Productivity Growth and Job Creation in the Development Process of Industrial Clusters[1]

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Poor management has long been suspected as a major constraint on job creation in the manufacturing sector in low-income countries. In this sector, countless micro and small enterprises in industrial clusters account for a large share of employment. This paper examines the roles of industrial clusters, managerial capacities, and entrepreneurship in improving productivity and creating jobs, by reviewing the literature and case studies, including recent experiments. We find that managerial capacities are major determinants of firms' employment sizes and productivity growth, and that it is high innovative capacities, accompanied by high managerial capacities, that boost cluster-based industrial development.

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1. Introduction

A large share of manufacturing employment, including the self-employed, in low income countries is accounted for by industrial clusters, namely, agglomerations of firms producing similar products or providing similar services in small geographical areas. This is because there are economic forces making it more profitable for firms to operate in an industrial cluster than in isolation. Such economic forces are termed localization economies after Marshall's (1920, Book IV, Ch. X) pioneering work on the "localization of industry." What will contribute to the betterment of wage workers, own-account workers, managers, and entrepreneurs in these clusters? What can be done to strengthen the ability of the clusters to create jobs? To answer these questions, we need a deeper understanding of the nature and the limitation of localization economies.

Krugman (1991, Ch. 2) lists "familiar examples of localization" in the United States, including Silicon Valley, Route 128, and North Carolina's Research Triangle as high tech centers, Hartford as an insurance city, Chicago as the center of futures trading, and Los Angeles as the entertainment capital. Even casual observers, however, know that a large number of industrial clusters both inside and outside the United States look quite different from these "familiar examples." In developing countries, there are rapidly growing clusters, declining clusters, and traditional and still active clusters, but the majority are what Altenburg and Mayer-Stamer (1999, p.1695) call "survival clusters of micro and small-scale enterprises which produce low-quality consumer goods for local markets." While almost all clusters were formed spontaneously due to localization economies, their performances vary considerably in growth, productivity, product quality, profitability, employment sizes, and wage levels.

In an attempt to identify the reason for such considerable variance, this paper focuses on the issues of how innovative and managerial capacities interact with localization economies and diseconomies and what impacts they exert on the productivity and employment of industrial clusters. We assume that entrepreneurship consists of innovative capacity to put new ideas into effect and managerial capacity to improve management efficiency given the level of technology. Our focus onmanagerial capacities is motivated by our observation that they are in short supply in industrial clusters in low income countries, especially in Sub-Saharan Africa. As is well-known, localization facilitates knowledge spillovers, but this property is not beneficial for the development of clusters when there are no new ideas about profitable products, new markets, or new production processes to be spilt over or to be imitated in the cluster. Localization does not encourage innovation or technology borrowing (i.e., learning from abroad), but rather dampens them by facilitating rampant spillovers or imitation. While localization may attract diverse human resources, such as skilled workers, engineers, and traders in one place, entrepreneurs may be unable to find a new useful combination of these resources if their management capacities are inadequate. There is no reason to assume that localization automatically nurtures entrepreneurship. Likewise, localization does not nurture managerial capacities to execute plans aimed at management improvement effectively.

This is not to say that industrial clusters are useless, however. On the contrary, industrial clusters provide numerous benefits for firms and their workers within the clusters. For example, the localization of industry saves on the cost of building infrastructure, enhances the development of markets for skilled labor, and attracts buyers and material suppliers. It also reduces transaction costs that arise from information asymmetry and imperfect contract enforcement. With low transaction costs, the division and specialization of labor among firms are promoted and the provision of trade credits is facilitated in industrial clusters. Of course, there are localization diseconomies as well. For example, infrastructure may be overused resulting in serious congestion problems. Yet the fact that a large number of firms are located in clusters indicates that localization economies outweigh localization diseconomies. The question is how to nurture entrepreneurship, including managerial capacities, while taking full advantage of localization economies in existing and new industrial clusters without aggravating localization diseconomies.

We use a simple model of micro and small enterprises (MSEs) in an industrial cluster to understand why managerial capacities impact on the cluster's capacity for job creation. In the model, the major task of management is to maintain control of output, quality, delivery, and costs, as emphasized by Deming (1982) and Toyota's Production System. Entrepreneurship has an element of initiative, imagination, or innovative capacity (Baumol, Schilling, and Wolff, 2009). Although its manifestation can have a variety of forms, the development of an industrial cluster is boosted by similar or almost the same set of innovations in different industries in different countries, according to case studies compiled by Schmitz and Nadvi (1999) and Sonobe and Otsuka (2006, 2011). Two hypotheses emerge from these discussions. First, in stagnant clusters, firms have almost equally small employment sizes, their labor productivity fluctuates wildly, and, therefore, in a cross section of firms, no clear association is found between labor productivity and employment sizes. Second, in dynamically growing clusters, employment size varies among firms, labor productivity has small variances particularly among large firms, and there is a positive association between labor productivity and employment sizes. The main purpose of this study is to demonstrate that main difference between stagnant and dynamic clusters can be attributed to the difference in management and innovative capacities of entrepreneurs.

The empirical part of this paper uses enterprise data collected in industrial clusters in Ghana, Ethiopia, Tanzania, Bangladesh, Vietnam, and China, with quite different characteristics and growth performances. The data indicate that firms' employment sizes are small if production fluctuates wildly, a reflection of bad management. The data provide suggestive evidence for the hypothesis that employment size is not closely associated with labor productivity in the absence of innovations. By contrast, in the clusters that have experienced innovations, employment sizes have grown rapidly and are associated positively with labor productivity.

The rest of this paper is organized as follows. The next section briefly reviews the factors associated with productivity, including localization economies and diseconomies. In Section 3, we develop a model highlighting the impact of managerial capacities on labor employment. In Section 4, we discuss entrepreneurship and innovations in industrial clusters. Toward the end of this section, we will develop hypotheses. Section 5 documents the empirical findings based on the selected case studies. Section 6 discusses policy implications and concludes the paper.

2. Localization economies and diseconomies

According to Mokyr (2005, pp. 1116 - 1117), there is a growing recognition among economic historians that technological change was less important than institutional changes in explaining episodes of economic growth before the Industrial Revolution. "The presence of peace, law and order, improved communication and trust… enforceable and secure property rights, and similar institutional improvements" reduce transaction costs and, hence, enable agents to specialize according to their comparative advantage and to take advantage of economies of scale. Such commercial progress, sometimes referred to as "Smithian Growth," can be more important than technological progress or "Schumpeterian Growth."[2]

"Smithian Growth" is commonly found probably in all industrial clusters. Becker and Murphy (1992) argue that transaction costs or coordination costs due to adverse selection, moral hazard, and imperfect enforcement are generally low in industrial clusters where transacting parties are located near each other. Low transaction costs facilitate the division of labor among manufacturers and traders, which, as Marshall (1920) mentions, enables manufacturers to use specialized machinery at high utilization rates. Moreover, the division of labor enables manufacturers to procure materials and parts flexibly and to specialize in a narrow range of the production process, which saves both working capital and fixed capital (Ruan and Zhang, 2009). The community mechanism found in industrial clusters differs from the one found in a traditional village community that closes its doors to outsiders and is counterproductive to the expansion of business networks (Babur and Sonobe, 2012).

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[2] The concepts of "Smithian Growth" and "Schumpeterian Growth" were pioneered by Parker (1984).

The pseudo community mechanism that is intentionally used to reduce transaction costs and to survive market competition accepts the entry of outsiders and is suitable to expansion (Hayami, 2009).

In low-income countries, not just transaction costs arising from information and enforcement problems but also physical transport costs are high due to the shortage of infrastructure (Eifert, Gelb, and Ramachandran, 2008). Industrial clusters or the localization of industry can be viewed as a grassroots countermeasure to this problem because being located nearby each other saves on the use of infrastructure. Other virtues of localization economies in relation to "Smithian Growth" include the clusters' ability to facilitate matching between job seekers with special skills and employers, which was pointed out by Marshall (1920), and the clusters' ability to pull in more customers without paying for advertising. Both reduce search costs. In addition, industrial clusters facilitate knowledge spillovers, as was also pointed out by Marshall (1920), so that new ideas of business spread quickly within clusters.

Syverson's (2011) list of the determinants of productivity at the firm or plant level has two broad categories: factors operating within the plant or firm, and external drivers of productivity differences. The latter consists of productivity spillovers, competition, deregulation or proper regulation, and flexible input markets. Note that the localization of industry activates three of these four external drivers if a flexible input market is akin to the developed division of labor among firms. This is the reason why most industries that have developed spontaneously are cluster-based.

Industrial clusters, however, have no advantage in the category of internal drivers of productivity differences, which include managerial practice/talent, higher-quality general labor and capital inputs, information technology and R&D, learning by doing, product innovation, and firm structure designs, according to Syverson (2011). Moreover, the localization of industry may be counterproductive to some of these drivers. For example, managerial talents and higher-quality labor of a firm may be poached by other firms in the same cluster because of spillovers of information on talents and skills. Similarly, the output of R&D and product innovation of a firm may be quickly imitated by other firms in the same cluster before the innovator reaps profits, which will discourage innovative activities. These are examples of localization diseconomies. Among other examples of localization diseconomies is the congestion problem, which arises from the inadequate provision of infrastructure.

Notwithstanding localization diseconomies, industrial clusters can have multifaceted innovations in products, production processes, marketing, material procurements, and the organizational design of firms, as the compilation of case studies of cluster-based industrial development in Latin America and East Asia by Schmitz (1999) and Sonobe and Otsuka (2006) attests. According to these case studies, an industry in developing countries begins by producing a low-quality imitation of an imported product. It is initially difficult for the pioneering producer to produce and market the product because of the lack of appropriate materials and because both the product and the producer are unknown to potential buyers. Once these difficulties are overcome, however, the pioneer earns high profits because of the absence of competitors. Observing the high profits, there will be followers, including the former workers of the pioneer, who faithfully imitate the pioneer's production and marketing methods. This initiation process of an industry may be viewed as "Schumpeterian Growth," but it is short-lived and followed by the "Smithian Growth" that is characterized by the formation of a cluster by the massive entry of imitators, who seldom improve products and production processes, and the development of the division and specialization of labor among enterprises. Thus, Sonobe and Otsuka (2006) refer to this process of cluster formation as "quantity expansion."

The new entry of imitators will continue as long as they expect positive profits. Unless a new market is developed, increases in the supply of their product to the local market will eventually lower their product price and hence the profitability of continuing to produce this product. A comparative study in Asia and Africa by Sonobe and Otsuka (2011) finds that most clusters in Sub-Saharan Africa have reached or are reaching their long-run equilibrium with zero profit. Such clusters are nothing but "survival clusters" of MSEs, to use the terminology of Altenburg and Mayer-Stamer (1999). Many clusters in this region have not yet had even an indication that "Schumpeterian Growth" is on the horizon, whereas many clusters in East Asia have experienced such growth.

3. Managerial Capacities

Although management performs diverse functions, we focus on one of the basic functions; that is, to maintain control of quality, output, delivery, and costs. We use a simple model to illustrate how this function is related to the firm's and the industrial cluster's capacity for productivity growth and job creation. Suppose that each firm in a cluster produces a single product by using a technology characterized by a production function, $\mu F(L)$, where L is labor input and μ is a positive constant. The function is assumed to be increasing, concave, and twice differentiable, i.e., $F'(L) > 0$, $F''(L) < 0$. While function F gives the expected output corresponding to input L, actual output x may fluctuate so that $x = \theta F(L)$, where θ is a random variable with mean μ and variance

σ^2. The profit is given by $\pi = p\theta F(L) - wL$, where p is the product price and w is the wage rate, which the MSE takes as given. We assume that μ is determined primarily by technology, whereas σ^2 is determined by management. The major results of the following analysis, however, remains unchanged even if better management not only reduces σ^2 by reducing the effects of unforeseen undesirable events but also increases μ to some extent, or if the introduction of a more productive but complicated new technology increases both μ and σ^2.

Fluctuation or variation in output arises from human fallibility and unforeseen events. It is a result of accidents, errors, or mistakes, such as machine failures, workers' injuries, spoiled materials, the delayed supply of materials and parts, and the use of wrong parts. These accidents, errors, or mistakes may be attributed partly to inadequate production plans and product designs and partly to the lack of work standards or the established way the workers do their jobs. In addition, there may be the ebb and flow of morale among workers. When serious accidents occur simultaneously and when morale among workers is low, actual output x will be smaller than $\mu F(L)$ and can be negative if we interpret px as value added (roughly equal to sales minus material cost). For example, a large part of the output may be rejected by the buyers on the grounds that the product quality is substandard. On the other hand, the actual output can be larger than $\mu F(L)$, when a positive shock hits the firm and work morale is high.

In what follows, we attempt to explore the optimum behaviors of firms under the two settings; when the decision maker is risk averse and when firm must incur cost of over- and under-production.

Risk aversion

The fluctuation is harmful when the decision maker is risk-averse. Consider a risk-averse MSE owner, who maximizes expected utility $E[U(\pi)]$, where U is a concave utility function. It is well-known that if U is an exponential utility function and π is distributed normally, this utility maximization is equivalent to

$$\text{Max} \quad E(\pi) - \tfrac{1}{2}\gamma V(\pi), \tag{1}$$

where γ is the constant coefficient of absolute risk aversion and $V(\pi)$ is the variance of π. Although p may be a random variable, we assume for a while that θ is the only source of risk. Thus, equation (1) can be rewritten

$$\text{Max} \quad p\mu F(L) - wL - \tfrac{1}{2}\gamma [pF(L)]^2\sigma^2. \tag{2}$$

The first-order condition is

$$p\mu F'(L^*) - \gamma p^2 F(L^*)\sigma^2 F'(L^*) = w. \tag{3}$$

This result is depicted in Figure 1. Under the assumption of the interior optimum, the employment size that maximizes the expected utility, L^*, is given by point E at which the downward-sloping curve representing the left-hand side of equation (3) cuts the horizontal line that shows the wage rate w. The variance, together with risk aversion, makes the downward-sloping curve located below the mean marginal product of labor curve $p\mu F'(L)$ and steep particularly for small values of L, thereby limiting the firm's employment capacity to a low level.

In the presence of risk aversion, what is the consequence of the fluctuation for job creation? It is clear from equation (3) and Figure 1 that individual firms' labor employment, L, decreases as variance σ^2 increases. It is also clear from equation (2) that the certainty equivalent profit also decreases as σ^2 increases. Suppose that management training reduces σ^2 while leaving μ unchanged, and that all the firms in the cluster eventually share the same σ^2.[3] Before the training a large variance $\sigma^2{}_H$ prevailed and after it a low variance $\sigma^2{}_L$ prevails. Before the training, the firm has a lower certainty equivalent profit and a smaller employment size (i.e., $L^*{}_H < L^*{}_L$). In the long-run equilibrium, a typical MSE owner's certainty equivalent profit is driven down to zero, because whenever it is positive, a new entrant will imitate the incumbents' businesses and start its own business, increasing the total output of the cluster, Z, and lowering the output price along the demand curve $p(Z)$ in the local market. It is easy to show that the long-run equilibrium employment is greater after the training than before it (i.e., $n^*{}_H L^*{}_H < n^*{}_L L^*{}_L$).

Overproduction, stock shortage, and waiting

Not all MSE owners are risk-averse. Some MSE owners operate several businesses, such as operating a retail store and renting tricycles to drivers. These affluent MSE owners may behave like risk-neutral decision makers. It does not

[3] If management training not just reduces σ^2 but also increases μ, the impact of the training on employment will be stronger than if μ is left unchanged.

necessarily follow, however, that their labor employment is given by the intersection point D at which $p\mu F'(L) = w$ in Figure 1. To see why, consider a firm producing more, sooner, or faster than required by customers. Such overproduction will cause the otherwise unnecessary time and cost of transporting excessive output between the workshop and the warehouse and may cause the deterioration of output, on the one hand. On the other hand, if the inventory is too small, it is difficult to meet the sudden demand of customers. Thus, both overproduction and stock shortages are costly, and this cost is likely to increase with $F(L)$ at an increasing rate.

Suppose that these costs, C, increase with the gap between the actual and average levels of output increases at an increasing rate, or that $C = c\,[\theta F(L) - \mu F(L)]^2$ where c is a positive constant.[4] In this case, the expected profit, which the risk-neutral owner maximizes, is written

$$E(\pi) = p\mu F(L) - wL - cF(L)^2\sigma^2, \qquad (4)$$

and the first-order condition for the maximization is

$$[p\mu - 2cF(L)\sigma^2]F'(L) = w. \qquad (5)$$

Except for a very small firm, such as a tailor shop where each sewer sews a whole piece of clothing alone, firms divide their entire production process into shorter processes. If a worker produces more, sooner, or faster than required by the next

[4] Suppose alternatively that the inventory cost is $c[\theta F(L) - \mathrm{m}]^2$ where m depends on the size of the warehouse. If m can be freely chosen, the inventory cost is minimized when $m = \mu F(L)$.

process, there will be an unnecessary stock of work-in-process which is being stuck between two stages in the processes. If the worker produces less or later or slower than required by the next process, the worker in the next process will have to stand or sit idle. These costs of overproduction and waiting may be captured by a quadratic function, $c[\theta_1 F_1(L_1) - \theta_2 F_2(L_2)]^2$, where $\theta_1 F_1(L_1)$ and $\theta_2 F_2(L_2)$ are the actual output of processes 1 and 2. The expected inventory cost is proportional to $\sigma_1^2 F_1(L_1)^2 + \sigma_2^2 F_2(L_2)^2 - 2\text{Cov}[\theta_1 F_1(L_1), \theta_2 F_2(L_2)] + [\mu_1 F_1(L_1) - \mu_2 F_2(L_2)]$, where μ_i and σ_i^2 are the mean and variance of θ_i. Toyota's Lean Manufacturing System regards overproduction, waiting, and keeping more than the minimum stock as wastes to be eliminated.

It should be clear that after taking into consideration these costs of fluctuation, the marginal value product goes down quickly as employment L increases, like curve *AE* in Figure 1. Thus, the same reasoning applies as before, and it can be easily shown that the long-run equilibrium employment in a cluster with high variances is smaller than that in a cluster with low variances.

Why is wide fluctuation so common?

Managers should take preventive actions to reduce accidents, mistakes, and errors that give rise to the fluctuations described above. The root cause of each abnormality should be sought out, which should be followed by planning a change aimed at improvement, carrying out or testing the change on a small scale, studying the result, and adjusting the new practice so that the variation in output is within a predicted range and the cost is predictable. Once the new practice is stabilized, a higher goal for a further improvement can be set, and efforts toward it are made through the plan-do-check-act (PDCA) cycle, which is also known as the Deming cycle and the

Shewhart cycle and emphasized in Kaizen, a common-sense, low-cost approach to management (Imai, 1997). The successful application of the PDCA cycle will reduce variance σ^2, increase mean μ, and accordingly increase the certainty equivalent profit. Of course, what is important is the knowledge and adoption of new practices that effectively prevent abnormalities from occurring, rather than the PDCA cycle. One may go through a process similar to the PDCA cycle, whether one knows it or not. The knowledge of the PDCA cycle, however, will make business owners more consciously aware of the need for deliberate planning and execution toward improvement.

In Japan, the PDCA cycle was unknown until W. Edwards Deming began teaching it in Japan in 1950. Since then, it has spread first among large firms and then to small and medium firms and has infiltrated itself, together with other major concepts of Kaizen, throughout Japan. It is now widely used also in other parts of East Asia, including Thailand and Indonesia, where there are a large number of Japanese firms and their subsidiaries operating. In addition, it is used in rapidly growing industries in South Asia, such as the garment industry and the pharmaceutical industry in Bangladesh and the automobile industry in India. As Bloom and Van Reenen (2010) argue, however, the international diffusion of managerial innovations takes a long time. It is little wonder then that Kaizen, the Lean Manufacturing System, and other managerial innovations have not reached MSEs in low-income countries.

Moreover, many MSEs in low-income countries suffer from a more primitive and hence more serious problem of not keeping any records of transactions, customers, suppliers, inventories of materials, work-in-process, and products, employment, or production.[5] Thus, it is not easy for the entrepreneurs to distinguish what is normal from what is abnormal. In our notation, it would be difficult for them to recognize precisely how high or low the realization of θ is relative to μ, and, hence, how much they lose from the risk due to the fluctuation of θ. Clearly, the lack of record keeping makes it difficult to recognize the significance of the problem of leaving variance σ^2 large, let alone to remedy the problem.

Such shoddy management is a constraint on job creation. Firms in a survival cluster look similar: they produce the same products by using the same technology and sell the product in the same local market for a long time. But some are larger than others in size. Suppose that all firms share the same means μ but different variances σ^2 of the random variable θ. Then those firms with lower σ^2 employ larger L, which reduces $F'(L)$. If we measure the average labor product (*APL*) by value added divided by the number of workers (or the number of workers times the number of months in operation) and plot the data on Figure 1, the data points for firms with small employment size (like L^*) would be more widely distributed (around point *B*) than the data points for larger firms, as illustrated by the three sets of vertically scattered dots in Figure 1. In this example, the larger firms have a lower mean of the average labor product than smaller firms. Of course, this is not always the case because larger firms may have higher efficiency or higher mean μ. But we cannot say that firm size is positively associated with labor productivity. This is somewhat counterintuitive because we tend to think that larger firms are more productive. The lesson from Figure 1 is that to what extent management can stabilize variation in output is a major

[5] See De Mel, Woodruff, and McKenzie (2009), Drexler, Fischer, and Schoar (2010), and Mano et al. (2012) among others for more detailed descriptions of this problem.

determinant of the employment size in clusters that do not have innovations, so that μ tends to be equalized across firms.

4. Entrepreneurship and Innovation in Industrial Clusters

Baumol, Schilling, and Wolff (2009, p.712) define innovative entrepreneurs as individuals "engaged in enterprises that offer new products, or new production processes, enter new market, etc." In our framework, such innovation tends to increase μ. While its effect on σ^2 is not necessarily clear, it may increase with the introduction of new technology but decrease with improvement of management practices.

According to the case studies of successfully developed industrial clusters in Latin America, East Asia, and South Asia, a real breakthrough begins with improvements of product quality followed by branding and the establishment of new distribution systems (Schmitz and Nadvi, 1999; Sonobe and Otsuka, 2006, 2011). Before the improvement of product quality, the product price is a function of the market supply of the product, $p(Z)$. By contrast, after the quality improvement, if product differentiation is successful, the firm can have price setting power and the price is a function of its own output x and the total supply, $p(x, Z)$. Branding is important because product differentiation is profitable only when the improved quality is recognized by consumers. New distribution channels, such as own retail shops and sales agents who deal exclusively in the affiliated firm's products, are important because brand names can be stolen and because ordinary traders and retailers deal in a mixture of the improved products and low-quality products, which undermines the effectiveness of product differentiation.

The quality improvement and the marketing reform increase the profit from other complementary changes. One is to strengthen the long-term relationship with reliable suppliers that produce high-quality parts and components necessary for the high-quality product. This is important to secure a stable supply and to prevent new designs from being stolen. Another major change complementary with quality improvement and the marketing reform is the expansion of the production capacity. The establishment of the brand name strengthens sales, and mass selling helps the brand name spread to every corner of a country or a region. Thus, to profit from this circular causation, there must be mass production. It can be achieved through the acquisition of other firms or through the construction of new factories.

The innovative entrepreneur, who began making the breakthrough, may design a few of these complementary changes and reforms alone but not all. He or she may have to learn from someone else to continue. But if these changes and reforms are new not only to the industrial cluster but also to the country, the entrepreneur will have to learn from abroad. Thus, technology borrowing in a broad sense including marketing and organizational knowledge assumes considerable importance.

Suppose that the product quality has been improved, that a brand name has been established, that the stable supply of high-quality intermediate inputs has been secured, that the secret of product design is well kept, that a mass selling distribution system appropriate for the branded product has been established, and that mass production facilities have been installed. All these reforms and changes will not bear fruit if the whole organization is not managed appropriately. Compared with MSEs, the firm in this stage has to tackle far more complicated cash flow management, incentive problems, quality control, marketing, and procurement, and also faces new challenges such as public relations and conflicts between divisions. Since the innovative entrepreneur cannot deal with all these problems alone, he or she will hire specialist managers and delegate the duties if such managers are available. The mutually complementary changes and reforms, complete with such strengthened management, compose the multifaceted innovation.

Based on the arguments about management and entrepreneurship in the previous section and this section, we would like to advance the following hypotheses.

Hypothesis 1: In survival clusters, employment size is small, labor productivity is low and has large variances particularly among small firms, and there is no clear association between labor productivity and employment sizes.

Hypothesis 2: In dynamically growing clusters in which some innovative firms introduce technological innovations, employment size varies among firms, and there is a positive association between labor productivity and employment sizes.

We expect that the management training offered in survival clusters will decrease σ^2. It is not clear *a priori* whether innovative firms have higher or lower σ^2 in dynamic clusters. But as appropriate management practices are established, we expect to observe that large firms have high μ and low σ^2.

5. Case Studies

In this section, we confront the above hypotheses with enterprise data collected in two industrial clusters in China and one each in Vietnam, Ghana, Ethiopia, and Bangladesh. This empirical exercise is not intended to perform rigorous hypothesis testing, but rather to provide suggestive evidence. The six clusters that we take up here as examples have different degrees of success in multifaceted innovation, as will be explained shortly. Table 1 shows each cluster's location, main product, population of final goods producing firms, the mean and median of employment size and labor productivity (which is defined as value added divided by the number of workers) in the year in which we gathered information.

Figure 2 consists of 12 panels of scatterplots showing the distributions of labor productivity and employment size in these six clusters for two years. The summary statistics of these distributions are reported in columns (5) and (6) of Table 1. The vertical axis of the scatterplots measures the monthly value added per worker in US dollars as labor productivity.[6] The horizontal axis measures the logarithm of the number of workers.[7] The scatterplots share the same scale on each axis to allow comparison among the clusters and are useful for seeing whether the data are consistent with our hypotheses. Later in this section, we will turn to Table 3, which presents the results of some randomized controlled experiments in which basic management training was provided for entrepreneurs.

Cluster 1 produces sweater and other knitwear items for an export market in Eastern Europe and for a small domestic market in the northern provinces in Vietnam (Nam, Sonobe, and Otsuka, 2009). Geographically, the cluster is small and coincides with a village. Our sample is nearly equal to the population of knitwear firms in this cluster. The quality of the cluster's products was improved when exporting began. Several firms adopt the factory production system employing more than 100 workers,

[6] This monthly value added per worker is not the value added per worker in a particular month, but it is the value added in a year divided by the number of months worked and the number of workers.
[7] The numbers, 3, 30, and 300 on the horizontal axis stand for 3 persons, 30 persons, and 300 persons.

but all other firms rely heavily on a large number of household subcontractors in neighboring villages for a substantial part of the production process. Thus, a small part of this cluster is dynamic. It is little wonder that small firms' labor productivity has a very large variance as shown in Figure 2-1a, if they are poorly managed. Note, however, that while we are talking about the random variation in labor productivity at each firm, the figure shows the variation among firms in a cross section. Can we take the range of the distribution of dots in the vertical direction at each employment size as indicating wide fluctuations in labor productivity? This is a legitimate question because in theory, if some firms always have a higher productivity than other firms, they will become larger. In reality, however, labor productivity fluctuates widely in this cluster. As column (7) of Table 1 shows, the autocorrelation of labor productivity between two consecutive years 2009 and 2010 is as low as 0.38, which is lower than the autocorrelation between 1995 and 2000 in Cluster 5 and much lower than the autocorrelation between two consecutive years in Cluster 6. Without fluctuation in labor productivity, Figure 2-1a is hard to understand. For example, not a few firms had negative value added per worker in 2009 as shown in Figure 2-1a. It is hard to believe that they had had negative value added every year. Similarly, if some small firms had always had very high value added per worker, we cannot explain why they remain so small in size. Thus, the range of the distribution of the dots in the vertical direction at each employment size is likely to reflect the variance of the fluctuating labor productivity of the firms to a significant degree. Without further analysis of dynamic changes, however, it is hard to draw definitive conclusions.

Consistent with Hypothesis 1, the variance is smaller for the firms with relatively larger employment, and labor productivity is not positively associated with employment size. Interestingly, a comparison between Figures 2-1a and 2-1b establishes that the variance in labor productivity in 2010 is much smaller than that in 2009. This reduction in the variance can be partly the result of a management training program that we provided in cooperation with the World Bank just before the busy season in 2010 as an experiment. There were two types of treatment: classroom training and on-site consultation. Nearly three quarters of our sample received either one type or both types of treatment. As we will explain shortly, there is strong evidence that the training had impacts on the management practices of the training participants. Moreover, there is no doubt that knowledge spilt over from the participants to non-participants because everyone in the village was a sibling, relative, school friend, or neighbor of the participants.[8] Thus, it is likely to be the good effects of the management training on the participants and, to a lesser degree, on the non-participants that reduced the variance in their labor productivity, even though the mean of the employment sizes and that of the productivity, as shown in Table 1, did not yet increase significantly in 2010.

Cluster 2 is now a typical survival cluster, even though it is huge in terms of the number of firms, which reflects its long period of quantity expansion. The cluster is located in the country's second largest city where the two artery roads from the seacoast become one leading to the inland arid region, and has an extraordinarily large number of car repairers fixing large trucks as well as passenger cars. The target of our case study there, however, is a minority group consisting of about 1000 metalworking firms. They are located in the car repair cluster because of the abundant availability of used

[8] According to our interviews with the sample entrepreneurs, everything related to the training program was the talk of the town during the program. Also note that there is a possibility that the variance of labor productivity was lower in 2010 than in 2009 partly because of the temporary fall of the market demand rather then the impact of management training.

metal as well as the demand for repair parts and other metal products consumed within the cluster and in the inland region. Our sample accounts for about 15 percent of this population of metalworking firms, and about one third of our sample were invited to a management training program toward the end of 2007 (Mano et al., 2012). This training program was also provided by the World Bank as an experiment.

The dominant mode of employment in this cluster is self-employment. For the last decade, almost all masters have paid at least a small amount of money to their apprentices. Thus, we count the apprentices as workers. Since many apprentices become masters after several years of training, firms producing the same products proliferate, which lowers the product prices and, hence, the profitability. This is why the metalworking firms in this cluster are small in size and unprofitable. The variance in labor productivity is large but it is smaller than the variance in Cluster 1. Indeed, Figures 2-2a and 2-2b show that Cluster 2 has a smaller employment size. The variance in the measured labor productivity is smaller in Cluster 2 than in Cluster 1, probably because the demand for metalwork products made in Cluster 2 is much more stable than the demand for knitwear products made in Cluster 1. Still it is large compared with the other clusters, as we will see below. A simple and astonishing finding from the above mentioned management training program in Cluster 2 is that only one out of four masters kept records of transactions and none separated household or personal finances from firm finances (Mano et al, 2012). Figures 2-2a and 2-2b indicate that firms with relatively large employment size have smaller variance in labor productivity, consistent with Hypothesis 1.

Cluster 3, a leather-shoe cluster in Ethiopia, may be classified as something between a survival cluster and a dynamic cluster (Sonobe, Akoten, and Otsuka, 2009).

The five largest firms have begun multifaceted innovation, but one thousand or more firms remain informal, very small in employment size, and continue completely manual production. Leather-shoe making was initiated in the early 20th century by Armenian traders, who taught the skills to Ethiopian workers. In the late 1990s, Addis Ababa was said to have more than 1000 self-employed shoemakers and more than 100 workshops and factories. In the early 2000s, the industry was hit by a flood of cheap leather shoe imports from China, which would reduce the number of local producers by a few hundred. A few years later, however, consumers began buying domestically produced leather shoes again because they had found that the shoes imported from Chines were of low quality. This is why the average employment size of the sample firms declined from 2000 to 2004 as shown in Table 1.

By 2004, the market demand for locally produced shoes began increasing and, more importantly, some large firms began improving product quality and production processes by borrowing technology from abroad, particularly from Italy. As the derived demand for high-quality leather recovered, the self-employed workshops became unable to buy such leather. This is why the labor productivity of the smallest firms was higher in 2000 than in 2004, as shown in Figure 2-3a. At the end of 2011, the large firms are successfully exporting their products to Europe and Middle East as well as to neighboring African countries. Their success should not come as a surprise because their high management capacities are manifested in the relatively small variance of labor productivity as shown in Figures 2-3a and 2-3b. This finding again reinforces the validity of Hypothesis 1.

Cluster 4, a garment cluster in China, has an even smaller variance in labor productivity (see Figures 2-4a and 2-4b). Firms in this cluster produce children's clothes and market them in provincial cities in China and export to Russia. In the 1990s, they were faced with increasing competition from an increasing number of firms producing children's wear within the cluster and outside (Sonobe, Hu, and Otsuka, 2002). Bernard, Jensen and Schott (2006), Syverson (2011), and Bloom and Van Reenen (2007, 2010) argue based on solid empirical evidence that increasing market competition necessitates improvements in management capacities. Probably, a reason why Cluster 4 could meet this need may lie in the abundant availability of experienced managers. The main source would be state-owned enterprises (SOEs) in the nearby cities, Shanghai and Hangzhou. This region, the Southern Yangtze River region, is known for its successful industrial development based on the massive transfer of knowledge from SOEs to the township and village enterprises (TVEs) (Otsuka, Liu, and Murakami, 1998). During the 1990s, the firms in Cluster 4 shifted their product line toward higher value-added items and accordingly their marketing channel from selling in the marketplace in the cluster to direct transactions with large retailers and wholesalers from distant cities (Sonobe, Hu, and Otsuka, 2002). Starting with these changes, the firms seemed to extend their targets of reforms to achieve multifaceted innovation, even though we do not have data on this process. What we know about this cluster after 2000 is that it ranked among the world's largest producers of children's wear (Fleisher et al., 2010). Behind this success, there would have been improvement in management, which reduced the variance of labor productivity.

As to Cluster 5, we have data that cover the period of its multifaceted innovation, and, thus, Figures 2-5a and 2-5b capture the impact of the multifaceted innovation on productivity and employment vividly. This cluster produces electrical fittings such as switches, power outlets, and ampere meters for housing and office buildings. The employment in the cluster grew tremendously in the 1990s, as seen in the figures. A factor behind the fast growth is the rapid increase in the demand for the cluster's products due to a construction boom. The question, however, arises as to why only Cluster 5 grew so fast. The main reason is that Cluster 5 was the first to achieve multifaceted innovation in this industry in China (Sonobe, Hu, and Otsuka, 2004).

The innovation started with the adoption of simple quality inspection, followed by branding, the spread of the network of exclusive sales agents across the country, the expansion of firm size through purchasing factories, and the employment of managers as well as engineers who had high education and work experience in SOEs. By 1990, only one firm had achieved all these changes. This innovator is shown in Figure 2-5a as the largest firm. Several other firms soon began imitating the multifaceted innovation and a few continued with it thoroughly to become larger than the innovator by 2000. In the late 1990s, about a dozen of other firms began imitating these imitators.

Having achieved the multifaceted innovation, firms produce higher-quality, higher value added products with higher efficiency, by using machinery more intensively and hiring more highly educated engineers and managers. At the same time, they have expanded their firm sizes since their established brand names make mass production and mass selling profitable. Indeed, Figure 2-5b shows that among such firms, labor productivity and employment size are positively associated. This result lends support to Hypothesis 2. In this dynamic cluster, the variance of labor productivity became larger in 2000 than in 1990, presumably because of the greater complexity of management under the dynamically changing production technology and products.

Cluster 6 is the cluster of export-oriented garment firms in Dhaka, Bangladesh. The country started the production of garment items for export about three decades ago and has become one of the world's largest garment producers (Mottaleb and Sonobe, 2011). The capital city, Dhaka, is the center of this industry, even though Chittagong, a port city, is another major cluster. The industry was initiated when its first export-oriented firm established in Chittagong sent 130 workers to South Korea for intensive training in production, quality control, international procurement, international marketing, and overall management. Soon, garment firms were established in Dhaka as well, equipped with the full set of expertise necessary for a successful kick-start. Thus, unlike the other examples discussed in this paper, Cluster 6 had the multifaceted innovation in its incipient period.

Mostly the current customers of the firms in this cluster are so-called global buyers, i.e., large retailers, wholesalers, and manufacturers with well-known brands in developed countries. The global buyers require their vendors like the garment firms in Cluster 6 to keep reducing production costs, shortening lead times, and improving product quality. If a vendor fails to meet such requirements, it will soon be replaced by another vendor in the same country or in another developing country. Many firms in Cluster 6 have stepped up the ladder of buyers from minor buyers to the top-class global buyers. This fact indicates clearly that since its kick-start, Cluster 6 has continued with improvements in efficiency and product quality.

Note, however, that this cluster's growth has other features. First, firms in this cluster have not established their own brand names because they are vendors for global buyers. Second, the scope for mechanization is limited. Third, good management is critically important to take the full advantage of the abundant supply of low-wage workers in Bangladesh, and the role of technological innovation is much less important. Probably, these features explain why a positive association between labor productivity and employment size is missing in Figures 2-6a and 2-6b, even though the variance of labor productivity is lower for larger firms..

Thus, the 12 panels of Figure 2 are consistent with Hypotheses 1 and 2. They also suggest that managerial capacities play an important role in determining employment size particularly in survival clusters, whereas entrepreneurship and innovation enhance job creation in dynamic clusters. Before closing this section, we would like to add that basic knowledge of management can be taught by business consultants to entrepreneurs of MSEs. In recent years, an increasing number of randomized controlled experiments have been carried out to test the effectiveness of management training or consulting provided to entrepreneurs (e.g., Karlan and Valdivia, 2011; Drexler, Fischer, and Schoar, 2010; Bruhn, Karlan, and Schoar, 2010; Field, Jayachandran, and Pande, 2010; Bjorvatn and Tungodden, 2010; Mano et al., 2012). These experiments have been conducted in various part of the developing world, but they share surprisingly similar results. We also conducted management training experiments in Clusters 1 and 2, together with the results of experiments in two other survival clusters in Vietnam and Tanzania (see Table 2) and obtained similar results. The outline and main results of our experiments may be summarized as follows.

In each cluster, management training was provided to entrepreneurs in a classroom setting by local business consultants in local languages and by international consultants accompanied by an interpreter. The program consisted of three modules: marketing and entrepreneurship, production management including an introduction to a few basic concepts of Kaizen, and record keeping. Before the program, we conducted a baseline survey of firms in the cluster and assigned sample firms randomly to the treatment group or the control group. It was up to the entrepreneurs in the treatment group to decide whether to attend the training program, which lasted three weeks.[9]

In the clusters in Vietnam and Tanzania, we also offered on-site training several months after the classroom training was completed.[10] The assignment to on-site treatment was random and independent of the random assignment to the classroom training. Thus, some entrepreneurs received both types of training. The follow-up survey was conducted a year later in Cluster 2, but in the other clusters, it was conducted only three months after the on-site training was completed.

From these experiments, we have learned that entrepreneurs of MSEs have little awareness of basic management practices, that they soon understand the usefulness of such practices and become willing to learn how to apply them, and that roughly half of the participants put the new knowledge into practice. Indeed, in all these clusters, the estimated impacts of the training effects on the adoption of various management practices that were taught in the program are positive and statistically significant. Another impact of the training program is found on the longevity of the firm. In Cluster 2, while not a few firms in the control group stopped operation or completely closed down, there was no incidence of exit among the participants. The difference was statistically significant.[11]

As shown in Table 2, the estimated effects of training on the participants' value

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[9] In the cluster of garment firms in Dar Es Salaam, Tanzania, the training program had four modules and lasted four weeks. Three modules were the same as in other study sites, and the fourth was about color coordination and other aspects of the design of garment items.

[10] In the on-site training program, instructors visited participants' firms to teach them how to apply a simple technique of Kaizen to their workshop or factory, and the instructors visited the firm again to check if the application was going well and to give further advice.

[11] In the other clusters, there has been no exit among the participants, even though there have been very few exits even among the non-participants.

added are insignificant or marginally insignificant, except for the on-site training in Tanzania. Note, however, that the follow-up data in Vietnam and Tanzania were taken only six months after the classroom training and three months after the on-site training was completed.[12] It is no wonder that the estimated effect is statistically weak. Moreover, these estimates neglect to take into account the favorable effect of the training on non-participants through knowledge spillovers. Thus, the estimated effect on value added is likely to be only a small part of the social benefit of the training program.

In our observation, participants expressed deep appreciation to the management training programs almost without exception. Suzuki and Sonobe (2012) find that the demand for the management training programs was low prior to the training, but increased greatly with own experience, which can be seen in changes in the willingness to pay the training fees before and after the training. Interestingly, upon hearing the value of the training program from participants, non-participants also expressed greater willingness to pay the training fees. These findings suggest that it is lack of knowledge about the benefits of training that hinders the development of management consulting businesses in developing countries.

The cost of the training program per participants shown in Table 2 includes the costs of local and international consultants' preparation of teaching materials, their travel and accommodation costs, and the cost of renting the venue.[13] Note that the cost per participant shown in the table includes costs that can be saved, such as the cost of

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[12] The training effects on value added in the Tanzanian case shown in Table 2 were estimated by comparing the quarterly value added from January to March in 2010 and those in 2011.

[13] The cost was low in Cluster 2, where international consultants were not hired, and the venue was provided by a nearby vocational school free of charge. The cost was high in Tanzania, where a large room in a hotel in the center of the capital city was used as the venue, and the local lead consultant's remuneration was high.

preparing teaching materials, if a training program is repeatedly provided.

It is remarkable that the estimated annual benefit tends to exceed the cost despite the overestimation of the cost and underestimation of the benefit in Table 2. Since the benefits will continue to accrue in coming years, the present value of benefits will be much greater. Thus, it is quite possible for future rounds of follow-up surveys to establish that the social benefit from the provision of the management training program exceeds the cost of the provision. Moreover, there may be room for the improvement in the training contents.

Many issues remain unresolved regarding the impact of training. For example, it is not clear yet what type of firms, e.g., size and the education and experience of managers, benefits more from training program and in what type of clusters it is effective, and what type of management information is highly demanded. It is also important to inquire the extent of complementarity among management and technical training programs and the provision of credit in improving firm performance.

6. Conclusions

It is widely accepted that good management is critically important for firms, especially large firms consisting of many groups with different functions (e.g., Drucker, 1973). The present paper has found that management is important for MSEs as well. Among various aspects of management, particularly important for MSEs is to keep control of the production pace because wild fluctuations in production make the expansion of employment size highly risky and cause overproduction and other wasteful uses of resources. For MSEs, it should be useful to teach the importance of record keeping and pricing based on the analysis of records and basic knowledge of marketing and workshop housekeeping. Actually, the results of randomized experiments carried out recently, including our experiments in Vietnam, Ghana, and Tanzania, indicate that basic management training helps training participants' firms improve management practices, reduces the incidence of exit, and is likely to benefit participants enough to justify the cost of providing the training.

Our analysis, however, indicates that the provision of basic management training is not enough to help firms grow dynamically so that they can create ample job opportunities. Dynamic firm growth is a result of multifaceted innovation led by entrepreneurship. Thus, it is important to nurture entrepreneurs' innovative capacity. Compared with managerial capacity, innovative capacity in general is probably more elusive and accordingly more difficult to teach to entrepreneurs. Nonetheless, our review of dynamic cluster development suggests that there is a common pattern: dynamic clusters in different sectors in different countries have shared similar experiences of a series of innovations starting with product quality improvement followed by branding, improvements in marketing, strengthening relationships with suppliers, and improvements in management of labor, inventory, and finances. This finding brings new hope: entrepreneurship relevant to industrial development in low-income countries may be taught. A considerable compilation of empirical studies of the operational practicalities of teaching management and entrepreneurship as well as the diffusion process of managerial and entrepreneurial knowledge is clearly warranted.

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Table 1. Characteristics of selected industrial clusters

	(1) City (Country)	(2) Product	(3) Year	(4) No. of firms in the cluster[a]	(5) Number of workers per firm		(6) Labor productivity (value added per worker)		(7) Correlation coefficient[e]
					mean	median	mean	median	
1	Hatay (Vietnam)	Knitwear	2009	170	19.5	9	600	383	*R*(1 year)
			2010	160	20.1	10	573	470	= 0.38
2	Kumasi (Ghana)	Metalwork	2004	1,000[b]	5.6	5	564	294	*R*(2 years)
			2008	1,000[b]	5.2	5	247	143	= 0.67
3	Addis Ababa	Leather shoes	2000	1,200	13.1	4	245	167	*R*(2 years)
	(Ethiopia)		2004	900	10.1	5.5	202	155	= 0.56
4	Huzhou, Zhejiang	Children's wear	1990	5,000[c]	8.4	8	357	295	*R*(4 years)
	(China)		1999	2,000	15.0	12	169	158	= 0.64
5	Wenzhou, Zhejiang	Electrical	1990	60	46.7	26	291	214	*R*(5 years)
	(China)	fittings	2000	120	338.6	110	603	431	= 0.54
6	Dhaka	Garment	2000	3,200[d]	697.5	350	449	298	*R*(1 year)
	(Bangladesh)		2005	4,100[d]	1231.7	724	405	312	= 0.94

Notes:

a. Only the final goods producing firms are counted unless otherwise indicated.
b. In the same cluster, a large number of car repairing garages and electricians are operating. The total number of firms in the cluster is estimated to be more than 10,000.
c. This number includes subcontractors.
d. This is the number of export-oriented garment manufacturers, including firms outside Dhaka.

e. This column shows the auto-correlation of labor productivity between 2009 and 2010 in Cluster 1, 2007 and 2008 in Cluster 2, 2002 and 2004 in Cluster 3, 1997 and 1999 in Cluster 4, 1995 and 2000 in Cluster 5, and 2004 and 2005 in Cluster 6. R(x years) stands for autocorrelation coefficient between year t and year $t + x$.

Table 2. Management training programs' costs and effect on value added

	Cost per participant (USD)	Estimated effect on annual value added (USD) [a]	Estimator [b]
Classroom-training			
Hatay, Vietnam	1,555	4,560 (16,829)	DID-ITT
Kumasi, Ghana	740	13,890* (8,339)	ANCOVA
BacNinh, Vietnam	2,050	27,302 (35,211)	DID-ITT
Dar es Salaam, Tanzania	4,179	4,181* (2,218)	DID-ITT
On-site training			
Dar Es Salaam, Tanzania	2,043	4,038** (1,987)	DID-ITT
Both classroom and on-site			
Dar Es Salaam, Tanzania	6,222	3,882* (2,309)	DID-ITT

Notes

Standard errors are in the parenthesis. * and ** indicate 10 percent and 5 percent significance, respectively. Classroom training was conducted in July-August 2010 in Hatay, Vietnam, in November-December 2007 in Ghana, in July-August 2010 in BacNinh, Vietnam, and in May-June 2010 in Tanzania. On-site training in Tanzania was conducted in December 2010.

a. The effects were estimated by using quarterly data in Tanzania.
b. DID-ITT stands for difference-in-differences estimation of intention to treat analysis. ANCOVA stands for Analysis of Covariance, which controls for observed covariates as well as past outcomes in the estimation of treatment effect using training invitation as an instrumental variable.

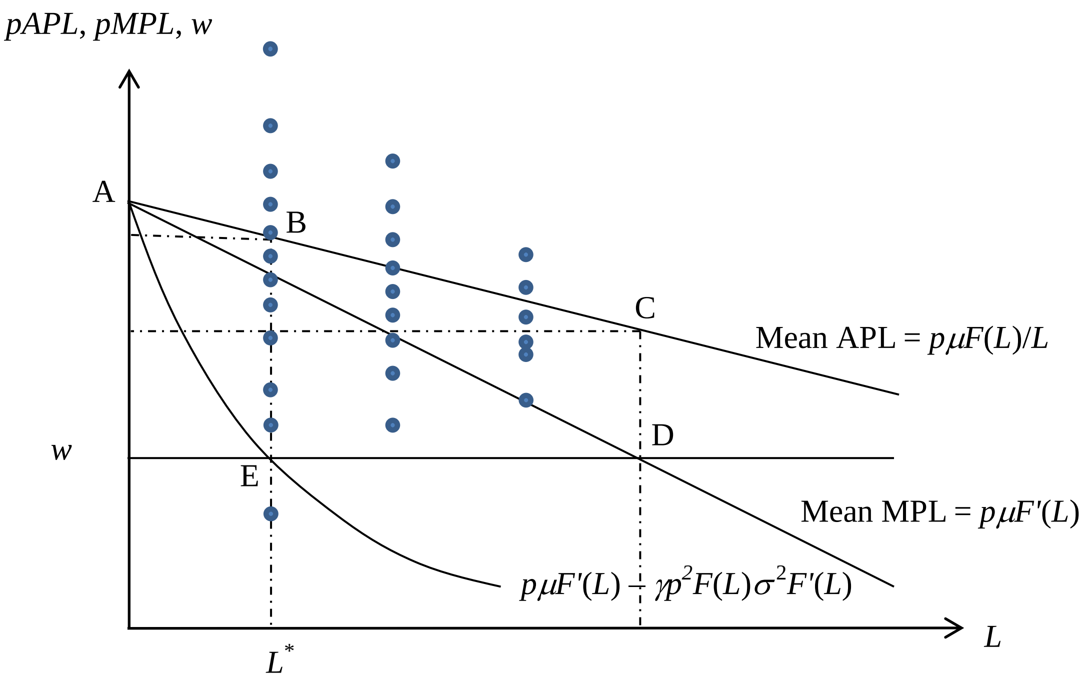

Figure 1. The effect of output fluctuation and risk aversion on employment size

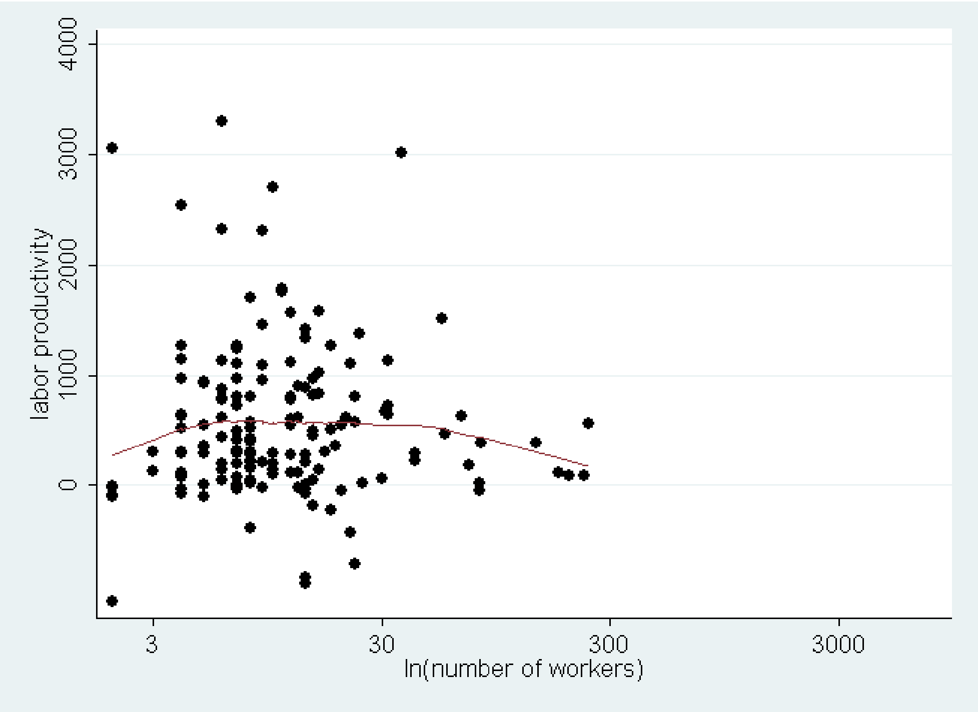

Figure 2-1a. Labor productivity and employment size
Hatay (Vietnam) garment cluster, 2009

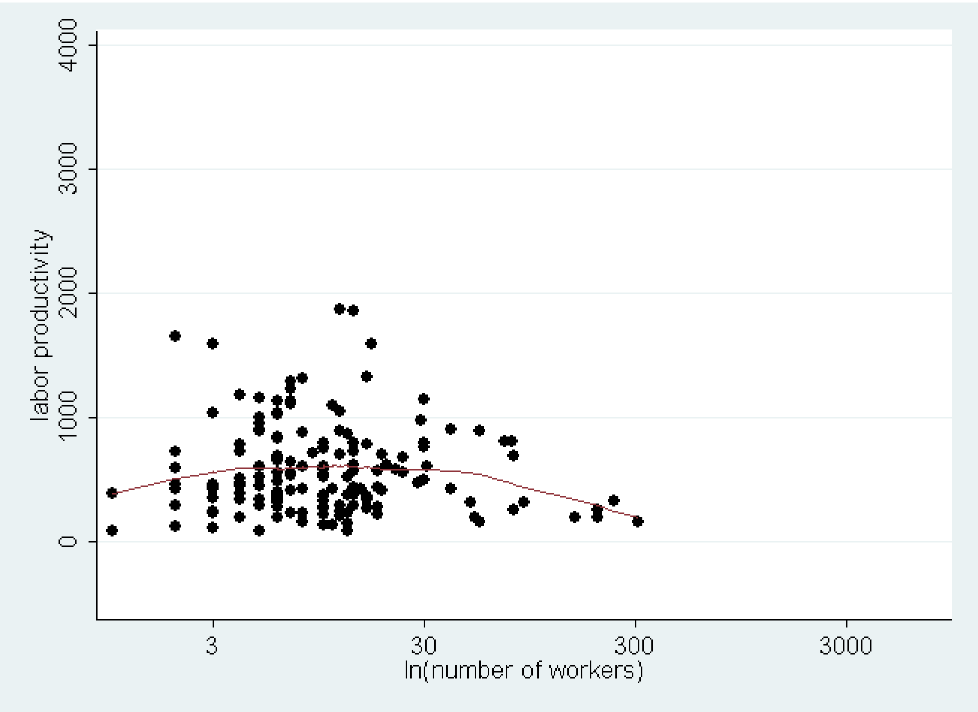

Figure 2-1b. Labor productivity and employment size
Hatay (Vietnam) garment cluster, 2010

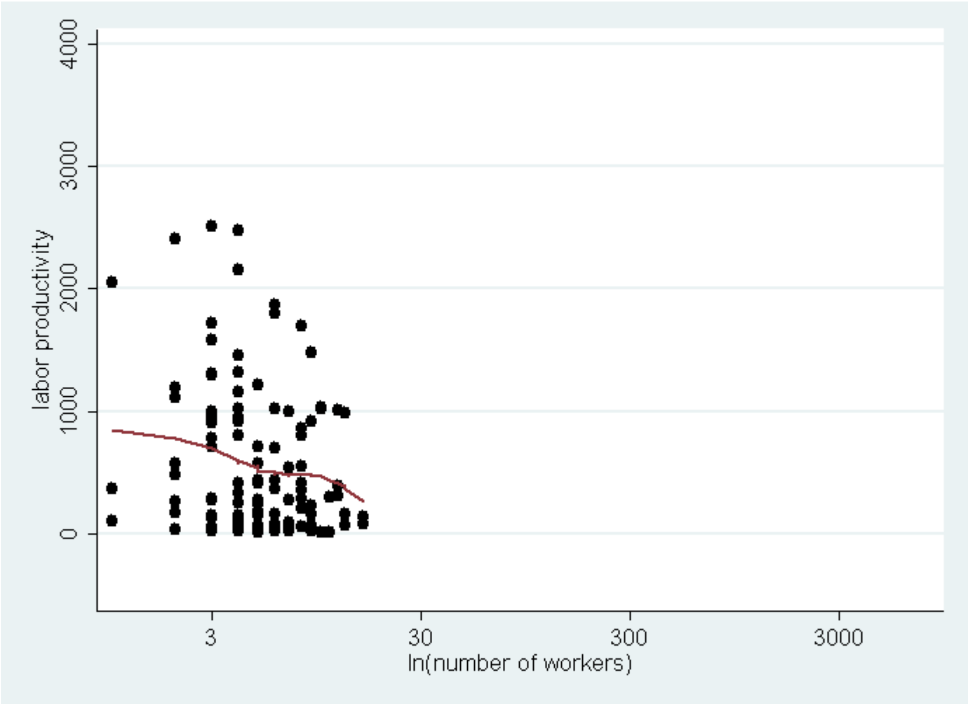

Figure 2-2a. Labor productivity and employment size
Kumasi (Ghana) metalworking cluster, 2004

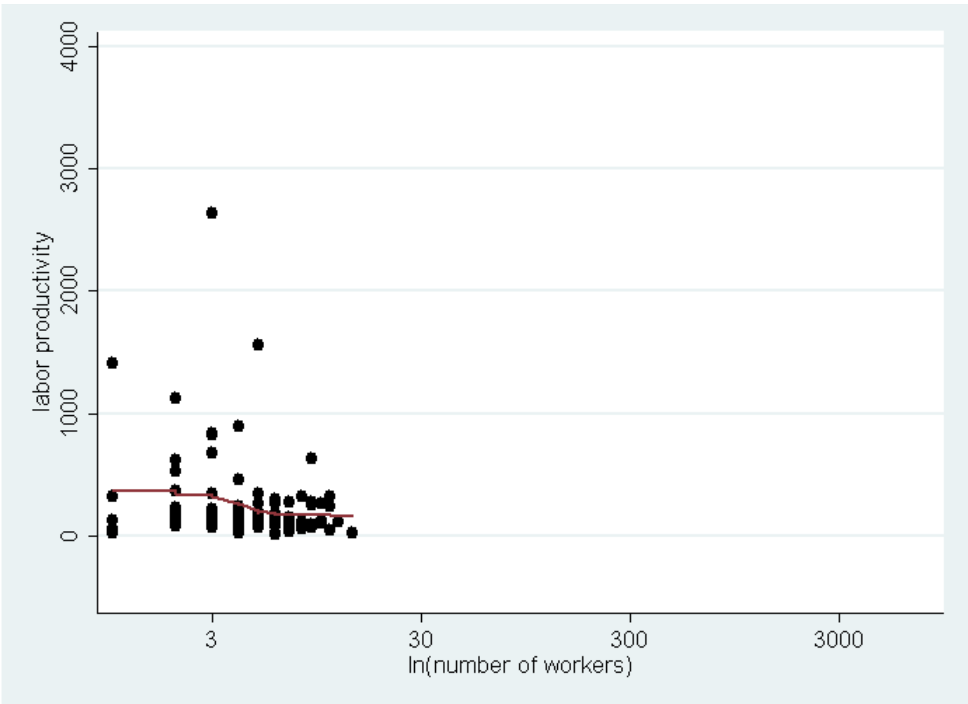

Figure 2-2b. Labor productivity and employment size
Kumasi (Ghana) metalworking cluster, 2008

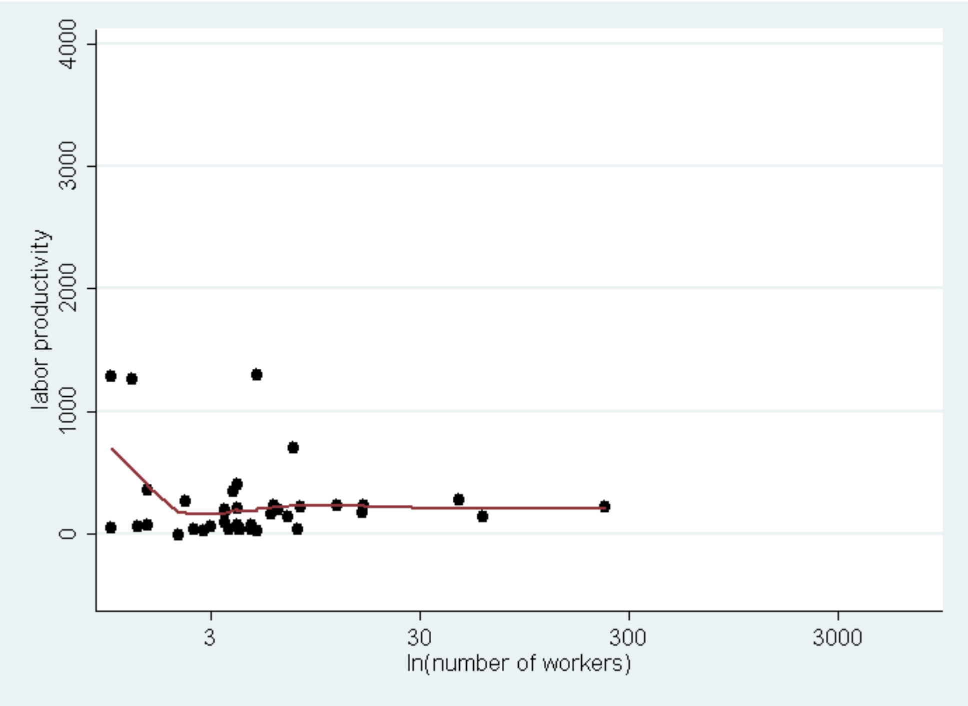

Figure 2-3a. Labor productivity and employment size
Addis Ababa (Ethiopia) footwear cluster, 2000

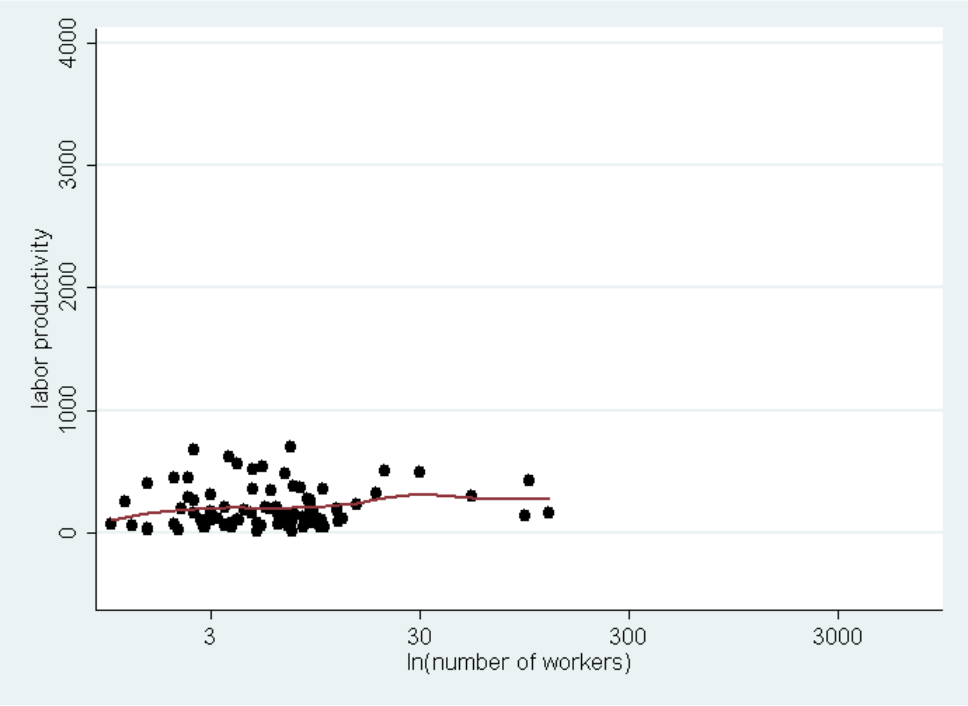

Figure 2-3b. Labor productivity and employment size
Addis Ababa (Ethiopia) footwear cluster, 2004

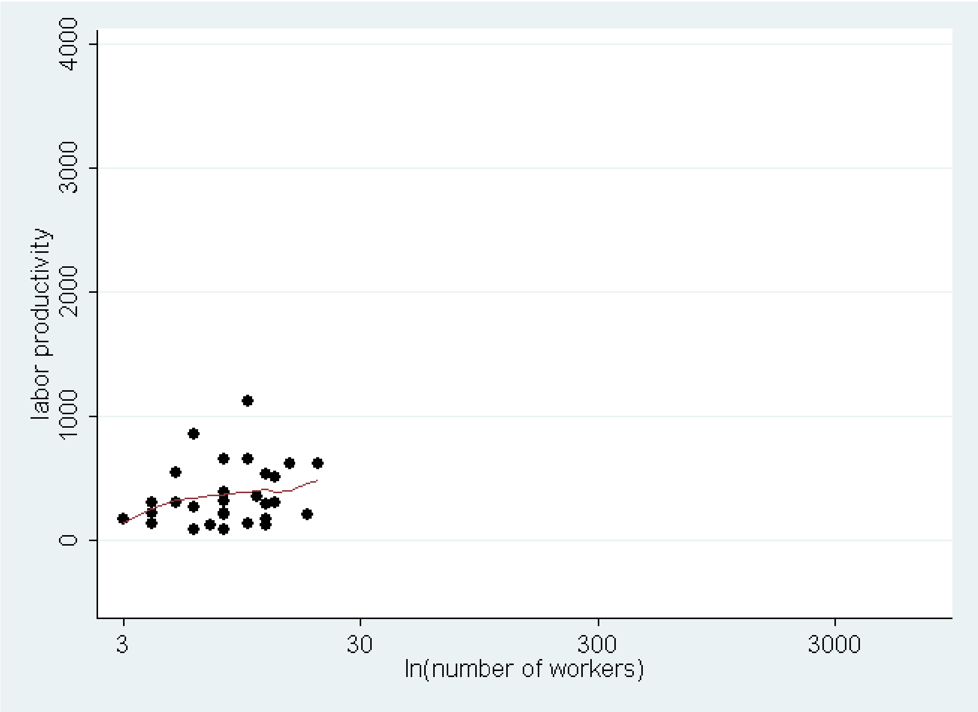

Figure 2-4a. Labor productivity and employment size
Zhili (Zhejiang Province, China) garment cluster 1990

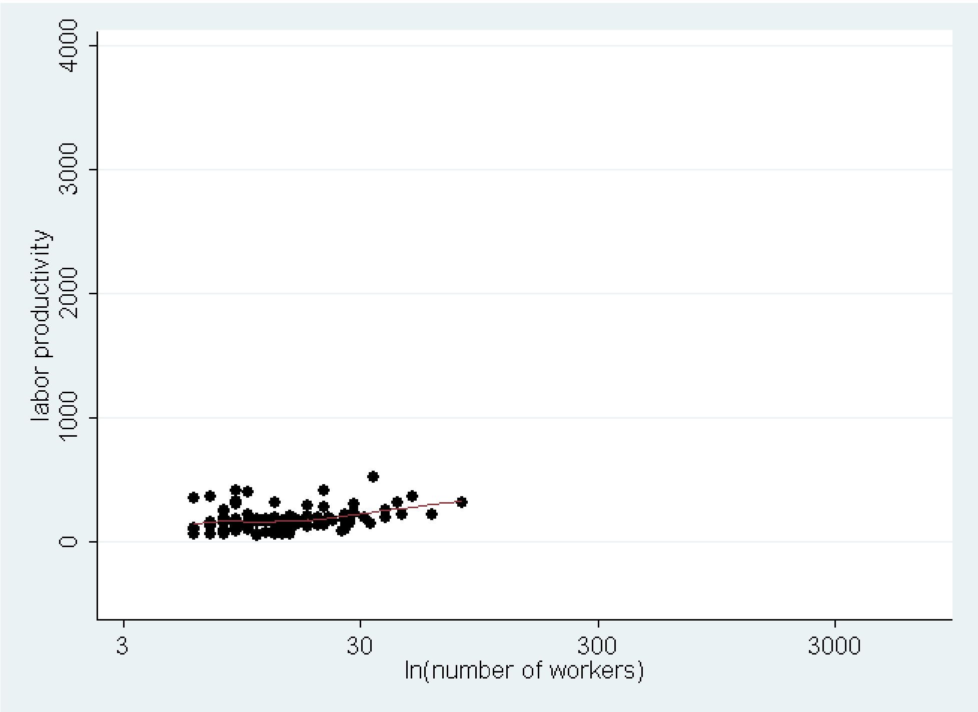

Figure 2-4b. Labor productivity and employment size
Zhili (Zhejiang Province, China) garment cluster 1999

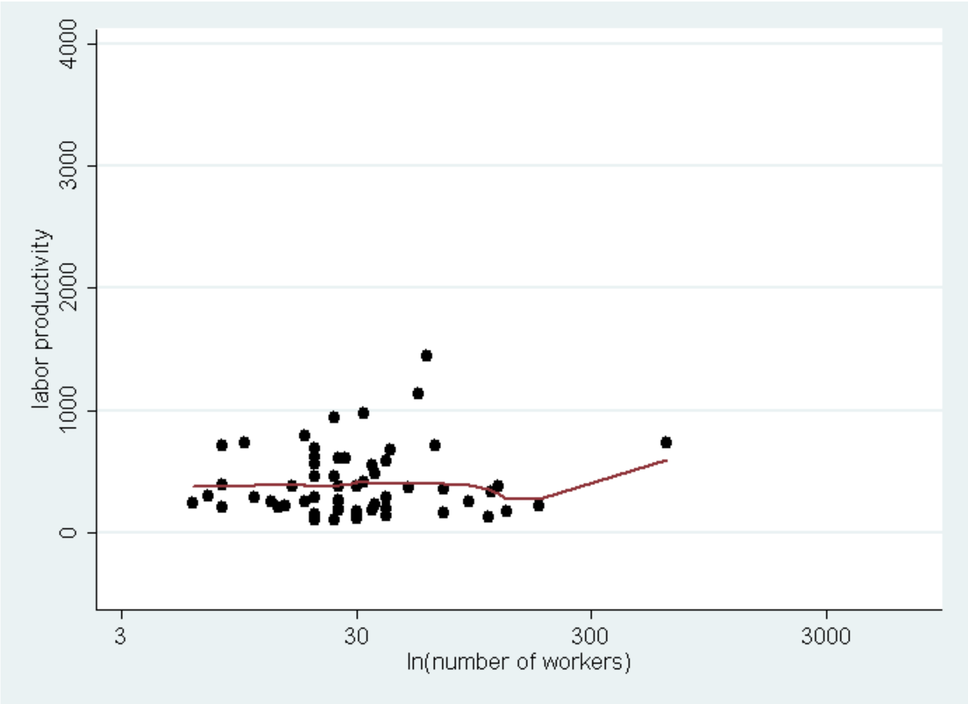

Figure 2-5a. Labor productivity and employment size
Wenzhou (Zhejian Province, China) electrical fittings cluster, 1990

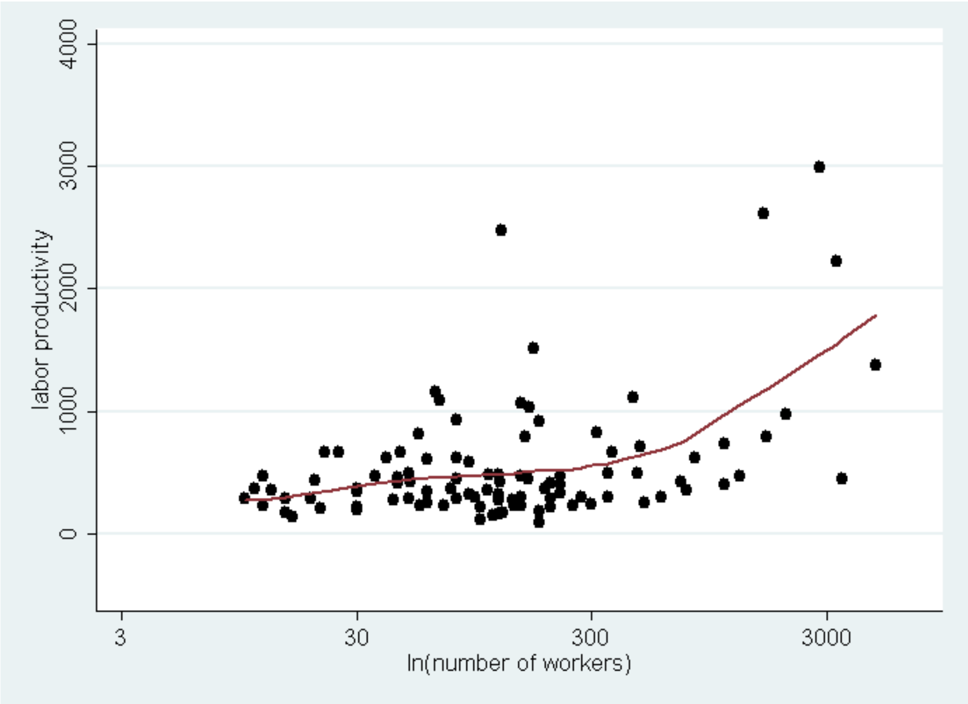

Figure 2-5b. Labor productivity and employment size
Wenzhou (Zhejian Province, China) electrical fittings cluster, 2000

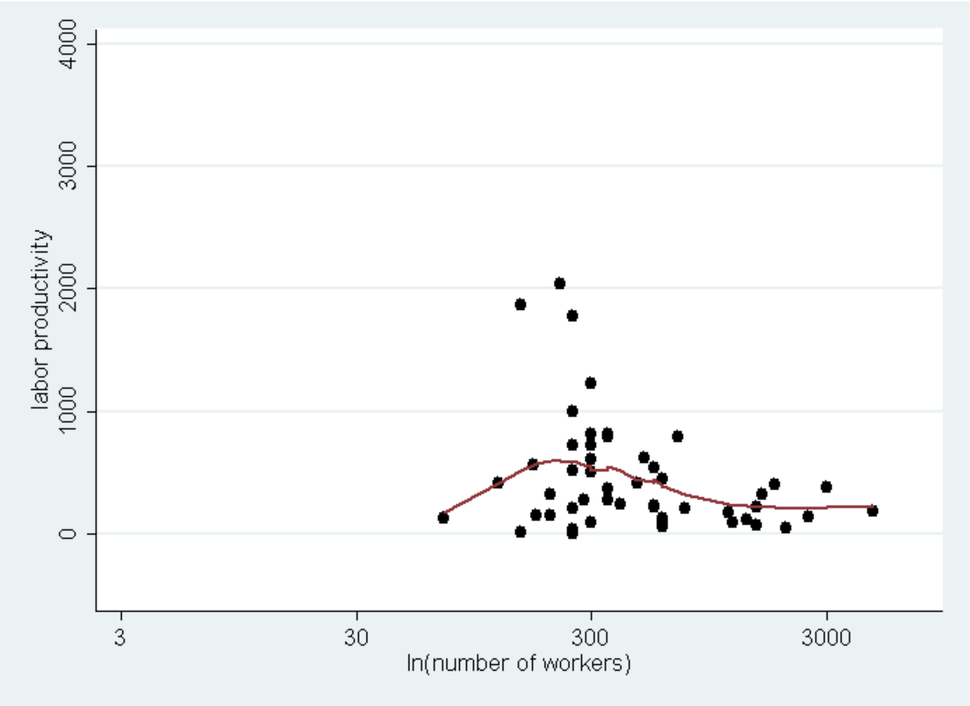

Figure 2-6a. Labor productivity and employment size
Dhaka (Bangladesh) cluster, 2000

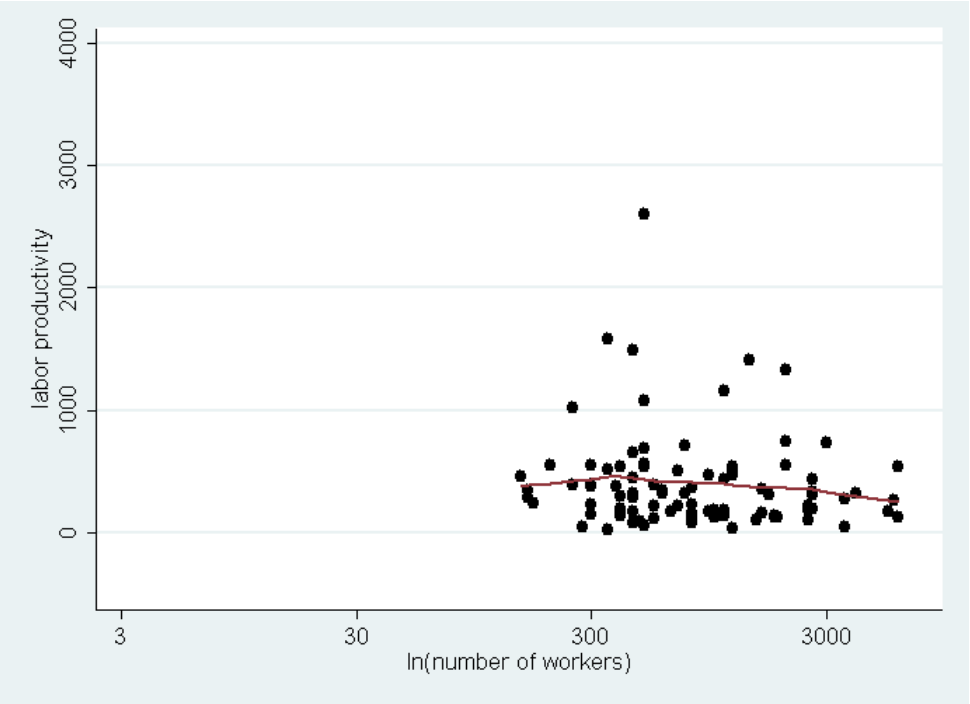

Figure 2-6b. Labor productivity and employment size
Dhaka (Bangladesh) cluster, 2005