

Teaching KAIZEN to Small Business Owners: An Experiment in a Metalworking Cluster in Nairobi

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February 2013

Abstract

In recent years, managerial capital has received attention as one of the major determinants of enterprise productivity, growth, and longevity. This paper attempts to assess the impacts of a management training program on the business performance of small enterprises in a metalworking cluster in Nairobi, Kenya. A previous study of this cluster observed that while several enterprises had successfully expanded operation, the majority had been experiencing declining profits due to increasing competition with imported products and with new entrants in the cluster. Based on the observed differences in management between successful and less successful enterprises, we designed a management training program featuring the basics of KAIZEN, an inexpensive, commonsense approach to management emphasizing the reduction of wasted work and materials, for the less successful enterprises. Although our initial intention was to use this training program as a randomized experiment, we had to give up randomization and allow every business owner interested in the program to participate in it, due to circumstances beyond our control. This paper finds that business owners operating smaller enterprises tended to be self-selected into training participation. The training effects combined with self-selection effect, which we estimate with panel data, were statistically significant and particularly strong on profits than on sales revenues, while other training programs that did not teach KAIZEN had positive effects on sales revenues, not profits. As a result, the participants caught up with and overtook the non-participants in terms of average sales revenues and average profits, respectively.

1. Introduction

In recent years, managerial capital, or the capability to manage a business, has become increasingly recognized among economists as one of the major determinants for enterprise productivity, growth, and longevity (Bruhn et al., 2010; Syverson, 2011; McKenzie and Woodruff, 2012). Several studies assess the impacts of managerial training intervention on business performances and find that even short-term basic training can improve their management practices (e.g., Karlan and Valdivia, 2011; Drexler et al., 2010; Bruhn, Karlan, and Schoar, 2010; Field et al., 2010; Bjorvatn and Tungodden, 2010).

These experimental training programs taught the basics of management, such as the importance of keeping records, how to make business plans, and the importance of identifying good customers. Such training contents may be suitable for the self-employed or microenterprise owners employing one or two workers, like the subjects of some of the management training experiments (e.g., Karlan and Valdivia, 2011; Berge, et al., 2011; de Mel et al. 2012). To more ambitious owners of microenterprises who want to expand their businesses, however, it may be useful to teach some other aspects of management as well.

This paper attempts to assess the impacts of teaching the very basics of KAIZEN, an inexpensive, commonsense approach to management emphasizing the reduction of wasted materials and activities, to owners of small enterprises on their business performance. This experiment was conducted in a metalworking cluster in Nairobi, Kenya. In this cluster, Sonobe, Akoten, and Otsuka's (2011) observational study found that the enterprises varied considerably in the way they were operated. At some enterprises, more than ten workers worked in an orderly fashion while keeping their workshops neat and tidy. Such enterprises expanded the size of operation within several years, and a few of them moved

to more spacious industrial areas. In the same cluster, however, stagnant enterprises abound. They failed to profit even from seemingly lucrative orders for their products or machining services because mishandling of materials, injuries, machine breakdown, and other troubles occurred with surprising frequency at their workplaces. Based on these observations, we designed our training program featuring the basics of KAIZEN, so that owners of small enterprises could learn how to motivate every worker to participate in workplace housekeeping to improve productivity, safety, and product quality.

Assessing the impacts of teaching KAIZEN is not new. Bloom et al. (2013) report substantial impacts of teaching lean management practices, which overlap with KAIZEN considerably, at 14 plants of 11 textile firms around Mumbai, India employing 100 to 1000 workers on their business performance. Berihu (2013) reports strong impacts of teaching KAIZEN on the business performance of the 30 largest manufacturing firms in and near Addis Ababa, Ethiopia. These training programs dispatched a number of management consultants based in the United States and Japan, respectively, to plants of the treated firms and lasted for more than two years. Our study examines whether even a much smaller-scale KAIZEN training program can have favorable impacts on the performance of small enterprises. In our training program, three management consultants from Ghana and Kenya taught 34 business owners in a classroom only 2.5 hours a day for 13 days.

This experiment differs from the existing studies of management training in a few other respects as well. First, while many existing studies look at the impacts of training on microfinance clients operating in various business sectors, all the enterprises in our sample were located in a geographically small cluster and engaged in metalworking activities. Second, however, our sample enterprises were more heterogeneous in terms of enterprise size and include the self-employed persons and small enterprises employing

more than 20 workers. The average number of employees was 4.3 before the training program and 5.4 after it. While training participation was obligatory or recommended by microfinance institutions in some of the preceding training experiments focusing on microfinance clients, it was freely self-selected in our training experiment.

Our original plan was to select a number of business owners randomly to invite to the training program and let them choose whether to participate in it. Just before getting started, however, this plan went astray because the post-election violence or 2007-08 Kenyan crisis broke out. The inside of the Kariobangi Light Industries, our study site, was peaceful during the crisis, but the cluster was close to the scene of mayhem. We postponed the program twice and skipped the initially scheduled enterprise survey. Instead we decided to use the data that we collected in 2006 as baseline data. We had initially intended to hold training sessions in the evening but instead held them during the daytime for security purpose. Because business owners were busier during the day than at night, we gave up the initial randomization scheme, which would have ended up with very few participants. Thus we invited all the business owners in our baseline sample to participate in the training program.

Our major findings are as follows. First, the free self-selection into the daytime training sessions led to a low take-up rate of 34 participants out of the 85 invited business owners, while the average take-up rate for the experimental training programs including those for microfinance clients was about 65 percent, according to the excellent review of these studies by McKenzie and Woodruff (2012). Second, the participants tended to be owners of smaller enterprises in terms of sales revenues and those with experience of working at large formal-sector factories and with experience of participating in other training programs. These results suggest that those who had lower opportunity (or time)

costs and were aware of the value of learning new knowledge tended to participate in our training program. Third, the combined effects of the training itself and the self-selection on value added and profits are positive and significant even after unobservable fixed effects of business owners are controlled for, while the combined effects on sales revenues are insignificant. The results remain qualitatively similar when the self-selection effect is mitigated by employing the difference-in-difference propensity-score matching method. By contrast, the participation in other training programs in the past is found to increase sales revenues, not value added or profits. These results suggest that the participants made efforts to reduce wasted materials and activities following the KAIZEN training.

The next section describes our study site and training program. Section 3 presents the empirical results concerning the factors associated with self-selection into participation, participants' attendance, and their test scores. Section 4 presents the empirical results concerning the impacts of the training on business performance and management practices. Section 5 discusses implications for future research and policies.

2. Kariobangi Light Industries and the KAIZEN Training Program

Our study site is near a large slum area in Nairobi and called the Kariobangi Light Industries. The local government designated this area as a place for artisans' light manufacturing activities in 1989 but did not provide infrastructure (Sonobe, Akoten, and Otsuka, 2011). Its development dates from the early 1980s, when the workers of formal-sector factories lost jobs as a consequence of the implementation of the Structural Adjustment Program and moved to this area. They cleared the bushes to construct roads and established garages and workshops. They call themselves Jua Kali in Swahili,

meaning informal sector artisans.¹ Many of their businesses are informal, but some are formal and employ as many as twenty workers.

We have studied the development of this cluster since 2004. In 2006, we conducted an enterprise survey to collect data of 127 enterprises on the educational and occupational backgrounds of their owners, production and costs, and marketing in 2000, 2002, and 2005, and on the number of employees in these years and 2006. Using these data, Sonobe, Akoten, and Otsuka (2011) find that more highly educated business owners were more likely to deal with quality-conscious customers, such as international organizations, NGOs, and government bodies, and tended to have higher rates of employment growth than their less educated counterparts. The same data set reveals that profits and enterprise sizes were larger for business owners with higher education.

These results remain unchanged if the effects of different product lines or categories are controlled for. Of the 127 enterprises surveyed, 85 were engaged in metalworking, such as the production of flour mills, scale balances, steel furniture, and bolts and nuts, and the rest 42 enterprises were engaged in hardware retailing, car repair services, soap making, printing and other miscellaneous activities. Within each category of products, enterprises varied considerably in business performance, even though they were located in the same place.

While the positive association between business owners' education levels and their business performance seems robust, what education represents is unclear. It can be the person's human capital, but it can also be his or her financial wealth and extensive network or social capital. Moreover, the positive association between education and business

¹ The literal translation of Jua Kali is "hot sun," and this term refers to informal-sector artisans because they work outside under the hot sun.

performance accounts for only a very small part of the variation in business performance across the enterprises producing similar products in the same industrial cluster.

The recent economics literature abounds with empirical findings indicating that management is a major determinant of business performance (e.g., Ichniowski, Shaw, and Prennushi, 1997; Bertrand and Schoar, 2003; Bloom and Van Reenen, 2007), and that management practices can be improved by proper training (e.g., Karlan and Valdivia, 2011; Drexler et al., 2010; Bruhn, Karlan, and Schoar, 2010; Field et al., 2010; Bjorvatn and Tungodden, 2010; Mano et al., 2012; Bloom et al., 2013). Although our 2006 survey did not attempt at measuring and recording management practices systematically, our observations of the way the enterprises were operated are consistent with these arguments about management in the recent literature.

First, about half the sample enterprises did not keep records of transactions or inventory, like many micro-entrepreneurs in Sri Lanka as described by de Mel, McKenzie, and Woodruff (2009). They were not sure whether they were making profits or losses. Whether to keep records or not may be a matter of habit rather than knowledge. Still, proper training should help participants grasp the importance of keeping records of transactions and inventory. Drexler et al. (2010) find that a simplified “rule-of-thumb” training in record keeping has favorable impacts on performance of micro-entrepreneurs.

Second, the majority of the business owners in our sample did not separate their business and household finance. Karlan and Valdivia (2011) find that a training program that taught, among other things, how to separate money between business and household increased business income of microfinance clients. Third, many of the business owners in our sample could not characterize who their good customers were. They had paid little attention to customer needs probably because they were unaware of the basics of

marketing. Berge, Bjorvatn, and Tungodden (2011) as well as Karlan and Valdivia (2011) report that learning basic marketing helped microfinance clients expand their businesses. The basics of record keeping and marketing are also core subjects of Start/Improve Your Business (SIYB) and Business Edge management training programs provided in a number of developing countries by ILO and International Finance Corporation (IFC), respectively.

Although not emphasized in the existing studies of management training experiments, there is another problem commonly observed at almost every workplace. It is the problem of motivating workers to pay attention to productivity, quality control, and machinery maintenance. For example, workshops and warehouses littered with broken machines and waste materials prevent workers from working quickly and smoothly, increase the risk of injury, and disappoint visitors who might otherwise offer loans or become customers. For another example, workers waste time in searching tools because they do not make a point of putting the tools away after they finish using them. Thus, workplace housekeeping is an important factor associated with business performance. We saw not a few business owners failing to motivate their workers to keep their workplaces neat and tidy. Similarly, we often heard from business owners that they had to give up their plans to produce higher-quality products by using higher-quality materials or machinery because their rough workers would have spoiled such expensive materials and machinery. These owners believed that they could not motivate workers to pay attention to housekeeping, proper work procedures, or machinery maintenance.

Experts in KAIZEN maintain that KAIZEN helps to motivate workers to pay attention to these aspects of business operation so as to improve productivity and product quality (e.g., Imai, 1997). KAIZEN and lean manufacturing are commonly practiced in East Asia and North America. As mentioned earlier, Berihu (2013) and Bloom et al.

(2013) present evidence for the favorable impacts of extensive training programs teaching KAIZEN or lean manufacturing to large firms in developing countries.

Few attempts, however, have been made to assess the impacts of KAIZEN training on small enterprises, even though KAIZEN training has been an important ingredient of a large number of technical aid projects that the Japanese aid agency has implemented in various parts of the world. An exception is a randomized controlled trial of a 15-day training program for small metalworking enterprises in Ghana (Mano et al., 2012). In this program in Ghana, five days (or 12.5 hours) were devoted to lectures on the basics of KAIZEN, and the rest ten days were used to teach basics of marketing, business planning, and record keeping. The impacts of the program on business performance were assessed to be positive and marginally significant. The present study was initially intended to replicate this randomized controlled trial in Kenya by hiring the same team of instructors consisting of two Ghanaians and one Kenyan. One Ghanaian instructor received KAIZEN training in Japan.

3. Participation, attendance, and understanding

Our original plan was to conduct an enterprise survey collecting data from a greater number of metalworking enterprises than our 2006 survey just before providing the training program. It was supposed to be followed by the random selection of business owners to be invited to the program and their self-selection into participation, so that we would be able to examine factors associated with self-selection and to assess the intention-to-treat (ITT) effects and local average treatment effects (LATE) of the training. As mentioned earlier, however, the post-election violence delayed the training program and shortened the period of training from 15 days to 13 days and from 2.5 hours a day to 2

hours a day. The violence also prevented the enterprise survey and forced us to have training sessions during the day time. Consequently, we had to use our 2006 survey data as the baseline data and expected a very low take-up rate. Because there were only 85 metalworking enterprises in the sample, we gave up randomization and invited all of them to the program. This means that we cannot assess the ITT effect or the LATE of the program.

Table 1 summarizes the background characteristics of the experiment subjects by participation status. In our definition, a business owner is regarded as a participant if he or she attended the training program more than 7 days. There were 39 business owners who attended the program at least one day, but five of them stopped showing up after the second or third day. The remaining 34 persons recorded high rates of attendance. The training was done in a classroom. Although the instructors made short visits to 16 participants' workshops, the main purpose of the visits was to get familiar with the environments of the Kariobangi cluster and the way in which the enterprises operated, not to give a suggestion to participants.

As the first two lines of Table 1 show, the 34 participants and 51 non-participants share about the same ages and years of schooling. On average, they were in their late 30s as of 2005 and had almost 12 years of education.² The participants differ significantly from the non-participants in other respects, however. Nearly 80 percent of the participants and 51 percent of the non-participants worked at large factories in the formal sector before they started their businesses in Kariobangi. The difference is statistically

² These entrepreneurs are much more highly educated than average workers in Kariobangi, who would have 8 years of education or so even though we did not collect data of workers systematically. According to Fafchamps and Söderbom (2006), the mean of the years of schooling is 8.5 for workers and 11.6 years for supervisors in the manufacturing sector in various countries in sub-Saharan Africa, and the corresponding figures for the manufacturing sector in Morocco are 7.3 and 13.9.

significant at the one percent level. In our impression, business owners with this kind of work experience tended to be more knowledgeable about production technologies used in modern factories operated by Indians or Europeans.

While 27 percent of the participants had participated in other training programs in the past, only 6 percent of the non-participants had such a learning opportunity. These training programs were mostly short-term business training programs held by international organizations and NGOs. According to our interview with a successful businessman, participation in a training program almost a decade ago boosted his business so that his metalworking factory moved from Kariobangi to a more spacious and convenient industrial area. The last line of Table 1 shows that the participants had operated their businesses significantly longer than the non-participants. Thus, the participants were more experienced in the operation of own businesses and had opportunities to see and hear modern technology and management than the non-participants.

These differences between the participants and non-participants are reflected in the estimated probit model of the self-selection into participation as shown in the column (1) of Table 2. The coefficients on age and schooling are insignificant, while the coefficients on the formal-sector experience dummy and the participation in other training dummy are positive and significant. While the coefficient on the years of operation is insignificant in column (1), it is positive and marginally significant in column (2), in which sales revenue in 2005 is added as an explanatory variable. The sales revenue here is intended to capture the opportunity cost or time cost of the business owner because the business owner would be busier if he or she was operating larger businesses. This result is robust as it is not altered if sales revenue in 2005 is replaced by sales revenue in other years or by the number of workers or value added.

A possible interpretation of the positive coefficient on the years of operation is that highly experienced business owners tend to have developed a kind of receptivity to welcome any potential opportunity which came around. As the number of years of operation becomes greater, however, the enterprise becomes larger and the owner becomes busier, which makes it more difficult for him or her to participate in the training program. In column (1), the insignificant coefficient on the years of operation mixes these two effects working in the opposite directions. This is why the significance and magnitude of this coefficient increases slightly with the inclusion of the enterprise size as a proxy of time cost.

Another possible interpretation is that owners of larger enterprises did not like to attend the training program which emphasized basic management skills with owners of smaller enterprises because of their great pride. In any case, owners of larger enterprises were less likely to participate in the training, and they tended to have longer experience in operating businesses.

Note also that the inclusion of the enterprise size also increases the significance and magnitude of the coefficients on the formal-sector experience and the training experience slightly. Probably, this is because of the positive correlation between these experiences and the enterprise size. The business owners with these experiences would think that training participation would be useful for their businesses. To sum, the business owners with formal-sector experience, training experience, and longer experience in management and operating relatively small enterprises were more likely to participate in the training program.

The program consisted of three modules: the first module explained entrepreneurship, business planning, and marketing (3 days), the second module was about basic KAIZEN

toward production management and quality management (5 days), and the third module emphasized record keeping and explained how to begin paying value added tax (5 days). The first module was originally planned to last for five days but shortened to three days. The participants took a short test at the end of each module. We rented a big room of a shabby restaurant in the Kariobangi cluster as the classroom. It had no air conditioner and was surrounded by small workshops making big sound of hummers. Still, the three instructors who had extensive experience in adult learning managed to keep participants from being bored. The attendance rates of the 34 participants were distributed from 77 percent to 100 percent, and the average was 94.9 percent. Their test scores were distributed from 47.0 to 93.3 out of 100 and the average was 69.1.

Table 3 reports the results of regressions linking the attendance rates and test scores to their background characteristics. In the regression equation explaining the attendance rate, the work experience in formal sector is the only variable that has a significant coefficient except for the intercept. The participants with such an experience skipped some classes probably because they thought they already knew the class content. The insignificant but negative coefficient on the same variable in the test score regressions indicates that these participants did not do well on the short tests. The good performers on the tests were those participants with higher education. This is probably because the test on record keeping included math questions or because such participants were used to multiple-choice tests.

4. Impacts of the Training Program

Although our experiment is a controlled experiment in the sense that there is a control group, it is not a randomized controlled experiment. It is difficult to assess the

average treatment effect of the treated (ATT), the most accepted measure of the treatment effect, because self-selection bias will remain even though we apply difference in differences and propensity matching. Moreover, there may be bias due to some psychological effects that will be discussed shortly. In this section, we attempt to examine the impacts of the training program while keeping these problems in mind.

Table 4 presents the data on the accounting-based indicators of business performance in the upper panel and the data on the adoption of recommended practices in the lower panel. A possible problem with the accounting-based indicators is that many enterprises did not keep accounts. We estimated sales revenues, material costs, and other costs by asking each business owner about the number of pieces sold and their prices by product type, material inputs and material prices, payments to subcontractors, and payments to workers. We believe our estimates are reasonably accurate because we checked that the estimate of gross profit was consistent with the entrepreneur's earnings, investment, living expenses, purchase of durable goods, and so on, and because we deliberately used written records, whenever available, taking into account that each entrepreneur might have his own unique concept of costs and that his calculation might be incorrect. Our 2006 survey produced the estimates of sales revenue, value added, and gross profit (= value added minus labor cost) in 2000, 2002, and 2005, while our 2008 survey produced estimates of these variables in 2006, 2007, and 2008. For 2008, we estimated the values in an average month during the period of six months after the training program. The upper panel of Table 4 shows the deflated monthly values of these variables.

It is clear from this table that business results were getting worse every year from 2000 to 2007. This is a result of the flood of imports from Asia, which were cheap and had good finishing. Probably market competition was also increasing because producers

of similar products were increasing in and around Kariobangi. From 2000 to 2007, the participants had consistently lower averages than the non-participants. This is why the results shown in Tables 2 and 3 were not essentially altered if the sales revenue in 2005 on the right-hand side was replaced by sales revenue in other years or the other financial variables. Another interesting point is that the ratio of value added to sales revenue and the ratio of gross profit to value added went down from 2000 to 2007 for both the participants and the non-participants. These observations are consistent with the view shared by both the participants and non-participants. Their view was that the product price relative to material prices were declining and labor costs were soaring. Such consistency between the data and our interview materials suggests that the data on financial variables are reliable.

For the non-participants, the downward trend in profitability continued in 2008. While their sales revenue in 2008 stayed at the same level as in the previous year, their value added and gross profits declined. Although not reported in the table, their average number of employees increased slightly in 2008, which might mean that some of them seriously miscalculated profitability and expanded production. By contrast, the participants increased sales revenues and regained high profitability. If we take difference in differences, the increase in gross profits for the participants was greater than that for the non-participants by $(61.0 - 35.2) - (38.0 - 45.0) = 33.2$. This relative increase amounts to more than 90 percent of the participants' average gross profit in 2007.

We, however, are concerned about a possible bias due to the Hawthorne effect. The participants might be willing to exaggerate the favorable impacts of the treatment they received. Although we do not think it was easy for them to exaggerate business results in 2008 because we checked the validity of our estimates of business results persistently, it

might be easy to lead us to underestimate their business results in 2006 and 2007, about which our check was less persistent. During our 2006 survey, we ourselves had no intention to conduct an experiment and, hence, the data collected at that time were not biased. Therefore, to mitigate the possible influence of the Hawthorne effect, difference in differences may be taken between 2005 and 2008. Then, the relative increase in gross profits of the participants is $(61.0 - 28.1) - (38.0 - 65.1) = 60.0$, which is even larger than the previous measure.

It is easy to imagine that the non-participants wanted to demonstrate that they did not miss out on the benefit of a useful training program, by exaggerating their performance. The non-participants with such an intention would lower our estimates of their business performance in 2007 and 2006 because they would find it more difficult to exaggerate their performance in 2008. In any case, the difference in the estimated business performance between 2008 and 2007 (or 2006) can be biased upward, while the difference in the estimated performance between 2008 and 2005 is less likely to be biased. If both the participants and the non-participants exaggerated their growth performance, however, the difference in differences comparing 2008 and 2007 may or may not be greater than the difference in differences comparing 2008 and 2005, depending on which group exaggerated more greatly.

Note that even if the difference in differences may not be biased in this way, it includes the self-selection effect and cannot be regarded as the impact of the training program itself. The participants would decide to participate in the training because they anticipated benefiting from it. We think that they could have right anticipation about the benefit from the training because they had read the flyer explaining the contents of the training and because they could choose whether to participate in the training after attending

a few classes. Actually there were five non-participants who attended one or two sessions, as mentioned earlier. Thus, we expect that the self-selection effect included in the difference in differences is non-negligible.

We turn to the data on the adoption of three recommended practices shown in the lower panel of Table 4. The first is to keep records of transactions and inventory. The second is to review records to detect abnormalities and to make business plans. The third is to set in order, or to designate locations at which materials are stored or to which tools are returned after being used. We did not gather information on these practices during our 2006 survey. The data were constructed from the respondents' answers to the question of when they adopted each of these practices.

We are concerned about biases in the practice adoption data due to the social desirability bias as well as the Hawthorne effect. The fact that we asked about these practices would suggest our respondents that we thought the adoption of these practices was desirable. It seems natural that they were tempted to answer these questions in a manner that would be viewed favorably by us. Like our estimates of business performance in 2008, the data on the adoption of practices as of 2008 are relatively reliable because we directly observed the practices on site by visiting the sample enterprises. However, the adoption rates in the earlier years can be greatly exaggerated.

Table 5 reports the estimated random-effects models of the determination of the business results. Although not reported in this table, we estimated the corresponding fixed-effects models. The fixed-effects estimates of the coefficients on the time-variant explanatory variables are very close to the random-effects estimates shown in this table (see the results of the Hausman test shown in the last line of Table 5). The random-effects model may be written

$$y_{it} = \beta_0 + \beta_1 P_i \times Year08 + \beta_2 P_i + X_i \gamma + \lambda_t + u_i + \varepsilon_{it},$$

where dependent variable y_{it} is the outcome (i.e., sales revenue, value added, and gross profit) of enterprise i in year t , P_i is a dummy variable indicating whether or not the owner of enterprise i participated in our training program, and $Year08$ is the year dummy for 2008, and X_i is a vector of the (time-invariant) characteristics of the owner i , λ_t is the year effect, u_i is an observable individual effect, and ε_{it} is an error term. The training impact is measured by coefficient β_1 , the coefficient on the interaction between the participation dummy and the 2008 year dummy.

In Table 5, the random-effects estimates instead of the fixed-effects estimates are presented because they turned out to be close to the fixed-effects estimates and because we are interested in β_2 and γ for which fixed-effects estimates do not exist. Note that both random- and fixed-effects estimation may be inconsistent because the self-selection into participation may relate the participation dummy P_i (and hence the interaction term $P_i \times Year08$ as well) to not only u_i but also the error term ε_{it} . The specification in columns (1), (3), and (5) uses the full set of data and includes five year dummies, while the specification in columns (2), (4), and (6) focuses on years 2000, 2002, 2005, and 2008 to make the estimates more immune from the possible bias due to the psychological effects discussed above.

The first line of Table 5 shows the estimates of β_1 . The first two columns indicate that the impact of the training program on sales revenue is positive but insignificant. By contrast, the next four columns indicate that the impacts on value added and gross profit

are significant at the five percent level. The estimated impact on gross profit shown in column (6) is about the same as the difference in differences that we calculated above. Both for value added and gross profit, the estimated impacts are smaller if the 2006 and 2007 data are included. This suggests that the non-participants might exaggerate their growth performance more greatly than the participants.

The coefficients on the participant dummy are negative and highly significant across the columns, indicating that the participants had smaller enterprise sizes than the non-participants. These results are consistent with the estimated probit model of self-selection into participation (Table 2). The coefficients on the schooling variable are positive and marginally significant in the sales revenue regression but not at all significant in the profit regression. By contrast, the formal-sector dummy has significant coefficients pointing to the usefulness of work experience in the formal sector in business operation.

An interesting result is that the other training participation variable has a positive and highly significant coefficient in the sales revenue regression but not in the value added or profit regression. This pattern of significance stands in contrast to that of the key coefficient β_1 . These contrasting results lend strong support to our hypothesis that a training program teaching KAIZEN will help enterprises reduce waste in intermediate inputs and wasted time and efforts, which is a neglected aspect of management in the conventional training program emphasizing increases in output and sales.

An alternative approach to estimate the training impacts with panel data is to use the lagged dependent variables model. In the labor economics literature, it is well known that earnings histories of participants in labor training programs in the United States typically exhibit a pre-program dip (e.g., Ashenfelter, 1978; Ashenfelter and Card, 1985). The lagged dependent variables model is employed to deal with the pre-program dip (Angrist

and Pischke 2009; Abadie, Diamond, and Hainmueller 2007). We applied this model to our data even though the business performance of the participants in our training program did not show a pre-program dip but was persistently declining and worse than the performance of the non-participants throughout the period before the training program, as shown in Table 4. The results were qualitatively similar to the results shown in Table 5.

Table 6 presents the results of the random-effects model estimation of the training effects on the adoption of recommended practices. Although we have to be cautious in interpreting the results because of the social desirability bias, three findings seem noteworthy. First, the coefficient on the interaction between the participation dummy and the year 2008 dummy is significant in every column. Second, this interaction has a particularly large and significant coefficient in the last two columns, indicating that the training encouraged the adoption of one of the essential housekeeping practices. Third, the schooling variable and the other training participation variable have significant coefficients only in the regressions of record keeping and analysis as shown in the first four columns, not in the KAIZEN practice. These results lend further supports to the hypothesis that the KAIZEN training improves an important but neglected aspect of management.

Finally, we report in Table 7 as well as Tables A-1 and A-2 and Figures A-1 to A-4 in the Appendix the results of applying the differences-in-differences propensity-score matching (DID-PSM) method (Rosenbaum and Rubin 1983; Heckman, Ichimura, and Todd 1997, 1998; Smith and Todd 2005).^{3, 4} Although there are variants of matching

³ Matching methods have been widely applied to non-experimental data from developing economies (Diaz and Handa 2006; Todo, 2008; Park and Wang, 2009; Iddrisu *et al.* 2009). For example, Rosholm, Nielsen, and Dabalén (2007) use the PSM to evaluate the impacts of technical training programs for workers on labor productivity in Kenya and Zambia, and Behrman *et al.* (2009) use both DID-PSM and DID-BCM to evaluate schooling impacts of conditional cash transfers on young children in Mexico.

methods available in the literature, Smith and Todd (2005) present suggestive evidence for the advantage of local-linear matching over standard kernel matching methods.⁵ We employ local-linear regression matching, an extension of local-linear matching that adjusts for remaining difference in covariates between the participants and the matched non-participants based on local-linear regression (Heckman, Ichimura, and Todd 1997).⁶

The first step of this method is to calculate the propensity score matching based on the estimated probit models similar to those reported in Table 2. We estimated four probit models: the first is exactly the same as the model in column (1); the second model includes sales revenues in 2000 to 2007 as controls; the third model does not control sales revenues but uses the entrepreneur's characteristics as of 2005; and the fourth model controls sales revenues only in 2005 like column (2) of Table 2. The first two probit models are intended to obtain difference-in-differences propensity scores in the case in which outcomes in 2007 and 2008 are compared. The third and fourth models are intended to compare outcomes in 2005 and 2008. The second step is to check the validity of matching, which is done in Appendix.

Table 7 shows the results of the DID-PSM estimation of the training impacts on business performance and the adoption of practices. This table has four rows corresponding to the four models just mentioned above and six columns corresponding to three indicators of business performance and three practice adoption rates. Rows (1) and (3) show the estimation results based on the matching of participants and non-participants who are similar to each other only in terms of age, education, experience in the formal

⁴ We use STATA command *psmatch2* (version 3.1.3) developed by Leuven and Sianesi (2008) to implement the DID-PSM matching.

⁵ These advantages include a faster rate of convergence near boundary points and greater robustness to different data design densities. See Fan (2002a, 2002b).

⁶ In contrast to regression adjustment estimators, bias-corrected nearest-neighbor matching estimators have the disadvantage of not being fully efficient (Abadie and Imbens, 2006).

sector, other training participation, and years of operation. According to these rows, the impacts of the training on business performance are positive and generally significant, and the impacts on value added and profit are particularly significant. The estimated impacts are stronger in row (3) (i.e., when difference in differences is taken between 2008 and 2005) than in row (1) (i.e. when difference in differences is taken between 2008 and 2007), which is consistent with our findings from Tables 4 and 5.

Rows (2) and (4) show the estimation results based on the comparison between participants and non-participants who are similar in terms of sales revenues as well. The estimated impacts on business performance are now drastically small and their significance is low. Still the estimated impacts on value added and profits in row (2) are marginally significant, and their magnitudes are not at all small compared with the levels of value added and profits in 2007. These results lend weak but additional support to the hypothesis that the KAIZEN training boosts profitability rather than sales. It is also noteworthy that estimated impacts on the adoption of practices are all significant as shown in columns (4) to (6), and that the magnitude of the impact on the KAIZEN variable is larger than that on record keeping and analysis, which is consistent with the result shown in Table 6.

5. Conclusions

Recently a number of randomized controlled experiments have been conducted in developing countries to estimate the impacts of basic business training on the self-employed, microenterprises, and small enterprises with a view to providing intellectual basis for designing effective technical cooperation. Such basic training programs usually emphasize business planning skills, marketing skills, and financial literacy. They seldom

teach even the principles of production management and quality management, including simple housekeeping rules. KAIZEN and lean manufacturing are approaches to this neglected but important aspect of management. The impacts of extensive training programs designed to teach KAIZEN or lean manufacturing to large enterprises have already been assessed in some recent studies. The present study is one of a few attempts that have been made to assess a small-scale, inexpensive training program that teaches basic KAIZEN to small enterprise owners.

The estimated impacts of our training program on sales revenues are statistically insignificant, but those on value added and profits are significant and economically strong. By contrast, those business owners who received other business training in the past had significantly greater sales revenues, but their value added and profits are not significantly different from the averages. These results support our hypothesis that KAIZEN training boosts value added and profits by reducing wasted materials and activities. We hasten to add, however, that our estimates of the training impacts are subject to self-selection bias because our controlled experiment was not randomized due to circumstances beyond our control.

Our examination of the factors associated with self-selection into training participation suggests that the participants tended to be the business owners who attached relatively high value to knowledge and had relatively low opportunity costs of participating in the training program. In other words, it is likely that the right persons for the training participated in the program. This would be non-negligible part of the reason why the training program had strong impacts on business performance.

These results of our analyses point to two agendas for future studies. One is to assess, by means of randomized controlled trials, the pure causal effects of training

programs that teach not only basic but also intermediate and advanced levels of KAIZEN, in order to find out what training contents are cost-effective. The other agenda is to find how to secure good matching between training contents and participants. The compilation of further studies in these two directions are warranted because the overall impact of a management training program increases with both its pure causal effect and the participation of persons who are highly motivated to learn from the training.

Appendix: Balancing Test

To see whether the matching is successful, we perform the balancing tests proposed by Sianes (2004) and Dehejia and Wahba (1999, 2002), which rely on the *t*-test of equality in the mean of each covariate between the participants and the non-participants, and the pseudo-*R* squared and likelihood ratios obtained from the estimation of probit model of participation. As shown in Tables A-1 and A-2, the after-matching probit models have no explanatory power. This confirms that matching is successful.

The participants and the non-participants differ in terms of entrepreneur's observable characteristics. The differences are apparent in Figures A1 to A4, which show the histograms of the propensity scores calculated from the probit models. If we simply compared the average performance of the participants with that of the non-participants, we would fail to isolate the effects of training participation from the effects of entrepreneur's characteristics. If the participants and non-participants differed completely, however, it would be impossible to estimate the counterfactual performance based on the performance

of the matched non-participants. Thus, the distribution of propensity score for the participants and that for the non-participants must have a common range of support, in order for the matching estimation to be feasible. Figures A-1 to A-4 clearly show that there exists such a common support, and we compare only training participants and non-participants belonging to this support.

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Table 1. Characteristics of the sample entrepreneurs as of 2005

	Participants (1)	Non-participants (2)	<i>p</i> -value for $H_0: (1)-(2)=0$
Number of observations	34	51	
Age	39.5	36.4	0.112
Years of schooling	12.0	11.7	0.694
Work experience in formal sector (yes = 1)	0.79	0.51	0.008***
Other training program participation (yes = 1)	0.27	0.06	0.007***
Years of operation	10.6	7.4	0.026**

Note. *** and ** indicate the 1 and 5 percent levels of statistical significance, respectively.

Table 2. Correlates with participation

	(1)	(2)
Entrepreneur's age	-0.0003 (-0.02)	-0.0006 (-0.03)
Years of schooling	-0.05 (-1.13)	-0.04 (-0.76)
Work experience in formal sector	0.76** (2.24)	0.91*** (2.54)
Other training participation	0.96** (2.44)	1.07** (2.48)
Years of operation	0.04 (1.36)	0.05* (1.65)
Sales revenue in 2005 (million Ksh)		-0.002** (-2.32)
Intercept	-0.75 (-0.90)	-0.76 (-0.89)
LR chi-squared	18.03***	22.61**

Notes. This table shows the estimated probit model of participation in the training program. The number of observations is 85. Entrepreneur's age, the years of operation, and the other training participation dummy used in this table are the values as of 2007. The numbers in parentheses are z-values. ***, **, and * indicate the 1, 5, 10 percent levels of statistical significance, respectively.

Table 3. Correlates with attendance and test score

	Attendance rate		Test score	
	(1)	(2)	(3)	(4)
Entrepreneur's age	-0.07 (-0.40)	-0.07 (-0.39)	-0.33 (-1.22)	-0.34 (-1.24)
Years of schooling	0.18 (0.41)	0.19 (0.41)	1.75** (2.63)	1.89** (2.69)
Work experience in formal sector	-6.55** (-2.05)	-6.70* (-1.97)	-4.70 (-0.97)	-5.23 (-1.03)
Other training participation	-0.64 (-0.22)	-0.71 (-0.22)	4.67 (1.04)	3.32 (0.69)
Years of operation	-0.15 (-0.66)	-0.15 (-0.63)	-0.18 (-0.53)	-0.18 (-0.50)
Sales revenue in 2005 (million Ksh)		0.28 (0.21)		-0.29 (-0.15)
Intercept	102.4*** (11.58)	102.1*** (11.01)	65.5*** (4.87)	65.7*** (4.75)
<i>R</i> -squared	0.15	0.15	0.35	0.37

Notes. This table focuses on the 34 participants. The dependent variable in columns (1) and (2) is the number of days attended as a percentage of the total number of training days, while that in columns (3) and (4) is the test score in percentage of the full score. The numbers in parentheses are *t*-values. ***, **, and * indicate the 1, 5, 10 percent levels of statistical significance, respectively.

Table 4. Mean business results and percentage of sample enterprises that have adopted recommended practices by participation status, 2000-2008

<i>Business results (per month, 1,000 constant Ksh in 2000)</i>						
	<i>Sales revenue</i>		<i>Value added</i>		<i>Gross profit</i>	
	Participants	Non-participants	Participants	Non-participants	Participants	Non-participants
	(1)	(2)	(3)	(4)	(5)	(6)
2000	153.5	261.1	72.2	118.6	41.6	93.2
2002	126.8	226.4	49.7	104.1	26.1	81.4
2005	135.1	195.1	53.7	95.8	28.1	65.1
2006	117.4	154.0	51.7	73.2	37.7	54.6
2007	120.4	180.0	50.6	69.4	35.2	45.0
2008	162.2	182.1	76.4	60.9	61.0	38.0

<i>Adoption of practices (% of the entrepreneurs)</i>						
	<i>keeping records</i>		<i>reviewing records</i>		<i>setting in order</i>	
	Participants	Non-participants	Participants	Non-participants	Participants	Non-participants
	(7)	(8)	(9)	(10)	(11)	(12)
2000	26.9	32.1	23.1	35.7	15.4	46.4
2002	35.3	37.2	26.5	27.9	20.6	32.6
2005	45.4	54.0	39.4	52.0	30.3	42.0
2006	55.9	61.2	50.0	57.1	41.2	46.9
2007	61.8	64.0	55.9	60.0	41.2	54.0
2008	85.3	72.5	79.4	68.6	73.5	62.7

Table 5. Random-effects estimates of the impacts of the training program on real sales, value added, gross profits per month (1,000 constant Ksh in 2000)

	Sales revenue		Value added		Gross profit	
	(1)	(2)	(3)	(4)	(5)	(6)
Participant	28.17	33.23	44.87**	54.34**	51.10**	63.31**
× Year 2008	(0.92)	(0.87)	(2.20)	(2.22)	(2.38)	(2.48)
Participant	-141.3***	-145.0***	-58.67***	-64.13***	-49.61***	-60.05***
	(-3.00)	(-3.03)	(-2.80)	(-2.76)	(-2.59)	(-2.65)
Years of schooling	8.99	9.580	3.31	4.098	1.58	2.655
	(1.40)	(1.49)	(1.17)	(1.32)	(0.61)	(0.88)
Work experience in formal sector	112.9**	125.4***	52.57**	57.07**	53.17***	59.60***
	(2.36)	(2.63)	(2.51)	(2.52)	(2.80)	(2.71)
Other training participation	112.3***	114.3**	10.27	5.65	-3.07	-3.189
	(3.29)	(2.54)	(0.51)	(0.22)	(-0.16)	(-0.13)
Entrepreneur's age	0.84	0.371	0.565	0.319	0.082	-0.244
	(0.31)	(0.14)	(0.47)	(0.24)	(0.08)	(-0.19)
Years of operation	6.96*	5.68	2.61	1.567	2.00	1.118
	(1.84)	(1.50)	(1.57)	(0.87)	(1.32)	(0.64)
Year 2002	-5.01	-6.33	-7.97	-10.28	-5.20	-7.387
	(-0.22)	(-0.24)	(-0.53)	(-0.61)	(-0.33)	(-0.42)
Year 2005	-8.81	-10.56	-6.12	-9.483	-9.97	-13.24
	(-0.39)	(-0.40)	(-0.41)	(-0.57)	(-0.64)	(-0.76)
Year 2006	-45.29**		-21.45		-12.78	
	(22.41)		(-1.44)		(-0.82)	
Year 2007	-32.61		-24.11		-19.01	
	(-1.44)		(-1.61)		(-1.21)	
Year 2008	-27.08	-31.05	-36.62**	-43.14**	-33.00*	-40.95**
	(-1.04)	(-1.00)	(-2.13)	(-2.17)	(-1.83)	(-1.97)
Intercept	-7.83	0.026	7.475	13.06	18.92	23.17
	(-0.07)	(0.00)	(0.15)	(0.23)	(0.40)	(0.43)
Hausman test χ^2	2.25	8.44	0.70	0.83	0.70	0.08
[p-value]	[0.95]	[0.133]	[1.00]	[0.975]	[0.99]	[1.00]

Notes. The number of observation is 466 in columns (1), (3), and (5), and 299 in columns (2), (4), and (6). The numbers in parentheses are *t*-values based on robust standard errors. ***, **, and * indicate the 1, 5, 10 percent levels of statistical significance, respectively.

Table 6. Random-effects estimates of the impacts of the training program on the adoption of recommended practices

	Keeping records		Analyzing records		Set in order	
	(1)	(2)	(3)	(4)	(5)	(6)
Participant	0.14**	0.14*	0.14***	0.14*	0.22***	0.25***
× Year 2008	(2.00)	(1.77)	(2.00)	(1.71)	(2.84)	(2.93)
Participant	-0.05	-0.05	-0.19	-0.12	-0.17*	-0.19*
	(-0.49)	(-0.55)	(-1.18)	(-1.43)	(-1.71)	(-1.99)
Years of schooling	0.04***	0.04***	0.04***	0.04***	0.004	0.01
	(3.66)	(3.77)	(3.54)	(3.68)	(0.31)	(0.72)
Work experience in formal sector	0.05	0.02	0.14	0.13	0.09	0.09
	(0.58)	(0.21)	(1.52)	(1.47)	(0.081)	(0.90)
Other training participation	0.17**	0.16*	0.12*	0.14	0.07	-0.01
	(2.20)	(1.92)	(1.58)	(1.55)	(0.91)	(-0.11)
Entrepreneur's age	-0.004	-0.002	0.003	0.003	-0.004	-0.002
	(-0.74)	(-0.36)	(0.51)	(0.60)	(-0.75)	(-0.36)
Years of operation	-0.01	-0.01	-0.01	-0.003	0.01	0.01
	(-1.40)	(-0.92)	(-1.03)	(-0.43)	(1.16)	(1.20)
Year 2002	0.02	0.04	-0.04	-0.02	-0.005	-0.001
	(0.40)	(0.81)	(-0.67)	(-0.29)	(-0.11)	(-0.02)
Year 2005	0.19***	0.20***	0.18***	0.20***	0.10**	0.10**
	(3.66)	(3.76)	(3.72)	(3.75)	(2.32)	(2.13)
Year 2006	0.26***		0.25***		0.15***	
	(5.17)		(5.03)		(3.55)	
Year 2007	0.30***		0.29***		0.20***	
	(5.89)		(5.78)		(4.44)	
Year 2008	0.39***	0.40***	0.37***	0.38***	0.29***	0.29***
	(6.70)	(6.33)	(6.47)	(6.03)	(5.30)	(4.75)
Intercept	-0.01	-0.097	-0.28	-0.317	0.35	0.23
	(-0.05)	(-0.47)	(-1.34)	(-1.58)	(1.50)	(1.01)
Hausman test χ^2	†	2.84	1.34	1.50	3.91	2.47
[<i>p</i> -value]		[0.724]	[0.99]	[0.91]	[0.79]	[0.78]

Notes. The number of observation is 466 in columns (1), (3), and (5), and 299 in columns (2), (4), and (6). The numbers in parentheses are *t*-values based on robust standard errors. ***, **, and * indicate the 1, 5, 10 percent levels of statistical significance, respectively. † indicates that the asymptotic assumptions of the Hausman test are not met.

Table 7. DID-PSM estimates of training effects

	Sales revenue (1)	Value added (2)	Gross profit (3)	Keeping records (4)	Analyzing records (5)	Set in order (6)
Difference between 2007 and 2008						
(1) Sales revenue is not controlled	53.10* (1.90)	59.83* (1.93)	57.83* (1.86)	0.18** (2.26)	0.18** (2.40)	0.30*** (4.09)
(2) Sales revenue is controlled	13.60 (0.77)	35.38* (1.72)	33.52* (1.71)	0.28*** (2.94)	0.28*** (2.97)	0.32*** (4.97)
Difference between 2005 and 2008						
(3) Sales revenue is not controlled	14.99 (0.29)	73.25* (1.68)	89.14** (2.08)	0.20* (1.77)	0.28*** (3.36)	0.30*** (3.83)
(4) Sales revenue is controlled	12.35 (0.30)	37.26 (1.19)	45.76 (1.64)	0.19*** (2.03)	0.24*** (2.76)	0.23*** (2.36)

Notes. The local linear regression matching method developed by Heckman, Ichimura, and Todd (1997; 1998) was used to match participants and non-participants. Rows (1) and (2) look at DID comparing values in 2007 (before the training) and 2008 (after the training), while row (3) and (4) compare values in 2005 (before the training) and 2008 (after the training). The propensity score used in row (1) comes from the estimated probit model reported in column (1) of Table 2, while that in row (2) is from a similar probit model that includes sales revenues in 2000 to 2007 as controls. Row (3) uses the propensity score based on the same model as in column (1) of Table 2 except that it uses the entrepreneur's age and the years of operation as of 2005, and row (4) uses the propensity score from the estimated probit model reported in column (2) of Table 2.

Table A-1 Balancing test for DID-PSM with differences taken between 2007 and 2008

	Participants	Non- participants	<i>t</i> -value for (1) - (2) = 0	Participants	Non- participants	<i>t</i> -value for (4) - (5) = 0
	(1)	(2)	(3)	(4)	(5)	(6)
Entrepreneur's age	39.1	41.3	-0.98	38.1	38.2	-0.02
Years of schooling	12.1	12.9	-0.73	12.05	12.6	-0.48
Work experience in formal sector	0.82	0.85	-0.33	0.77	0.77	0.05
Other training participation	0.36	0.31	0.48	0.14	0.17	-0.33
Years of operation	11.7	13.7	-1.30	11.0	11.7	-0.46
Sales revenue 2002				142.4	158.3	-0.35
Sales revenue 2005				154.5	180.3	-0.59
Sales revenue 2006				113.7	136.5	-0.60
Sales revenue 2007				127.8	150.4	0.55
Summary statistics for the probit model						
Pseudo R^2	0.035			0.016		
LR chi2	3.21			1.00		
$p > \text{chi2}$	0.67			0.99		

Notes. The first three columns of this table show the results of balancing test for DID-PSM estimation reported in row (1) of Table 7, and the next three columns of this table correspond to row (2) of Table 7. The participants and non-participants in columns (1) and (2) are matched by using the propensity score obtained from the estimated probit model reported in column (1) of Table 2, and those in columns (4) and (5) are matched based on the propensity score obtained from the estimated probit model with the same covariates and sales revenues in 2002 to 2007.

Table A-2 Balancing test for DID-PSM with difference taken between 2005 and 2008

	Participants	Non- participants	<i>t</i> -value for (1) = (2)	Participants	Non- participants	<i>t</i> -value for (4) = (5)
	(1)	(2)	(3)	(4)	(5)	(6)
Entrepreneur's age	36.9	38.1	-0.50	37.3	37.0	-0.10
Years of schooling	12.6	12.9	-0.65	12.1	12.4	-0.27
Work experience in formal sector	0.81	0.80	0.12	0.81	0.80	0.04
Other formal training	0.22	0.22	0.01	0.19	0.16	0.34
Years of operation	9.6	10.8	-0.73	9.6	10.3	-0.51
Sales revenue 2005				139.5	136.2	0.11
Summary statistics for the probit model						
Pseudo R^2	0.01			0.01		
LR chi2	1.11			0.70		
$p > \text{chi2}$	0.95			0.99		

Notes. The first three columns of this table show the results of balancing test for DID-PSM estimation reported in row (3) of Table 7, and the next three columns of this table correspond to row (4) of Table 7. The participants and non-participants in columns (1) and (2) are matched by using the propensity score the same model as in column (1) of Table 2 except that it uses the entrepreneur's age and the years of operation as of 2005, and those in columns (4) and (5) are matched based on the propensity score from the estimated probit model reported in column (2) of Table 2.

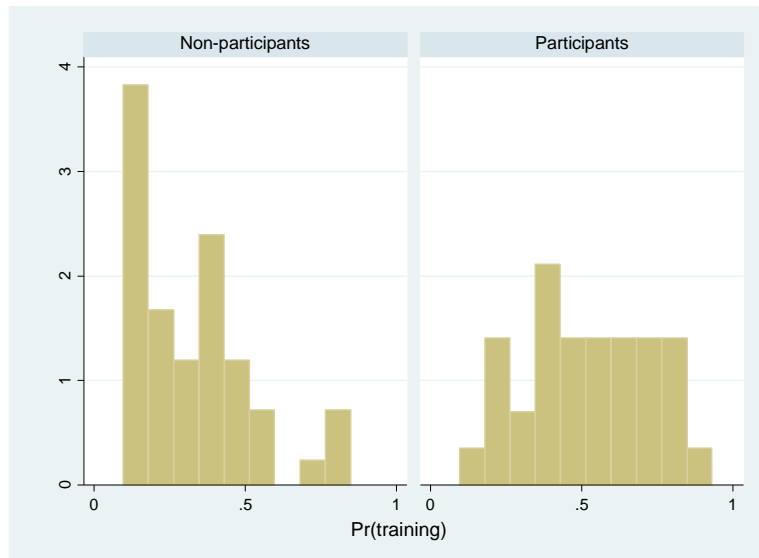


Figure A-1. Estimated propensity score by training participation corresponding to DID-PSM 2008-2007 reported in row (1) of Table 7

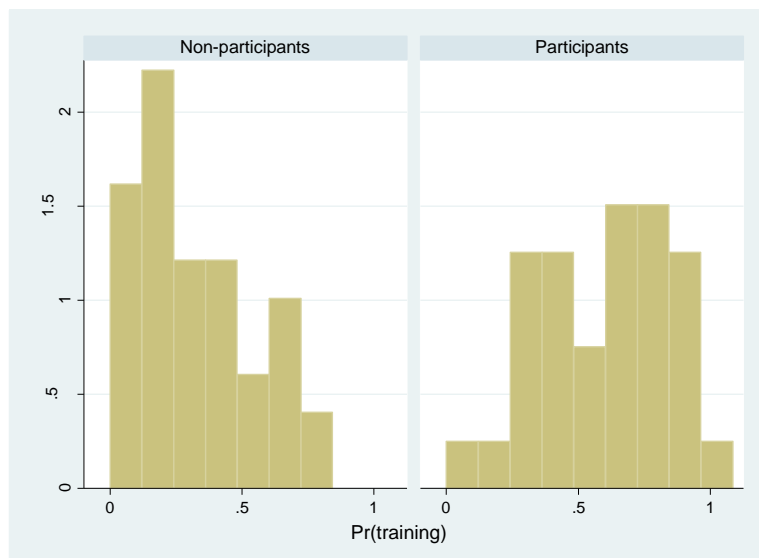


Figure A-2. Estimated propensity score by training participation corresponding to DID-PSM 2007-2008 controlling for the sales revenue history reported in row (2) of Table 7

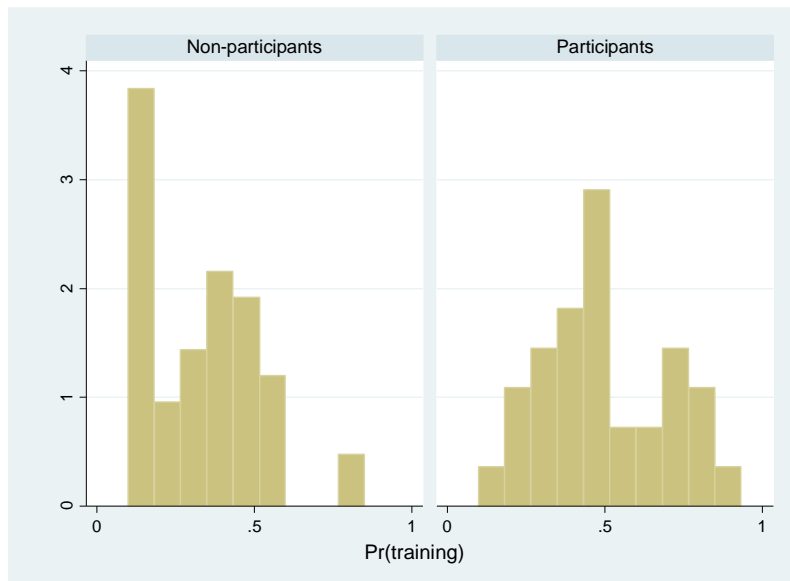


Figure A-3. Estimated propensity score by training participation corresponding to DID-PSM 2005-2008 reported in row (3) of Table 7

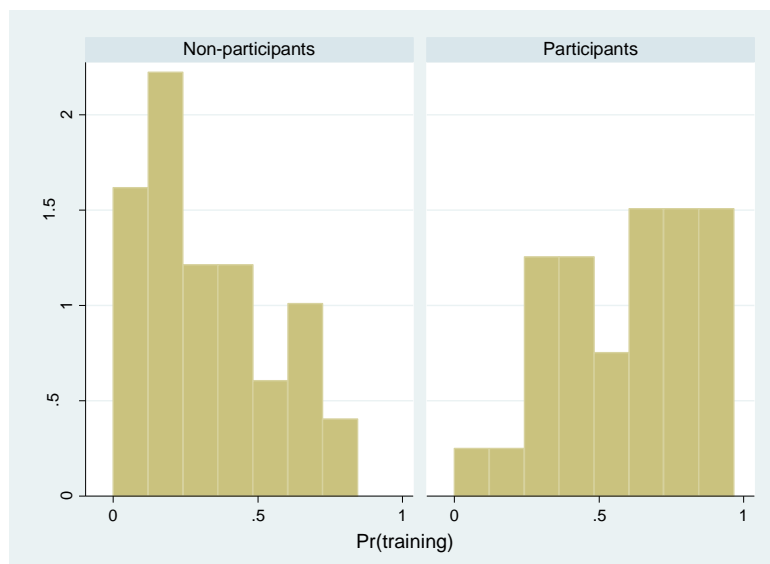


Figure A-4. Estimated propensity score by training participation corresponding to DID-PSM 2005-2008 controlling for the sales revenue in 2005 reported in row (4) of Table 7.