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Infrastructure and Cluster Development

A Case Study of Handloom Weavers in Ethiopia

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ABSTRACT

Rural nonfarm development plays a key role in generating employment in many developing countries. Clustering is an important form of industrial organization in the rural nonfarm sector. Based on a primary survey of both urban and rural handloom weaver clusters in Ethiopia, one of the country's most important rural nonfarm sectors, this paper examines the mechanism and performance of clustering. That cluster-based handloom production survives even in remote rural areas illustrates its vitality in restricted environments. In the absence of financial institutions, clustered producers set up interconnected trade credit linkages to ease working capital constraints. Moreover, geographical clustering enables entrepreneurs with limited capital to enter the business through shared workspaces and fine division of labor. Despite the viability of the clustering model of production operating in harsh environments, an improvement in infrastructure can further enhance firm performance in a cluster. Our survey indicates that producers in electrified towns work longer hours than those in towns without electricity. In addition, the rental cost of shared lit workspaces is minimal, attracting more poor entrepreneurs to participate in handloom production than would otherwise be possible.

Keywords: industrial clustering, productivity, handloom weavers, Ethiopia

1. INTRODUCTION

Rural nonfarm development is a strategic priority for many developing countries during their economic transformation from an agricultural to an industrial society. It plays an important role in generating local employment and linking with other sectors (Haggblade, Hazell, and Reardon 2007). Despite its importance, there remains a great knowledge gap on how rural nonfarm activities are organized in rural areas, especially in more remote places. One major challenge in developing the rural nonfarm sector is credit constraints. The poor usually have neither enough financial resources nor access to formal credit to start a business in the nonfarm sector. Therefore, a common view in the literature is that a functioning financial market is a precondition for industrial development (Ayyagari, Demirgüç-Kunt, and Maksimovic 2006; Banerjee and Newman 1993; Goldsmith 1969; King and Levine 1993; McKinnon 1973; Rajan and Zingales 1998). Yet in many developing countries, development of a functioning financial market is often a daunting task in itself. Rather than wait for financial markets to develop, it would be useful to identify alternative approaches of industrial development that adapt to and arise from an environment that lacks formal institutions.

Industrial clustering is one way of overcoming such constraints. A cluster is a sectoral and geographical concentration of enterprises (Porter 2000; Schmitz 1995). Adam Smith (1904) was the first to chronicle the economic gains available to firms through the division of labor, a key feature of industrial clustering. Through the division of the production process into many incremental steps in an industrial cluster, many firms can realize such economic gains. In addition to the efficiency gains, industrial clusters enjoy at least three more well-known major benefits: access to markets, labor market pooling, and technological spillovers (Krugman 1991; Marshall 1920). These benefits, also referred to in the literature as "collective efficiencies," can enable more entrepreneurs to participate in industrial production that may otherwise be inaccessible to them (Schmitz 1995; Schmitz and Nadvi 1999). Ruan and Zhang (2009) highlight a further key collective efficiency of the clustering mechanism: clustering can help lower the capital barriers to entry through division of the production process among firms, thereby enabling more potential entrepreneurs with limited capital to enter the production process and achieve returns to their investment.

There is a distinct body of literature empirically studying industrial clusters and their impact on economic development (Bell and Albu 1999; Fujita, Krugman, and Venables 2001; Gordon and McCann 2000; Meyer-Stamer 1998; Nakabayashi 2006; Porter 2000; Ruan and Zhang 2009; Sonobe and Otsuka 2006; Weijland 1999). Most of these studies focus on urban and peri-urban areas. Compared to the larger body of literature on Asian countries, studies on Africa are more scant, with a few exceptions.

Oyelaran-Oyeyinka and McCormick (2007) present nine case studies of clusters across seven African nations. Over half of the case studies presented in the work reflect qualitative studies, focusing on secondary data collection or case study interviews with significant informants in each cluster. Of the 36 clusters presented, only five are rural: one textile cluster, two furniture or woodworking clusters, one fisheries cluster, and one metalworking cluster. Overall, these case studies illustrate the importance of market linkages as well as the role of clustering in promoting innovation. Joint action and interfirm linkages are cited as key factors of success in seven of the nine case studies, highlighting the importance of linkages in cluster productivity. Infrastructure is also mentioned in all the case studies as one of many factors involved in day-to-day operation, but there is no rigorous assessment of the impact of infrastructure on firm productivity within a cluster.

In a book of 10 case studies in seven African countries, Zeng (2008) describes the development process of clusters and illustrates some features of clusters in fostering technological innovation and knowledge sharing. The studies in Zeng's book focus in large part on the origins of and mechanisms of overcoming institutional constraints to development in each cluster. Of the 10 case studies, only two address rural clusters specifically. The first examines the Lake Naivasha cut flower cluster in Kenya near Nairobi (Bolo 2008). Bolo finds that the major keys to success for this cluster proceed from a conjunction of natural resource endowments with excellent infrastructure connecting the cluster to the international market. The second case study with a rural focus is the Nnewi automotive components cluster in Nigeria, which is located in a rural area but is dominated by large automotive firms (Abiola 2008). Abiola describes how the cluster initially was financed through automotive parts traders' own savings, but has expanded through connections to international supplier markets. Abiola also mentions (somewhat in passing) that electricity is so important to clustered firms that 98 percent of firms have standby generators and 79.5 percent of firms spend 1 to 20 percent of total investment on power generators. Both case studies mention the importance of infrastructure in the evolution of the clusters, but in a rather descriptive way. More quantitative evidence is needed to further test the importance of infrastructure in rural clusters.

The two books show that clusters are ubiquitous across the continent and that the classical collective efficiencies of clustering in promoting technological spillover and market linkages hold true in the African context. However, the advantage of industrial clustering in reducing financial constraints has not been fully explored. The literature has yet to fully explore the production organization, structure, and mechanisms of clusters in Africa where formal financial institutions are generally lacking and infrastructure is often limited.

To fill in the knowledge gap, this paper investigates an in-depth case study of handloom clusters in Ethiopia, with particular interest on the workings of rural clusters. Studies of clustering within Ethiopia to date have maintained a geographical focus on the capital city of Addis Ababa and nearby areas (Abdella and Ayele 2007; Sonobe, Akoten, and Otsuka 2006). Handloom weaving clusters in Ethiopia are geographically concentrated, in both rural and urban environments. In this study, we survey not only three urban clusters in the capital city but also six rural clusters in southern Ethiopia. This study supplements the already growing literature by providing evidence of clustering mechanisms even in remote rural Ethiopia, and by showing the impact of infrastructure on productivity within geographically clustered producers.

Based on a primary survey of 486 producers and 154 traders in both rural and urban clusters, we map out the structures and linkages among producers. In the Ethiopian handloom context, steps of production are divided such that each firm can specialize in one specific phase of production (for example, weaving cloth). Yarn factories exist locally so that individual handloom weavers are saved the effort of spinning and dyeing yarn themselves, and traders travel from market areas to weaver locations to purchase finished products. Although the system may look fairly primitive, with only wooden handlooms and modest profits to each individual firm, the story of small firm specialization mimics the beginnings of the Industrial Revolution in western countries, and could hold great potential for further industrialization.

There are four main areas in which the clustering method has helped Ethiopian handloom weavers to perform better: reductions in transaction costs through better market linkages; technological spillovers; lower cost of entry; and ease of trade credit through repeated interactions. In the Ethiopian handloom weaving context, traders need only travel to one location to purchase from numerous producers, while at the same time producers do not need to travel far to sell their products, saving both trader and producer marketing costs. In terms of technological spillovers, the proximity of firms enables new entrants to the market to observe established firms, allowing room for innovation among the new entrants. Those innovations stimulate the cluster as a whole, providing economic gains to the whole industry. The gains, in turn, help foster entrepreneurship among individuals who may become new entrants and thereby increase the production base across the cluster.

Whereas the advantages of market linkages and technological spillovers are well-documented collective efficiencies inherent in industrial clustering, in this paper we highlight two additional cluster-related benefits that are not fully appreciated in the literature: lower entry cost and access to trade credit. As each individual producer in the Ethiopian handloom weaving cluster is liable for only one specific portion of the production chain, producers need only purchase a wooden handloom, which can be a castoff from a previously established firm, to enter the market. According to our data, the median price paid for a handloom was 80 Ethiopian birr (ETB) (US$10), which is just over 3 percent of the 2008 Ethiopian gross domestic product (GDP) per capita in current U.S. dollars (World Bank 2009). In addition, widespread trade credit among producers and traders eases the working capital requirements of a firm. In these geographically concentrated clusters, individual firms must interact on a one-to-one basis with one another constantly. Consistent with a repeat-game scenario, when firms interact repeatedly the probability of default decreases. If a particular firm makes a habit of defaulting, or otherwise delaying production, other firms will see this activity and avoid working with the defaulting firm. Therefore, traders feel more secure in providing credits (and vice versa among producers) as each actor in the cluster can see clearly when another actor fails to satisfy an agreement. In this study, we find that 47 percent of producers were involved in receiving or giving trade credit (of which 30 percent were both recipients and creditors).

In addition to the collective efficiencies of clusters, in this paper we also examine cluster performance, particularly with respect to access to infrastructure. We find that access to electricity matters to firm performance. In communities with electricity, producers work longer hours thanks to lighting conditions. Even the poorest segment of the population can work in the sector through sharing lit rental space. Therefore, it is possible to facilitate cluster growth through infrastructure investment.

2. BACKGROUND AND DATA COLLECTION

Handloom weaving is one of the most important nonagricultural sources of income in Ethiopia (Central Statistics Agency 2003a). According to the Central Statistics Agency's 2003 Cottage/Handicraft Manufacturing Industries Survey, the textiles industry has the second highest number of establishments in the cottage and handicraft manufacturing industry (221,847), representing 23 percent of the total number of cottage and handicraft enterprises, with almost 55 percent of these located in rural areas (see Table 1). Across the nation the textile industry employs the second highest number of people among the cottage and handicraft manufacturing industries, following food products and beverages. This industry accounts for 23 percent of the total employment in the cottage and handicraft manufacturing industries, and 20 percent of the rural employment in the cottage and handicraft manufacturing industries. Weaving enterprises make up 73.2 percent of the textile industry in number of establishments, and 42.8 percent in total number of workers. Table 1 presents figures on the other types of nonfarm, small-scale industries (Central Statistics Agency 2003b).

Table 1. Cottage and handicraft industries

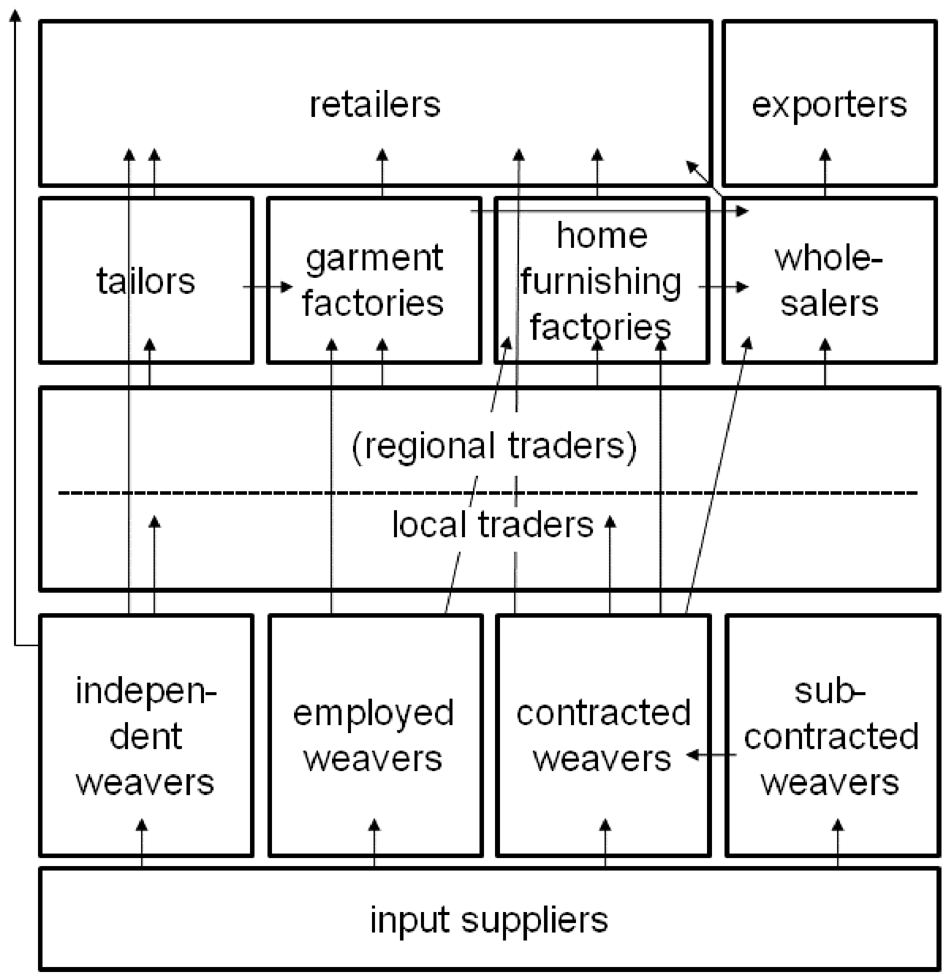
Industry	Number of Establishments	Employment	Value-Added (Market Price)[a]	Value-Added per Worker (Market Price)[b]
Manufacture of food products and beverages	524,172	720,897	358,009	497
Manufacture of tobacco products	966	1,116	606	543
Manufacture of textiles	221,847	296,737	154,797	522
Preparation and spinning of textile fibers; weaving of textiles[c]	*162,398*	*127,036*	*134,452*	*1,058*
Manufacture of wearing apparel; dressing and dyeing of fur	24,137	32,402	49,676	1,533
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness, and footwear	12,025	15,065	11,484	762
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	60,463	70,137	23,572	336
Publishing, printing, and reproduction of recorded media	197	240	966	4,025
Manufacture of chemicals and chemical products	1,117	2,124	2,273	1,070
Manufacture of other nonmetallic mineral products	92,404	109,783	46,131	420
Manufacture of fabricated metal products, except machinery and equipment	20,787	33,536	27,503	820
Manufacture of furniture; manufacturing not elsewhere classified	16,562	24,831	60,569	2,439
Total	974,677	1,306,868	735,586	563

Source: Central Statistics Agency (2003b).
Notes: [a] In thousands of birr.
[b] Calculated as value-added (market price)/employment.
[c] Subset of "manufacturing of textiles"; this is where handloom weavers are registered.

Handloom weaving is one of the few nonagricultural sectors with a discernable presence in both urban and rural areas. In both such areas of Ethiopia, one sees strong patterns of geographically clustered handloom activities. Clustered handloom activities are apparent in Addis Ababa as well as in parts of the countryside that have been traditionally associated with weaving.

The pathways of the handloom weaving production process, although short relative to those of other industries, are complex. Figure 1 illustrates the production process, moving from input suppliers at the bottom to the weavers, then to local and regional traders, then to wholesalers and factories, and finally to retailers. Input suppliers include machinery, accessories, and fiber suppliers, as well as yarn dyers and spinners. Weavers source materials locally and sell their products locally as well.

Figure 1. Handloom production process



Source: Abdella and Ayele (2007).
Note: Input suppliers include fiber suppliers, spinners, yarn dyers, accessories suppliers, and machinery suppliers.

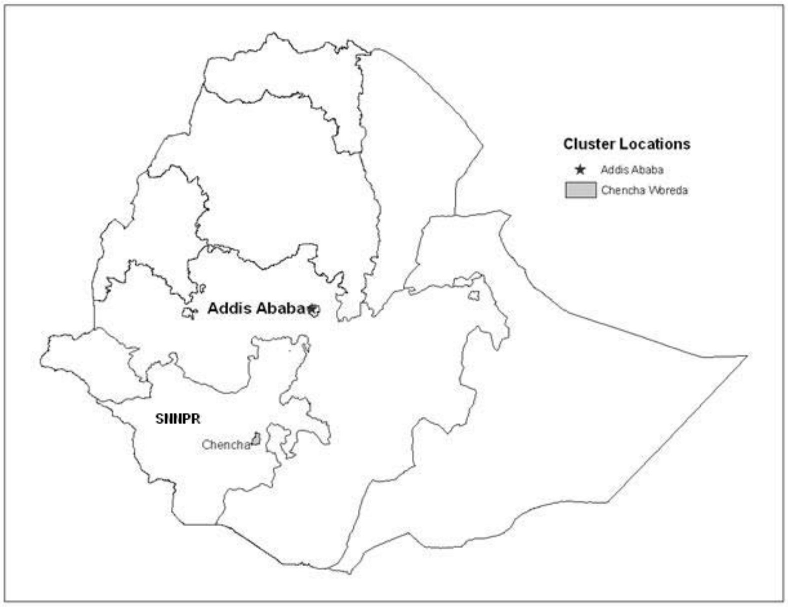
Handloom weaving technologies vary by the types of producers in the industry. Wooden looms are employed mainly by rural weavers and come in two forms: traditional and modern. The traditional wooden looms are made entirely of wood and are typically made using simple tools by a local handcrafter or by producers themselves. Modern wooden looms have been slightly modified to include limited metal materials for added durability and comfort. The second major type of weaving technology is the metal loom, which is usually made by a local blacksmith or skilled artisan. Although the technology is superior in that they are more durable and comfortable to work with, this type costs nearly twice as much as a wooden loom. Additionally, metal looms can be difficult to purchase if a blacksmith or artisan is not located within a reasonable traveling distance from the producer.

In urban areas, the handloom weaving industry is fairly similar to urban industrial clusters in any developing country. The majority of producers operate out of workshops, source their inputs from all over Ethiopia, and may sell from established shops (four walls and a roof). Urban producers make use of improved looms and also tend to work full-time on handloom weaving activities. In contrast, in the rural areas, producers use wooden looms exclusively, and they tend to work on handloom weaving projects only during the agricultural slack season or in other spare time. Additionally, traders travel to one location in the rural areas to collect products, so individual producers need not fund their own marketing efforts, saving marketing costs for both the traveling traders and producers. In electrified towns in addition to the urban areas, producers also share workspace, reducing transaction costs for utilities and other services.

Our study covers both urban and rural clusters. Survey sites include three cluster areas within Addis Ababa (Shiro-Meda, Adisu-Gebeya, Kechene-Medhaniyalem), classified as “urban” and referred to as “Addis Ababa” in this study, and six sites in the Gamo zone, 500 kilometers south of Addis Ababa in the Southern Nations, Nationalities, and Peoples Region (SNNPR). The Gamo zone is largely rural, and our survey sites were centered in the Chencha district (Figure 2), so we classify these as “rural” and refer to them as “Chencha” for the purposes of this study. The Chencha district was identified through various informal discussions with local handloom actors as being an area with prominent handloom production, with around 80 percent of rural households in that woreda being engaged in weaving in addition to farming. Within the Chencha group, all six sites are market towns with handloom activities, but only three of these towns have regular electricity and all-weather road access. For a full list of survey sites, see Table 2. Regarding primary data collection, the survey instruments consist of (a) a producer questionnaire, (b) a trader questionnaire, and (c) a community questionnaire. The questionnaires are based on previous interviews and field visits as well as cluster research performed elsewhere.[1] We reviewed both published and unpublished reports regarding handloom production as a prelude to the primary data collection. We interviewed a large number of informants, producers’ associations, producers, and traders to understand the cluster structure and function in various places before designing the questionnaire. The questionnaire was further amended in the field after a pilot test.

[1] We intentionally adopt some of the questions and structure of surveys done elsewhere to allow for some cross-country comparison of the histories and strategies of similarly clustered firms in different settings. In particular, our producer and trader questionnaires have much overlapping content with survey instruments developed for children’s clothing and footwear clusters in China (Huang, Zhang, and Zhu 2008; Ruan and Zhang 2009).

Figure 2. Study sites



Source: GIS data from EASE (2004)

Table 2. Urban and rural sample breakdown

Urban Clusters (Addis Ababa)	Producers	Traders	Total
Shiro-Meda (kebele 18, 19–21; woreda 11)	98	76	174
Adisu-Gebeya (woreda 11)	35	21	56
Kechene-Medhaniyalem (woreda 16)	62	0	62
Total	195	97	292
Rural Clusters (SNNPR, Chencha woreda)	**Producers**	**Traders**	**Total**
Chencha	55	15	70
Dorze	51	21	72
Ezo	39	16	55
Shama (Shama town and wobera)	39	0	39
Mesho (mesho, kale shaye, losha)	64	5	69
Zozo (seten borche, boyena tuppa, gendo gambela)	43	0	43
Total	291	57	348

Source: Producer and trader surveys (2008).

The producers surveyed in urban clusters are classified into producers who operate from their homes and producers who operate as part of an association; classification of rural clusters is based on access to electricity. The sample size of each classification was determined according to the proportion of the sample population. The rural sample was divided almost equally between electrified and nonelectrified towns (Table 3), while the distribution of the sample in the urban study varied in each cluster according to the sample population of subclusters and types of producers. In total, 486 producers are studied. Of 195 producers studied in urban settings, 51 are from 15 active associations in two subclusters and the remaining 144 are households working at home. Of the 291 rural producers, 145 and 146 are from electrified and nonelectrified towns, respectively.

The second component of the study is a trader survey drawn mainly from traders who are working in shops, in the open market, and along the roadside. A total of 154 traders were surveyed, of which 97 were in urban and 57 were in rural clusters. Roadside traders are found only in the rural cluster in the Dorze area, and eight of them are included in the study. In this paper, trader survey data will be used to complement credit and production information from the producer survey. The third component consists of focus group discussions in 13 communities. Of those, four were from Addis Ababa and the remaining nine were from the Chencha district. The community survey data will be used to identify infrastructure differences between the various rural and urban communities.

The Chencha district includes 45 rural and 5 "urban" *kebeles,* or neighborhoods, with a total about 12,045 household heads. Of these kebeles, only five are electrified. The district classified 50 kebeles into eight service-rendering units; however, for the purpose of this study we classified them into six service-giving units in consultation with the district administrative office, medium- and small-scale manufacturing statistical authority, and other stakeholders. In Chencha, access to electricity and thin-roofed houses are two of the many determinants of labor productivity for rural producers. They influence productivity in two specific ways: producers with access to electricity prefer to work longer hours using electric light, and the hut houses in which the majority of rural producers operate have thin roofs prone to leakage, which can contribute to significant quality control issues during the rainy season.

One interesting feature of rural handloom markets is that a few traders from Addis Ababa, Awassa, and other major towns collect output in bulk over a few market days and supply it to the major towns where they base their businesses. These traders were mostly born and raised in the Chencha region and have family ties to the rural areas, but they base their business in outside towns. They collect products on each market day from rural markets and stay for a month or a few weeks, depending on the volume of product they need to obtain. Some travel widely, depending on the market for the products. Other traders who are based in rural towns also assemble products and sell them in Addis Ababa and other major towns. More than 95 percent of the rural handloom products consumed are bought and used (via traders) by other-town consumers. Almost none of the traders working in the Chencha district have trade licenses and very few specialize in handloom sales; rather, the majority mix handloom sales with other trading activities.

3. STRUCTURE AND FUNCTION OF CLUSTERS

Based on the survey data, we isolated several producer cluster characteristics. Three production types exist: household, rented workspace, and workshop. Household producers were more prevalent in the rural setting (see Table 3) than in the cities, both proportionally and in absolute terms. The types of products sold by producers in each category are listed in Table 4. The use of the products varies by geographic location and tradition of local populations. A *gabi* is a large shawl that may be used as a blanket when cold. A shawl is lighter weight than the gabi and is used like a scarf for colder outdoor weather. A *buluko* is a big, heavy blanket that men wear as a wrap when it is very cold (this item is locally quite common in Chencha's mountainous climate). In urban settings these garments are largely ceremonial in nature, being used mostly for weddings and religious ceremonies. In rural settings, however, they see almost daily use. As the majority of Ethiopia's population is rural, the market for such items is fairly large. Moreover, the handloom industry can be seen as a stepping stone to further industrial development and entrepreneurship, providing a way for rural inhabitants to move beyond agricultural income.

Table 3. Composition of the sample

	Addis Ababa		Electrified		Not Electrified	
Total number of observations	195		145		146	
Types of producer enterprise						
Household	109	55.9%	72	49.7%	114	78.1%
Rented workspace	74	38.0%	72	49.7%	32	21.9%
Workshop	12	6.2%	1	0.7%	0	0.0%
Technology of production (# of producers)						
Traditional/wooden	147	75.4%	145	100.0%	146	100.0%
Improved wooden	0	0.0%	0	0.0%	0	0.0%
Improved metal	43	22.1%	0	0.0%	0	0.0%
Modern/semiautomatic	5	2.6%	0	0.0%	0	0.0%

Source: Producer surveys (2008).
Note: "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.

Table 4. Types of products sold

Addis Ababa	Electrified	Not Electrified
Gabi	Gabi (2)	Gabi (2,3)
Netella (2)	Netella (1)	Netella (1)
Shawl (3)	Shawl	Shawl
Kemis (1)	Kemis	Kemis
Kuta	Kuta (3)	Kuta
Buluko	Buluko	Buluko
Linen	Linen	Linen
Pillowcase	Pillowcase	Pillowcase
Bedspread	Bedspread	Bedspread
Curtain	Curtain	Curtain
Hat	Hat	
Fabrics	Handbag	
Handbag	Other traditional clothes	
Tie/kerebat, shirts, other traditional clothes		

Source: Producer surveys (2008).
Note: Numbers in parentheses identify the products that were most often cited in each category as being the most, second most, and third most important products. "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.

Financing

The average size of enterprise varied widely between urban and rural producers. For urban producers, the average starting capital was 194 ETB (US$22), whereas for rural electrified producers this fell to 95 ETB (US$11). The average starting capital necessary was less than the 2008 Ethiopian GDP per capita of US$328 (World Bank 2009). This finding is largely consistent with McKenzie and Woodruff (2006), who found that many Mexican microenterprises were able to enter the market despite credit constraints, as the start-up costs for small-scale enterprises were small enough to come from entrepreneurs' own savings.

Table 5 presents detailed funding information for each type of cluster. The most common method of starting capital across both urban and electrified rural clusters is from a household's own savings, indicating that those taking part in the clusters had enough private capital to invest to get their businesses going. All categories of producers indicated that a minimum of 40 percent of their starting capital came from their own savings, ranging up to 86 percent for urban producers (Table 5). The second most common source of starting capital is borrowing from friends and family. At least 20 percent of producer starting capital came from friends and family.

Table 5. Starting capital

	Addis Ababa		Electrified		Not Electrified	
Value of starting capital (in Ethiopian birr)	194.29		95.23		114.86	
Value of starting capital (in U.S. dollars)	21.68		10.63		12.82	
Source of starting capital[a]						
Own savings	48.4	86	45.3	62	41.25	51
Borrowing from friends and family	27.4	47	34.5	46	43.24	54
Loan from foreign bank of donor agency	0.0	0	0.0	0	0.0	0
Loan from bank	0.0	0	0.0	0	0.0	0
Loan from suppliers	0.0	0	0.0	0	0.0	0
Loan from traders	0.0	0	0.0	0	0.0	0
Gift from family	19.1	35	18.6	27	14.8	21
Loan from private money lender	0.5	1	0.9	1	0.0	0
Gift from employer	1.1	2	0.7	1	0.0	0
Loan from microfinance	2.0	3	0.0	0	0.0	0
Relatives/friends	0.0	0	0.0	1	0.0	0
Support NGOs	0.3	0	0.0	0	0.0	0

Source: Producer surveys (2008).
Notes: "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.
[a] The first column represents the average percentage of starting capital reported in each category; the second column reflects the number of firms reporting 100% of starting capital from this category.

Trade credit between producers and traders is widespread in clusters. Trade credit is a term of deferred payment offered by a buyer or seller. For example, an input supplier may provide a trade credit to a producer through delivery of supplies while receiving payment in the future. Likewise a trader may receive finished goods from a producer and wait to pay producers until their products have been sold. This reduced need for operating capital makes it easier to enter the market, enabling a greater number of participants. Of the 486 producers surveyed, 21.1 percent of producers gave trade credit, and 40.7 percent of producers received it. Initiation of trade credit was bound by several conditions. Most important to the decision to provide credit or not was a history of successful business together. The average time period for establishing that history varied but stayed largely between 1 and 1.5 years. The rather low capital requirement for entry into the market reduces reliance on formal institutions, enabling a larger number of people to engage in handloom production through their own savings. Wide availability of trade credit further eases working capital constraints. Overall, it appears that cluster-based handloom production can occur even in the absence of the formal financial institutions that much of the literature deems necessary. This finding is consistent with the clustering stories documented in China (Huang, Zhang, and Zhu 2008; Ruan and Zhang 2009).

Production and Trade Structure

Next, we examine the structure of production as it pertains to flows between producers and traders. Whereas most rural producers sold directly to the open market, with more than 90 percent of respondents acknowledging this channel, urban producers had a more varied approach with only 64 percent of respondents indicating that the open market was their main channel of sale (Table 6). Shops, which require a large fixed cost, existed only in the urban producer cluster for several reasons. First, since shops are more expensive to set up, only the relatively rich urban traders can afford to establish one. Second, shops send a signal of high product quality. Producers would like to market their product in shops because merchandise displayed in shops is usually deemed higher quality than that sold roadside and can therefore command a higher price. Third, in urban centers, the large sale volume can help offset the higher cost of shops. In the rural areas, producers rely more on the open market and visits from traders.

Table 6. Sale of products

	Addis Ababa	Electrified	Not Electrified
Method of sale (% of respondents)			
Open market	63.7	93.8	99.3
Door-to-door buyers	8.2	2.1	0.0
Third party	14.9	4.1	0.7
Street stand/shop	13.3	0.0	0.0
Most important buyer (% of respondents)			
Open market (same town)	43.1	87.6	41.8
Open market (other town)	8.7	4.4	56.9
Shopkeeper (same town)	23.1	1.4	0.0
Shopkeeper (other town)	4.6	1.4	0.7
Visiting trader	5.1	0.0	0.0
Direct sale to consumers	2.1	0.7	0.7
Order by contract/third party	12.8	3.5	0.0
Door-to-door buyers	0.0	0.7	0.0
Other	0.5	0.7	0.0

Source: Producer surveys (2008).
Note: "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.

The main raw materials used in handloom weaving production are cotton yarn and thread. The flow of raw materials in the greater handloom production process is seen in Figure 1. The raw materials are generally produced locally, and the quality of the raw materials dictates what type of products producers can sell. Additional raw materials include coloring dyes, used for coloring yarn and thread for specific customized items. In terms of sourcing raw materials, the picture in Addis Ababa varied from that in the rural districts in that 98.5 percent of the raw materials were sourced from shops, whereas in the rural districts shops provided only 77.2 percent of electrified producers' raw materials and only 58.2 percent of nonelectrified producers' raw materials (see Table 7). With fewer shops in rural clusters, it is natural to see that shops play a less important role in providing raw materials.

Table 7. Inputs of products

	Addis Ababa	Electrified	Not Electrified
Source of raw materials (% of respondents)			
Open market	1.5	22.1	41.8
Third party	0.0	0.7	0.0
Shop	98.5	77.2	58.2
Most important supplier (% of respondents)			
Open market (same town)	2.6	24.1	19.9
Open market (other town)	0.0	0.7	28.8
Shopkeeper (same town)	91.3	69.0	20.6
Shopkeeper (other town)	6.2	6.2	30.8
Visiting trader	0.0	0.0	0.0
Other	0.0	0.0	0.0

Source: Producer surveys (2008).
Note: "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.

Quality Control and Conflict Resolution

As production is dispersed widely among various individual producers, quality control issues are a potential problem. Among urban producers, an average of 2.7 quality control complaints was reported per producer in the last year. The numbers for rural producers were slightly lower (an average of 2.2 complaints) for the last year. More interesting, however, are the methods employed by producers to correct quality problems.

When quality problems occur, the involved party rarely uses courts to resolve conflicts. Among producers, police and court systems were never used to resolve a quality control issue. The vast majority of respondents in all categories made use of "talking directly with trader/buyer" as a method of resolving a quality control dispute, with 100 percent of rural producers and 97.67 percent of urban producers acknowledging use of that method of resolution in the past year. These results indicate the importance of unofficial means of conflict resolution, and the ability of enterprises in a cluster to operate in the absence of formal contractual institutions as described in Fafchamps (2004).

4. PERFORMANCE

Having shown that cluster-based handloom production can exist even in poor areas, next we examine under what conditions a cluster performs better. In other words, does the government have effective instruments at hand, such as infrastructure investment, to nurture cluster development? The basic hypothesis proposed by this paper is that infrastructure improvements facilitate cluster productivity. Urban versus rural clusters, and within rural clusters electrified versus nonelectrified clusters, demonstrate different productivities based on the specific environment available. This paper proposes that labor productivity in clusters with access to electricity will be higher than in those that do not have access to electricity.

As producers in different locations produce different goods, it is hard to compare the labor productivity of each good directly across clusters. To ensure that we compare the same products across clusters, we selected the most widely cited most important product in the rural areas, the *netella,* a lightweight shawl used as a scarf, which was also the second most widely cited most important product in Addis Ababa (see Table 4). Production figures are presented in Table 8. The average monthly production for the most important product was 25.31 units[2] in the urban clusters, compared with 15.55 units in rural electrified and 14.83 units in rural nonelectrified clusters.[3] Our results indicate that in the electrified rural clusters, on average, it takes 1.19 days to produce one netella, whereas in the nonelectrified rural clusters, it takes an average of 1.32 days. The price for one item in these two places was similar. This is consistent with our thesis in that electrified rural clusters are more productive than are their nonelectrified counterparts. In Addis Ababa, our results were slightly puzzling: the production time for one unit of netella was 1.61 days. This could be because the netella was listed as the most important product for only 27 percent of producers. In addition, the unit price for the netella is 50 percent higher in Addis Ababa than in rural clusters, suggesting better product quality and probably a more demanding labor requirement. The most widely cited most important product in Addis Ababa was the *kemis,* the long traditional dress worn by women, which takes an average of six days to produce. Moreover, enterprises in Addis Ababa produce far more types of products than elsewhere, as shown in Table 4. As a result, the total monthly production figures for Addis Ababa are still significantly higher than those in the rural clusters, reiterating the increased productivity of these clusters.

To examine whether infrastructure has a smoothing effect on monthly production, we calculated the coefficient of variation across months for each location type (reported in Table 8). With a coefficient of variation of 0.05, the urban clusters had less seasonal variability than did rural electrified clusters (0.15), and distinctly less than the rural nonelectrified clusters (0.23). Our informal interviews with subjects indicate that the relatively higher variation among rural and nonelectrified clusters is likely due to electrified clusters' ability to operate consistent working hours through access to lighting independent of the season, and to access collective workshops with sturdy roofs, which helps prevent quality control issues associated with hut roofs in the rainy season. In addition, this seasonality is related to seasonal demand, as rural products target the rural demand, which tends to be more seasonal in nature (rather than ceremonial).

The average sales price of one unit of the most important product is significantly higher for urban clusters than for the rural ones, and again for electrified clusters as opposed to nonelectrified ones. The cost of raw materials is also greater for urban clusters than for rural clusters. The same is true of total costs in general. This probably reflects the fact that urban producers and traders are engaged in higher-end products in a setting with stiffer competition than those in the rural sectors.

[2] "Unit" refers to one complete product unit. For a full list of the possible products, see Table 4.
[3] Table 8 reflects the average for all most important products as a whole, rather than for one type of product in particular.

Table 8. Production

	Addis Ababa	Electrified	Not Electrified
Number of observations	195	147	146
Average monthly production for top product (in product units)	25.31	15.55	14.83
Monthly coefficient of variation (variation across months for each location)	0.05	0.15	0.23
Average sales price of one unit of most important product (in Ethiopian birr [ETB])	114.67	55.53	47.56
Cost of raw materials to produce one unit of most important product (ETB)	68.44	39.41	33.24
Number of days taken to produce one unit of most important product	1.71	1.86	1.68
Loan interest rate (last month)	2.54%	0.91%	0.63%
Average other costs in the last month (as % of total costs)			
Rent paid	22.8	25.0	51.3
Electricity payment	8.2	19.8	4.0
Water payment	5.5	0.5	0.0
Telephone payment	9.1	3.3	0.4
Fuel payment	0.0	0.4	0.0
Transportation (excluding fuel) payment	12.0	11.5	16.7
Office supplies payment	0.1	0.0	0.0
Wage paid	37.0	29.7	0.6
Insurance paid	0.0	0.0	0.0
Promotion/advertising/design	0.0	0.0	0.0
Shop/other maintenance	2.9	2.3	10.1
Tax paid	0.1	2.6	7.4
Storage payment	0.0	0.0	0.0
Payment to meals provided to workers	2.0	1.2	0.0
Payment to security/janitor	0.0	0.0	0.0
Payment for accommodation/food	0.0	0.0	0.0
Other major costs	0.2	3.8	9.5
Total costs (ETB)	148.46	29.65	10.87

Source: Producer surveys (2008).
Notes: "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.
1 U.S. dollar = 8 Ethiopian birr.

To address the question of differing productivity between clusters with access to infrastructure and those without in a more rigorous way, we first perform a set of pair-wise *t*-tests between the rural and urban clusters, and then between rural clusters with and without access to electricity. An examination of average daily hours worked shows that workers in nonelectrified rural villages worked only 7.21 hours per day, whereas their counterparts in other electrified (but rural) villages worked 10.73 hours per day (Table 9). A comparison of rural and urban clusters yielded a similar result, with those clusters located in Addis Ababa, who all have access to electricity, working 10.3 hours per day and those in the rural areas as a whole working 9.03 hours per day. In a word, producers in clusters with access to electricity do work longer hours than their nonelectrified counterparts.

Enterprise size was the next variable to be analyzed. Urban clusters, electrified clusters, and nonelectrified clusters have 1.83, 1.31, and 1.67 workers per enterprise, respectively. The small enterprise size in electrified clusters is largely because of more frequent sharing of lit workspaces. To determine the productivity of the workers in each location, we ran pair-wise *t*-tests for the average annual revenue per worker. We found that annual revenue per worker was significantly higher in the urban clusters than in the rural clusters (14,859 ETB/worker compared with 7,237 ETB/worker, significant to the 0.001 level).

Given the higher operational costs associated with better-quality products, this finding is not surprising. Similarly, rural nonelectrified clusters had far smaller revenue per worker than did their electrified counterparts (6,021 ETB/worker compared with 8,461 ETB/worker, significant to the 0.10 level).

Table 9. Productivity measures, 2008

	Addis Ababa	Chencha[a]	*P*-Value	Electrified	Not Electrified	*P*-Value
Hours worked per day (average)	10.3	9.03	0.001	10.73	7.21	0.000
Average number of workers per enterprise	1.83	1.49	0.003	1.31	1.67	0.000
Average annual revenue per worker (in Ethiopian birr/worker)	14,859.38	7,236.93	0.000	8,460.75	6,021.49	0.021
Average annual value-added per worker (in Ethiopian birr/worker)	4,427.22	2,168.72	0.000	2,543.74	1,796.28	0.086

Source: Producer surveys (2008).
Notes: Value-added = revenue − fixed and variable capital costs + wage + taxes. 1 U.S. dollar = 8.96 Ethiopian birr. "Electrified" versus "Not Electrified" refers to small towns or villages located in the SNNPR.
[a] All rural clusters, as a whole.

Next, we calculated value-added, defined as revenue less operational costs and cost of raw materials, and tested the profit per worker for urban versus rural clusters and electrified versus nonelectrified clusters. The results are presented in Table 9 as well. Once again, the producers in electrified towns were more productive than their counterparts without electricity. An additional run of testing was completed with targeted measures for rented workspace producers as compared to household producers, with and without access to electricity. Starting capital for rented workspace producers in electrified clusters was significantly lower than that of clusters without access to electricity. Electrified clusters clearly have a greater incidence of migrants than do nonelectrified clusters, corroborating anecdotal evidence indicating a preference for electrified towns on behalf of migrants.

However, the simple *t*-test comparisons may omit some important factors, such as capital, which could contribute to the observed differences between electrified and nonelectrified towns. Our next level of examination was to control for capital availability per labor and other factors in multivariate regressions. We record labor productivity through two different measures—revenue per worker and value-added per worker—to test the robustness of our findings.[4] The estimation regression for revenue/labor is as follows:

$$\ln\frac{Y}{L} = \alpha + \beta \ln\frac{K}{L} + \boldsymbol{\gamma} \cdot \boldsymbol{X} + \varepsilon \qquad (1)$$

where *Y* stands for the annual sales revenue for the top three most important products; *L* stands for the number of workers who contributed to production; and *K* stands for the sum of fixed assets, operating costs, and annual cost of raw materials. $\boldsymbol{X}$ is a vector of enterprise type and community and infrastructure controls (dummy variables for rented workspace and workshop, Addis Ababa, and electrified), and ε is an error term. Rented workspace producers are all considered to have a single worker (as each enterprise is made up of one owner/operator who is renting workspace from a separate entity). Fixed assets are defined as the current value if sold (in ETB) of major assets, specifically production equipment. Operating costs are defined as recurring monthly costs in ETB of operating the business, aggregated to a full year, and include (but are not limited to) taxes, utilities, insurance, and other costs as appropriate. Cost of raw

[4] An alternate definition of labor productivity, based on labor hour production data, was considered, but due to missing observations, the dataset would have been cut by a third were we to include the labor hour specification, so we elected not to include it.

materials is the self-reported per-unit cost expressed in ETB multiplied by annual production units. Operating costs and cost of raw materials are taken together with fixed assets because for these producers, in keeping with the low capital investment required for market entry, fixed assets play such a small role in production that they do not vary widely among firms. The main driver for profit is cost of raw materials, followed by operating costs, so we take these together as the overall cost of doing business.

The second measurement is value-added/labor, with the following estimation regression:

$$\ln\frac{\overline{Y}}{L} = \alpha + \beta \ln\frac{\overline{K}}{L} + \boldsymbol{\gamma} \cdot \boldsymbol{X} + \varepsilon \qquad (2)$$

where $\overline{Y}$ is the annual value-added; $\overline{K}$ is the total amount of fixed assets per enterprise; $\boldsymbol{X}$ represents the same vector of enterprise type and community and infrastructure controls; and ε is an error term. Value-added is defined as the annual sales revenue of the three most important products less the annual cost of raw materials and operational costs.

Tables 10 and 11 report the findings from our initial regression analysis for labor productivity measured in revenue and value-added, respectively. Five specifications are presented in the tables. The first specification is for the whole sample, including a set of dummy variables: electrification, Addis Ababa, rented workspace, and workshop. In addition, the year the business has been established is included as a control variable. Next, we run regressions based on two stratified samples: the urban clusters (Addis Ababa) and rural clusters (Chencha). In the last two regressions, the Chencha sample is further stratified into electrified and nonelectrified samples. The coefficients for the "capital per worker" variable are significant in all the specifications in Table 10 and four out of five specifications in Table 11. However, the coefficients for the electrified variable are not significant in any of the regressions in the two tables, which is somewhat contrary to the simple *t*-test results in Table 9. To solve this puzzle, we ran a nonparametric Lowess[5] plot of labor productivity for both measures. Those plots are presented in Figure 3.

Table 10. Regression results: Revenue/labor

	All	Addis Ababa	Chencha	Electrified	Not Electrified
$\ln[(K + CORM)/L]$	1.004***	0.970***	1.030***	1.045***	1.025***
	(0.020)	(0.032)	(0.027)	(0.027)	(0.042)
Electrified	-0.042		-0.040		
	(0.028)		(0.027)		
Addis Ababa	0.065**				
	(0.032)				
Year established	0.003***	0.005***	0.001	0.001	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
Rented workspace	-0.029	-0.004	-0.044	-0.017	-0.086**
	(0.026)	(0.050)	(0.027)	(0.036)	(0.041)
Workshop	-0.085	-0.039			
	(0.071)	(0.077)			
Constant	-5.545***	-8.479***	-2.740	-2.437	-3.064
	(1.861)	(3.066)	(2.193)	(2.721)	(3.231)
Adjusted *R*-squared	0.919	0.892	0.920	0.932	0.906
AIC	94.688	80.974	3.515	-45.024	40.253
Observations	480	190	290	144	146

Source: Producer surveys (2008), authors' calculations.
Notes: *K* is the total amount of fixed assets plus operating costs; *CORM* is the annual cost of raw materials; *L* is the number of workers involved in production per enterprise. *Rented workspace* is a dummy variable indicating an observation in a shared-rent workspace, with each respondent operating a separate enterprise. *Workshop* indicates a wholly owned building, operating as one enterprise. Workshops were found to exist only in Addis Ababa. *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively. Robust standard errors are in parentheses.

[5] A Lowess plot is a locally weighted polynomial regression that allows for more variability in estimation.

Table 11. Regression results: Value-added/labor

	All	Addis Ababa	Chencha	Electrified	Not Electrified
ln(*Fixed Assets*/*L*)	0.292***	0.305***	0.336***	0.083	0.575***
	(0.057)	(0.082)	(0.096)	(0.127)	(0.150)
Electrified	0.175		0.213		
	(0.139)		(0.143)		
Addis Ababa	0.461***				
	(0.147)				
Year established	0.007*	0.018***	-0.002	-0.006	0.001
	(0.004)	(0.006)	(0.005)	(0.008)	(0.006)
Rented workspace	0.206	0.091	0.236	0.333*	0.130
	(0.130)	(0.247)	(0.153)	(0.199)	(0.234)
Workshop	0.370	0.335			
	(0.348)	(0.376)			
Constant	-8.538	-28.716**	8.933	17.703	1.793
	(8.305)	(12.711)	(10.080)	(15.734)	(12.854)
Adjusted R-squared	0.215	0.201	0.066	0.012	0.132
AIC	1417.979	538.485	877.034	439.922	435.566
Observations	472	185	287	142	145

Source: Producer surveys (2008), authors' calculations.
Notes: *L* is the number of workers involved in production per enterprise. *, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively. Robust standard errors are in parentheses.

Figure 3. Electrified versus nonelectrified Lowess plot—Chencha revenue and value-added

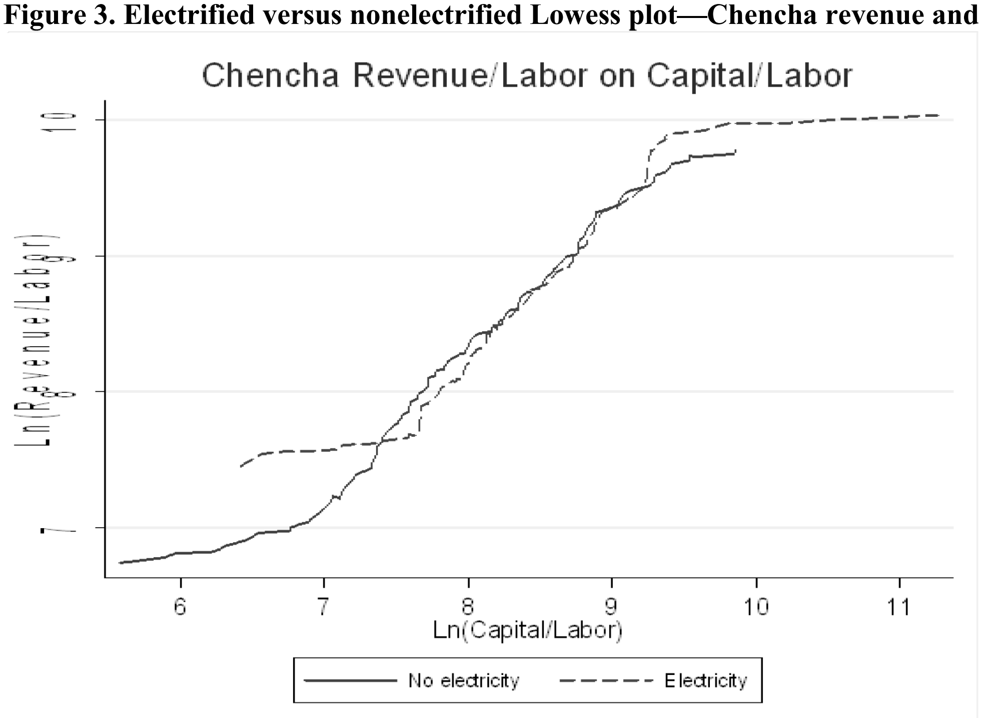
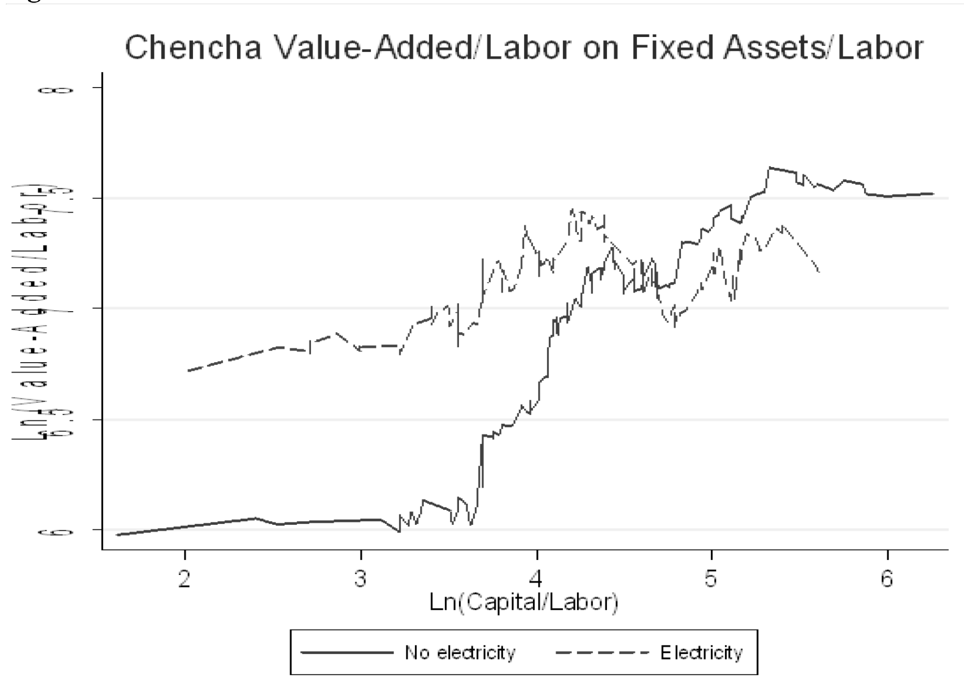


Figure 3. Continued



Source: Producer surveys (2008), authors' calculations.
Notes: The first chart shows revenue/labor versus capital/labor. The second shows value-added/labor versus fixed assets/labor. Both charts show the Chencha region. "Electricity" versus "No electricity" indicates small towns or villages located in the SNNPR.

From the Lowess plots of electrified versus not electrified communities in Figure 3, we can clearly see that the labor productivity performance differs greatly among the bottom segment of the producers in terms of capital per worker. For enterprises with the smallest ratio of capital to labor, typically those with little financial resources, labor productivity is significantly higher for those enterprises with access to electricity. This trend seems to be more prevalent in measures of value-added per worker.

Revenue is not a good indicator of labor productivity as it includes the cost of raw materials and operational costs. After controlling for capital and other factors, revenue no longer varies between producers in electrified towns and those in nonelectrified towns. To clarify the relationship of electricity within the different groups, we focus on value-added per worker, a better measure of labor productivity, by running the same equation as previously used but this time stratifying the sample into thirds by size of fixed assets to workers. We ran these regressions only for the Chencha region, which is considered rural, to bring out the specific impact of electricity and other infrastructure variables, as opposed to including Addis Ababa in the sample. Table 12 shows the results.

The results are consistent with the visual patterns revealed in Figure 3, particularly for the bottom third of the sample. The value-added per worker regressions indicate that for the bottom third of the sample, enterprises with access to electricity are 60 percent more productive than their counterparts in nonelectrified communities. This implies that the electrification improves the productivity for those with the least access to credits. For enterprises on the lower end of the spectrum, access to shared workspace provides an additional 67 percent productivity increase over household production. This access to shared workspace and electricity provides opportunities for finer division of labor, greater entry into the market, and longer working hours, all of which contribute to higher returns.

Table 12. Regression results: Segmented value-added/labor

	Bottom Third	**Middle Third**	**Top Third**
Fixed assets/labor	0.275	0.809	0.723**
	(0.304)	(0.498)	(0.330)
Electrified	0.598**	0.239	-0.150
	(0.255)	(0.248)	(0.266)
Year established	0.000	-0.005	0.001
	(0.008)	(0.009)	(0.009)
Rented workspace	0.668**	0.165	0.062
	(0.273)	(0.235)	(0.258)
Constant	5.204	14.459	1.375
	(16.943)	(18.117)	(17.392)
Adjusted R-squared	0.109	-0.003	0.016
AIC	291.545	286.655	300.335
Observations	95	97	95

Source: Producer survey (2008), authors' calculations.
Notes: The sample for Chencha was divided into thirds based on the size of the capital-to-labor ratio.
*, **, and *** stand for significance levels of 10%, 5%, and 1%, respectively. Robust standard errors are in parentheses.

In theory, towns with access to electricity's improved productivity should take on production, whereas those towns with no such access should focus on other activities. However, it should be noted that handloom weaving is primarily a supplemental activity for many producers who also engage in farming and livestock production. Our comparison in productivity is limited to only handloom activities. As weaving offers a relatively inexpensive option for supplementing income even without infrastructure improvements, producers in nonelectrified areas are unlikely to cease production in the short term even in the face of competition from more productive producers in electrified towns.

5. CONCLUDING COMMENTS

The study presents primary data describing cluster activities in Ethiopia. It differs from other industrial clustering studies in that it covers both rural and urban clusters in an African country in detail, an area that researchers have previously given only limited attention. Rural clustering is an understudied topic, particularly in the context of African developing countries. With the lowered cost of entry afforded by the division of production steps along with the market access and other cost reductions that come with clustering, clustering is a viable mode of improving nonfarm incomes in rural areas, which are often financially constrained.

Our study shows that cluster activities can survive even in harsh environments with no formal institutions and limited infrastructure. Further, clustered activities like handloom weaving can serve as gateways to entrepreneurship and industrial development. Entrepreneurs are able to seek new production structures to circumvent the constraints they face. With the lower cost of entry inherent in the clustering mode of production, as shown by the relatively small capital investment required by handloom weaving enterprises in this study, many potential entrepreneurs with limited financial resources can engage in productive nonfarm activities that add to overall household income. The use of trade credit helps entrepreneurs ease the constraints of operating capital necessary to run their business.

Despite the high degree of adaptability inherent in the organizational structure of clusters, improvements in infrastructure can further boost labor productivity. Clusters with access to electricity can work longer hours, increasing labor productivity. Electricity enables many poor producers who otherwise could not afford to participate in the marketplace to share workspace with access to light at rather low cost. Both average revenues and value-added per worker are higher for clusters with access to infrastructure. Even after controlling for other factors, it is evident that access to electricity greatly contributes to higher labor productivity for those with limited financial assets.

Within the African context, the promotion of less-capital-intensive production systems can be extremely useful when capital markets are less developed and most entrepreneurs have limited financial resources. The clustering production structure provides a way for potential entrepreneurs to participate in nonfarm activities, particularly in the rural sector. Further research is needed to examine the origins and evolution of clusters as well as ways to facilitate their growth.

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