00	1.00						
LnEmp	-0.54	0.54	1.00					
Ln(1+age)	-0.11	0.11	0.41	1.00				
Duration	0.03	-0.03	0.11	0.41	1.00			
Dur-sq	-0.04	0.04	0.14	0.41	0.92	1.00		
Bus Network Intro	-0.16	0.16	0.24	-0.04	-0.04	-0.08	1.00	
Social Network Intro	0.14	-0.14	-0.18	0.02	0.17	0.13	-0.16	1.00
Visit Supplier at Least Once b/f 1st sale	0.26	-0.26	-0.11	0.26	0.16	0.13	-0.01	0.10
Trade Credit (0/1)	0.33	-0.33	-0.18	0.10	0.14	0.12	-0.11	0.20
TradeCredit %	0.30	-0.30	-0.14	0.15	0.13	0.10	-0.17	0.23
Have Other Supp	-0.22	0.22	0.20	0.17	0.09	0.10	-0.21	0.12
Lock-in: a day or less	-0.29	0.29	0.46	0.18	0.05	0.11	0.13	-0.25
Lock-in: more than 1 week	-0.02	0.02	-0.12	-0.07	-0.02	-0.04	-0.13	-0.23
Visit Supp Weekly	0.07	-0.07	0.04	0.20	0.12	0.16	0.13	0.14
% inputs <1km	-0.14	0.14	0.06	0.04	0.02	-0.01	0.09	0.17
% Inputs Import	-0.27	0.27	0.48	0.08	-0.10	-0.08	0.26	-0.18
Other Supp Find Out About Cheater	-0.09	0.09	0.07	-0.06	-0.05	-0.06	-0.07	-0.05

	Vendor Dummy	*Exporter Dummy*	*LnEmp*	*Ln(1+age)*	*Duration*	*Dur-sq*	*Bus Network Intro*	*Social Network Intro*
Belief in Courts	0.14	-0.14	0.03	0.06	0.01	-0.01	-0.18	-0.18
Court Exporter*	-0.21	0.21	0.19	0.10	-0.08	-0.07	-0.12	-0.02
Dispute Leads Higher Adv Pay	-0.10	0.10	-0.15	0.15	0.06	0.07	0.03	0.10
Talk Weekly w/Other Firms	0.35	-0.35	-0.12	0.30	0.18	0.17	-0.19	0.35

	Visit Supplier at Least Once b/f 1st sale	*Trade Credit (0/1)*	*TradeCredit %*	*Have Other Supp*	*Lock-in: a day or less*	*Lock-in: more than 1 week*	*Visit Supp Weekly*
Visit Supplier at Least Once b/f 1st sale	1.00						
Trade Credit (0/1)	-0.06	1.00					
TradeCredit %	-0.06	0.85	1.00				
Have Other Supp	-0.20	0.10	0.09	1.00			
Lock-in: a day or less	-0.16	0.03	0.00	0.03	1.00		
Lock-in: more than 1 week	0.01	-0.19	-0.20	-0.24	-0.23	1.00	
Visit Supp Weekly	0.14	0.21	0.16	-0.01	0.11	-0.06	1.00
% inputs <1km	0.00	-0.07	-0.06	-0.28	-0.18	0.19	0.02
% Inputs Import	-0.01	-0.10	-0.15	0.04	0.51	-0.15	0.10

	Visit Supplier at Least Once b/f 1st sale	*Trade Credit (0/1)*	*TradeCredit %*	*Have Other Supp*	*Lock-in: a day or less*	*Lock-in: more than 1 week*	*Visit Supp Weekly*
Other Supp Find Out About Cheater	-0.08	-0.04	-0.06	-0.04	-0.16	0.27	0.24
Belief in Courts	0.05	-0.02	-0.04	-0.16	-0.07	0.25	-0.32
Court Exporter*	-0.04	0.04	-0.03	0.15	0.02	0.00	-0.21
Dispute Leads Higher Adv Pay	-0.07	0.12	0.11	0.03	-0.17	0.26	0.13
Talk Weekly w/Other Firms	0.35	0.42	0.38	0.12	-0.11	-0.20	0.39

	% inputs <1km	*% Inputs Import*	*Other Supp Find Out About Cheater*	*Belief in Courts*	*Court* Exporter*	*Dispute Leads Higher Adv Pay*	*Talk Weekly w/Other Firms*
% inputs <1km	1.00						
% Inputs Import	-0.09	1.00					
Other Supp Find Out About Cheater	0.22	-0.01	1.00				
Belief in Courts	0.28	0.05	0.17	1.00			
Court Exporter*	0.20	0.19	0.13	0.63	1.00		
Dispute Leads Higher Adv Pay	0.27	-0.13	0.06	0.07	0.25	1.00	
Talk Weekly w/Other Firms	-0.09	-0.14	-0.18	-0.18	-0.05	0.18	1.00

Table F16: Correlation Table for Joint Action Variables

	Emp	*Emp-sq*	*Age*	*Age-sq*	*SellProducts Own Name*	*Sell to hospitals*
Emp	1.00					
Emp-sq	0.93	1.00				
Age	0.12	0.02	1.00			
Age-sq	0.09	0.01	0.96	1.00		
Sell Products Own Name	-0.01	0.00	-0.15	-0.17	1.00	
Sell to hospitals	-0.01	-0.02	-0.10	-0.10	0.11	1.00
Would do joint action	-0.13	-0.14	0.05	0.09	0.27	0.30
Duration oldest cust	0.10	-0.01	0.73	0.68	-0.26	-0.01
Dur-Sq	0.06	-0.02	0.66	0.66	-0.27	-0.04
Talk weekly other firms	0.08	0.07	0.17	0.21	-0.01	0.11
CreditAccess	0.18	0.07	0.03	0.04	-0.20	-0.16

	Would do joint action	*Duration oldest cust*	*Dur-Sq*	*Talk weekly other firms*	*CreditAccess*
Would do joint action	1.00				
Duration oldest cust	-0.06	1.00			
Dur-Sq	0.03	0.95	1.00		
Talk weekly other firms	0.19	0.11	0.09	1.00	
CreditAccess	-0.07	0.07	0.03	-0.20	1.00

Appendix G: Additional Information on Survey Instrument and Data Gathering

The field work for the survey was carried out by Shamyla Chaudry, a faculty member of the Lahore School of Economics in Lahore, Pakistan between April and August 2002. Ms. Chaudry visited Sialkot a number of times during the field work. The first step was to obtain permission and the support of SIMA, the Surgical Instrument Manufacturers Association to conduct the survey. The surveys (in English) were mailed to the 180 exporting firms found to be operating at the time. The interviewer followed up with phone calls to the exporters to collect the surveys. 99 returned the surveys, out of which 76 were at least partially filled out. Since this was a smaller sample size than originally foreseen, Ms. Chaudry supplemented the results with additional data obtained from the vendor firms, which are mainly sub-contractors for the exporting firms. For this purpose, the survey was translated in Urdu. Face-to-face interviews were conducted of 47 vendor firms.

Sialkot Firm Questionnaire

Name of Firm being interviewed:_____

Note to interviewer: Please ask interviewee to answer questions as to conditions ***before September 2001***.

This survey is being conducted as part of a thesis on clusters or groups of firms that are located close together and produce similar products. Sialkot is an important cluster, and I have written about it extensively in my thesis. The purpose of the survey is to understand better how surgical instrument firms like your own interact with your customers and suppliers. Thank you very much for taking the time to complete this survey.

Part 1: GENERAL QUESTIONS about interviewed firm:

1. What is the name of your firm? _____

2. How many employees do you have in August 2001? _____

3. When did your firm start to operate? _____

4. How many different products does your firm manufacture? _____

5. What percentage of your firm is owned by:
(a) the top manager or his family? _____%
(b) other private individuals? _____%
(c) other private firms? _____%
(d) other _____%

Part 2: Questions about cooperation and marketing

6. Does your largest customer
(a) sell the surgical instruments you produce only under their own brand name
(b) sell the surgical instruments you produce only under your company's name
(c) sell some items under their brand name and others under your company's name

7. Does your second largest customer
(a) sell the surgical instruments you produce only under their own brand name
(b) sell the surgical instruments you produce only under your company's name
(c) sell some items under their brand name and others under your company's name

8. Do you currently sell any surgical instruments directly to hospitals? (0) No (1) Yes
If yes, do you use the internet/world wide web to market your products? (0) No (1) Yes

9. 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 *(if answer is yes, continue to next part of question, otherwise, go to question 10)*
Would you still want to do that if it meant you lost your business relationship with the surgical instrument companies that currently buy from you? (0) No (1) Yes

10. Would you join in a cooperative with other manufacturers in Sialkot to market your products directly to hospitals or doctors rather than selling to surgical instrument companies in the U.S. and Europe if:
(a) the price that hospitals paid for surgical instruments rose 10%? (0) No (1) Yes *(if answer is no, continue to part (b), otherwise go to question 11)*
(b) the price that hospitals paid for surgical instruments rose 25%? (0) No (1) Yes *(if answer is no, continue to part (c), otherwise go to question 11)*
(c) the price that hospitals paid for surgical instruments rose 50%? (0) No (1) Yes *(if answer is no, go to question 12, otherwise go to question 11)*

11. If the price that hospitals paid for surgical instruments rose and you were considering joining the cooperative, would you still want to join the cooperative if it meant you lost your business relationship with the surgical instrument companies that currently buy from you? (0) No (1) Yes

12. If the minimum quality standards demanded by surgical instrument companies rose, would you join a cooperative with other manufacturers in Sialkot to market your products directly to hospitals? (0) No (1) Yes *(if answer is yes, continue to next part of question, otherwise, go to question 13)*
Would you still want to join the cooperative if it meant you lost your business relationship with the surgical instrument companies that currently buy from you? (0) No (1) Yes

13. If hospitals were willing to buy surgical instruments directly from Sialkot firms through the internet, would you consider doing that? (0) No (1) Yes *(if answer is yes, continue to next part of question, otherwise, go to question 14)*
Would you still want to joint the cooperative if it meant you lost your business relationship with the surgical instrument companies that currently buy from you? (0) No (1) Yes

14. Would you be more likely to join such a cooperative if the other firms joining were mostly large firms? (0) No (1) Yes

15. Would be more likely to join such a cooperative if the other firms joining were mostly small firms? (0) No (1) Yes

16. Additional comments: Has the idea of a cooperative among Sialkot firms to avoid the middleman and sell directly in the U.S. and Europe ever been discussed? What factors would influence your decision?

_____
_____
_____
_____
_____

Part 3: Questions about CUSTOMERS of the interviewed firm:

(The "First Customer" refers to your largest customer at the time your firm started as a private firm.)

	First Customer	**Newest Customer**
17. Are quality specifications	(1) written in a contract/order? (0) discussed orally?	(1) written in a contract/order? (0) discussed orally?
18. Do you sell this good only to this customer, or do you produce the same good for other customers?	(0) unique (1) same for other	(0) unique (1) same for other
19. Do you maintain inventories of this good, or do you produce it only to fill orders?	(0) to order (1) inventory	(0) to order (1) inventory
20. What percentage of your sales go to this customer?		
21. Is he currently a customer?	(0) No (1) yes	(0) No (1) yes
22. How long has he been a customer?	_____Years _____Months	_____Years _____Months
23. How did you first make contact with this customer?	(a) through a government agency (b) SIMA (c) previously unknown to you *and* (c1) they contacted you (c2) a third party introduced you (c3) you advertised (d) other_____	(a) through a government agency (b) SIMA (c) previously unknown to you *and* (c1) they contacted you (c2) a third party introduced you (c3) you advertised (d) other _____
24. What type of firm is this customer?	(a) a domestic middleman (private trader) who resells the good to: (a1) domestic customer (a2) foreign customer (b) government firm (d) a foreign firm (from what country?_____, and is this a large foreign firm?_____)	(a) a domestic middleman (private trader) who resells the good to: (a1) domestic customer (a2) foreign customer (b) government firm (d) a foreign firm (from what country?_____ , and is this a large foreign firm?_____)
25. Before you began working with him, what were your sources of information about this customer?	(circle all that apply) (a) have no information (b) other businesspeople who make products similar to yours (c) other suppliers	(circle all that apply) (a) have no information (b) other businesspeople who make products similar to yours (c) other suppliers

	(d) credit bureau/business association (SIMA) (e) a government agency (f) your own research (g) family (h) other (specify) _____	(d) credit bureau/business association (SIMA) (e) a government agency (f) your own research (g) family (h) other (specify) _____

26. Do you give credit to the customer? (In other words, do you allow the customer to make payment after delivery?)	(1) yes (0) no	(1) yes (0) no
27. If yes, how long did you work with this customer before you offered credit?	_____Years _____Months	_____Years _____Months
28. When does the customer pay you?	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery
29. If this customer refused to accept delivery of an order, how long would it take you to find another customer for these goods?	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month (e) would be impossible	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month (e) would be impossible
30. If you failed to deliver an order, how long would it take this customer to find replacement goods?	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month (e) would be impossible	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month (e) would be impossible
31. Currently, do you talk with other suppliers of this customer?	(a) no (b) yes, daily (c) yes, weekly (d) yes, monthly (e) yes, but infrequently	(a) no (b) yes, daily (c) yes, weekly (d) yes, monthly (e) yes, but infrequently

GENERAL QUESTIONS ABOUT CUSTOMERS of the interviewed firm:

32. Has a customer ever failed to pay for a product after you have delivered it? _____
If so, describe the incident and the actions you took to resolve it:
[Note to interviewer: please make general notes about the case, including information such as: a) the final outcome (write off debt or recovered some money), b) if an outside agency assisted in the case (such as courts or local government), c) when the incident occurred, d) how long the Sialkot firm had worked with this customer when the dispute occurred, e) where the customer was located, and f) if the Sialkot firm still works with this customer.]

_____
_____
_____

33. What percentage of your shipments are returned by customers because the quality is defective? _____%

34. How do you resolve disputes with customers over the quality of goods delivered?
(a) I accept the returned merchandise
(b) negotiate a partial settlement without outside assistance
(c) take them to court
(d) appeal to the local government authorities
(e) appeal to SIMA
(f) other (specify_____)

Do you agree or disagree with the following statements:

35. If I had a dispute with a customer, my other customers would surely find out about it.
(0) Agree (1) Disagree (2) Indifferent

36. Businesses will refuse to deal with a customer who has dealt unfairly with me.
(0) Agree (1) Disagree (2) Indifferent

37. Local government is important in resolving disputes with customers.
(0) Agree (1) Disagree (2) Indifferent

38. If a customer of mine cheats another firm, I will surely find out about it.
(0) Agree (1) Disagree (2) Indifferent

39. If a customer cheated me, all of the other firms producing the products I produce would hear about it. (0) Agree (1) Disagree (2) Indifferent

40.Courts are very important for resolving disputes with customers.
(0) Agree (1) Disagree (2) Indifferent

41. Industry trade associations (such as SIMA) are a good source of information about the reliability of potential customers. (0) Agree (1) Disagree (2) Indifferent

42. SIMA helps to resolve disputes with customers.
(0) Agree (1) Disagree (2) Indifferent

Part 4: Questions about the SUPPLIERS of the interviewed firm:

(For this section, consider only those suppliers accounting for 3 % or more of your procurement bill. If more than one supplier has been a supplier for the same length of time, answer the questions with reference to the biggest supplier in this group. Oldest continuous supplier refers to the supplier that you worked with for the longest time)

	Oldest Continuous Supplier	**Newest Supplier**
43. What input is provided by this supplier?		
44. Does this supplier make the exact same product for other firms, or is the input specific to your firm?	(1) unique (0) same for other	(1) unique (0) same for other
45. How long has he been a supplier?	_____Years _____Months	_____Years _____Months
46. Does the supplier maintain inventories of this product, or produce it only to fill your orders?	(1) to order (0) inventory	(1) to order (0) inventory
47. Are quality specifications	(1)written in a contract/order? (0)discussed orally?	(1)written in a contract/order? (0)discussed orally?
48. How did you first make contact with this supplier?	(a) managed/owned by family or friend (b) you used to work in this firm (c) a previous business acquaintance (d) previously unknown to you *and* (d1) they contacted you (d2)a third party introduced you (d3) you advertised (d4) other	(a) managed/owned by family or friend (b) you used to work in this firm (c) a previous business acquaintance (d) previously unknown to you *and* (d1) they contacted you (d2) a third party introduced you (d3) you advertised (d4) other
49. Is this supplier located	(1) in Sialkot? (0) outside Sialkot?	(1) in Sialkot? (0) outside Sialkot?
50. Is this supplier	(a) a state enterprise? (b) a private enterprise? *and* (b1)an individual or household (b2)private trading company (b3)manufacturing firm (b4)other private enterprise	(a) a state enterprise? (b) a private enterprise? *and* (b1)an individual or household (b2)private trading company (b3)manufacturing firm (b4)other private enterprise

	Oldest Continuous Supplier	**Newest Supplier**
51. Before you began working with him, what were your sources of information about this supplier?	(circle all that apply) (a) other businesspeople who make products similar to yours (b) other suppliers (c) SIMA (d) a government agency (e) your own research (f) you used to work there (g) family (h) other (specify) _____	(circle all that apply) (a) other businesspeople who make products similar to yours (b) other suppliers (c) SIMA (d) a government agency (e) your own research (f) you used to work there (g) family (h) other (specify) _____
52. How many times did you visit this supplier's factory before you purchased from it?	(a) never (b) 1-3 times (c) 3-6 times (d) more than 6 times	(a) never (b) 1-3 times (c) 3-6 times (d) more than 6 times
53. Does the supplier give you credit? (meaning, are you allowed to pay part of the bill after the supplies are delivered?	(1) yes (0) no	(1) yes (0) no
54. If yes, how long did you work with this supplier before he offered credit?	_____Years _____Months	_____Years _____Months
55. When do you pay the supplier?	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery
56. The first year you worked with this supplier, when did you pay him?	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery	(a) ___% when the order is placed (b) ___% on delivery (c) ___% after delivery
57. Do you have other suppliers of this input?	(1) yes (0) no	(1) yes (0) no
58. If this supplier failed to deliver an order, how long would it take you to find replacement supplies?	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month	(a) a day or less (b) more than a day, less than a week (c) more than a week, less than a month (d) more than a month
59. How often do you visit his factory?	(a) daily (b) weekly (c) monthly (d) less often	(a) daily (b) weekly (c) monthly (d) less often
60. How often does he visit your factory?	(a) daily (b) weekly (c) monthly (d) less often	(a) daily (b) weekly (c) monthly (d) less often

	Oldest Continuous Supplier	**Newest Supplier**
61. Currently, do you talk with other clients of this supplier?	(a) no (b) yes, daily (c) yes, weekly (d) yes, monthly (e) yes, but infrequently	(a) no (b) yes, daily (c) yes, weekly (d) yes, monthly (e) yes, but infrequently
62. If another firm you have never purchased from offered to supply this input for a price 10% less than this supplier, would you purchase from the new firm instead of this supplier?	(a) yes (b) no (c) buy from both	(a) yes (b) no (c) buy from both

GENERAL QUESTIONS about SUPPLIERS of the interviewed firm:

63. What portion of your supplies in 2001 were purchased from firms located:
(a) within 1 km of your firm _____%
(b) further than 1 km, but within Sialkot _____%
(c) outside of Pakistan (imports) _____%

64. Has a supplier ever failed to deliver supplies AND not returned your advance payment? _____. If so, describe the incident and the actions you took to resolve it:
[Note to person conducting survey: please make general notes about the case, with information such as:
a) the final outcome (write off debt or recovered some money), b) if an outside agency assisted in the case (such as courts or local government), c) when the incident occurred, d) how long the Sialkot firm had worked with this supplier when the dispute occurred, e) where the supplier was located, and f) if the Sialkot firm still works with this supplier.]
_____
_____
_____
_____

65. What percentage of supplies do you return to the supplier because the quality is defective? _____%

66. How do you resolve disputes with suppliers over the quality of goods delivered?
(a) I accept the low-quality supplies
(b) negotiate a partial settlement without outside assistance
(c) take them to court
(d) appeal to the local government authorities
(e) appeal to SIMA
(f) other (specify_____)

67. Have you ever tried to buy inputs from a supplier but couldn't because the supplier had already sold his inputs to another customer? (1) yes (0) no. If yes, what did you do in this situation?_____
_____

68. What determines the decision to make your own inputs instead of buying inputs from suppliers? Rank these in order of importance.

(a) changes in demand for your product
(b) uncertainty that supplier will have enough inputs to satisfy your needs
(c) other.
Explain_____
_____
_____

Do you agree or disagree with the following statements?

69. A trade dispute with one of my suppliers causes serious problems with my relationships with other suppliers. (0) Agree (1) Disagree (2) Indifferent

70. I would never purchase from a supplier if I heard they had cheated another firm.
(0) Agree (1) Disagree (2) Indifferent

71. The only way I can be sure of having good quality supplies is to have long-term relationships with suppliers. (0) Agree (1) Disagree (2) Indifferent

72. Local governments are a good source of information about the reliability of potential suppliers.
(0) Agree (1) Disagree (2) Indifferent

73. If I have a dispute with one of my suppliers, my other suppliers will surely find out about it.
(0) Agree (1) Disagree (2) Indifferent

74. The only reliable suppliers are firms owned or managed by my relatives.
(0) Agree (1) Disagree (2) Indifferent

75. The only reliable suppliers are firms owned or managed by members of my biraderi.
(0) Agree (1) Disagree (2) Indifferent

76. Courts are very important for resolving disputes with suppliers. (0) Agree (1) Disagree (2) Indifferent

77. Businesses will refuse to deal with a supplier who has dealt unfairly with me.
(0) Agree (1) Disagree (2) Indifferent

78. SIMA is a good source of information about the reliability of potential suppliers.
(0) Agree (1) Disagree (2) Indifferent

79. SIMA helps to resolve disputes with suppliers.
(0) Agree (1) Disagree (2) Indifferent

80. If one of my suppliers cheated another firm, I would find out about it.
(0) Agree (1) Disagree (2) Indifferent

81. If I have a dispute with one of my suppliers, my other suppliers will demand a bigger advanced payment. (0) Agree (1) Disagree (2) Indifferent

82. Fluctuations in demand for surgical instruments would make me to buy inputs from suppliers rather than to make my own inputs. (0) Agree (1) Disagree (2) Indifferent

83. Fear that my supplier will not have enough supplies to fulfill my needs causes me to make some of my own inputs. (0) Agree (1) Disagree (2) Indifferent

Part 5: FINAL GENERAL QUESTIONS

84. How often do you talk with other surgical instrument manufacturers in Sialkot?
(a) daily
(b) weekly
(c) monthly
(d) less frequently / not at all

85. If yes, what do you talk about? (all that apply)
(a) suppliers
(b) customers
(c) technology
(d) product design
(e) government regulations
(f) labor
(g) pricing
(h) other _____

86. What benefits do you get from SIMA?
(a) information about technology
(b) information about the identity and location of new customers/suppliers
(c) information about the trustworthiness of customers/suppliers
(d) contract and/or dispute arbitration
(e) other _____

87. Do you currently receive state or private bank financing? (1) yes (0) no

88. Do you belong to any sort of credit or saving association? (1) yes (0) no

89. What are the two most important factors in determining the price you charge for your products? (rank the two most important factors)
(a) cost of inputs _____ (rank)
(b) Relationship with the customer_____
(c) competitors prices_____
(d) bargaining power of buyer_____
(e) seasonal demand of product_____
(f) Other (_____) _____

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