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# Identifying and Decomposing Peer Effects on Decision-Making Using a Randomized Controlled Trial

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# Identifying and Decomposing Peer Effects on Decision-Making Using a Randomized Controlled Trial

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Abstract

This paper investigates peer effects on firm managers' decisions. We invited 131 randomly selected firm representatives to three one-day seminars on export promotion. We found that peers' invitation in the seminars has a positive effect on firms' participation. We distinguish between peers' invitation on the same day and other days, finding that the former has a positive effect while the latter has no significant effect. These results imply that peer effects arise mostly through a reduction of psychological cost of participation. Our results suggest that multiple equilibria in the share of participants within each network of firms may emerge. (C93, D22)

Keywords: peer effects, social networks, information confirmation, free riding, randomized controlled trials

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## 1. Introduction

Peer effects – that is, the effects of peers' behavior on actors' own behavior through social networks – have been recognized in the theoretical and empirical economics literature (Blume et al., 2011; Jackson and Zenou, 2015). Although many studies have examined peer effects on performance, e.g., the effects of classmates on students' test scores (Angrist and Lang, 2004; Sacerdote, 2001; Zimmerman, 2003), one strand of this literature focuses on peer effects on the decision to participate in social programs. For example, Duflo and Saez (2003) analyzed the role of social interactions in employees' decision to enroll in a retirement plan. They conducted an experiment in which they provided randomly selected employees with monetary incentives to participate in information fairs and found a positive peer effect on participation in a business program focused on information dissemination.

Peer effects may affect participation in social and business programs, particularly in those focused on information dissemination, for three reasons. First, actors may be more likely to participate in a program if their peers also participate because the participation of peers lowers the psychological costs of participation. Second, peers' participation encourages actors to participate by if they expect to be able to discuss the information provided in a program with these peers and thereby enhance their understanding of the information. In a similar context, Centola (2010) found that the reinforcement of the same information by multiple peers promotes behavioral adoption; we refer to this channel as information confirmation. Finally, peers' participation discourages actors' participation in programs because these actors may be able to obtain the information that their peers receive in the program at no personal cost ("free riding").[1] In short, reducing the psychological costs of participation and information confirmation lead to a strategic complementarity of behaviors among peers, which results in positive peer effects, while free riding results in strategic substitution and negative peer effects.

Whether actors' behaviors are strategic complements or substitutes largely affects equilibrium characteristics (Jackson and Zenou, 2015). On one hand, if strategic complementarity dominates because the psychological costs of participation are reduced,

[1] Another possible channel of peer effects is word-of-mouth, which was examined by, for example, Aral and Walker (2011) and Banerjee et al. (2013). In this study, we do not find this channel because the time span between the seminars – that is, the time that allows for the diffusion of word-of-mouth – is too short. Cai et al. (2009) isolated the effects of learning from others through observations from the effects through direct communication. We do not focus on the distinction between these two types of effects.

for example, in a Nash equilibrium, no participant within a network participates in the program. In this situation, if only one actor participates, her welfare may decline because of the great psychological costs of participation if none of her peers participates. However, in another Nash equilibrium, everyone in a network participates because peer effects lower the costs of participation. On the other hand, if strategic substitution due to free riding dominates in a typical equilibrium, only a few actors participate and diffuse the information that they obtain in the program, while others free ride and thus also obtain this information (Bramoullé and Kranton, 2007). In either case, peer effects may result in a low participation rate in programs for information dissemination. In practice, the take-up rate of social and business programs is indeed often quite low (Bertrand et al., 2004; Currie, 2004; McKenzie and Woodruff, 2014). For example, when Bruhn and Zia (2013) provided business and financial literacy programs to the loan clients of one of the largest microcredit institutions in Bosnia and Herzegovina, only 39 percent of the 297 target individuals participated.

Therefore, to improve take-up rates, the empirical question of how peer effects work in such programs is relevant for program organizers and policy makers. However, empirically identifying peer effects is difficult because of the reflection problem articulated by Manski (1993) and because of endogeneity in peer behavior. The reflection problem arises because average group behaviors are a mirror image of individual behaviors; thus, it is difficult to identify causality from the correlations between behaviors. Endogeneity arises because of the self-selection of peers and unobserved group effects.

To accurately identify peer effects, recent studies have utilized natural and randomized experiments on peer formation and participant selection (Aral and Walker, 2011; Banerjee et al., 2013; Bobonis and Finan, 2009; Cai and Szeidl, 2016; Dahl et al., 2014; De Giorgi et al., 2010; Duflo and Saez, 2003; Fafchamps and Quinn, 2015; Falk and Ichino, 2006; Sacerdote, 2014; Zimmerman, 2003). This study follows this literature on identifying peer effects based on randomized experiments. In particular, we conducted a randomized controlled trial (RCT) in which we invited 151 randomly selected firm representatives from a population of 296 registered small and medium-sized enterprises (SMEs) in 16 traditional garment and textile clusters in Vietnam to seminars on export promotion. Before the RCT, we conducted a survey among all the SMEs to capture the complete information exchange network of the firms within each cluster. The network peers are the information-exchange partners solicited. We identify the peer effects by

estimating the impact of the number of invited peers on managers' participation, while controlling for the total number of peers.

This study contributes to the literature on the identification of peer effects in the following three ways. First, this study is the first attempt to identify peer effects on firm managers' decisions to participate in business programs, although several papers, such as Cai and Szeidl (2016) and Fafchamps and Quinn (2015), found positive peer effects on firms' performance and practices using RCTs. Our focus, i.e., peer effects on participation, is as important as peer effects on performance because take-up ratios in policy programs are often low, as mentioned above, although participation in these programs often improve firm performance (McKenzie and Woodruff, 2014).

Second, we define peers according to firms' actual links to the exchange of business information. Most existing studies defined peers according to group membership, such as roommates and classmates in colleges (De Giorgi et al., 2010; Sacerdote, 2001; Zimmerman, 2003) and employees in the same department (Duflo and Saez, 2003). However, all members in a particular group are not necessarily closely connected for information or utility exchange, and estimates from these studies are thus difficult to interpret (Carrell et al., 2011). Therefore, some recent studies have defined peers more precisely. For example,
Bursztyn et al. (2014) and Falk and Ichino (2006) examined peer effects between two actors who were matched in experiments. A disadvantage of these studies is that the number of peers is always one and shows no variation among the observations. Alternatively, Aral and Walker (2011), Banerjee et al. (2013), Calvó-Armengol et al. (2009), and Card and Giuliano (2013) targeted entire networks of many actors to identify all the peers for each actor. The current study follows this line of the literature and identifies all the peer firms within the cluster with which firms exchange business information by asking firm representatives directly. Then, we estimate the effects of the number of peers invited to the seminars on firm decisions to participate while controlling for the total number of peers. Because this specification is analogous to the linear-in-means model of Manski (1993), our results are more comparable to those of previous studies.

Third and most importantly, we separate peer effects through the reduction of the psychological costs of participation from the other two channels, namely, information confirmation and free riding. In our experiment, we invited each participant to one of the

one-day seminars held over three consecutive days. The invited representatives were allocated to the three seminars randomly, and they were not allowed to change the date of participation. This unique experiment structure enables us to isolate the peer effects through the reduction of the psychological costs of participation. The firm representatives could be affected by their peers through all three above-enumerated channels if they were invited on the same day. However, they might be affected by only two channels (information confirmation and free riding) if they were invited on different days because the psychological costs of participation are not reduced when two actors participate in different seminars (even if the content of both seminars is the same). Therefore, the difference between the effects of peers participating on the same day and the effects of peers participating on other days should constitute the peer effects that result from reducing the psychological costs of participation.

A decomposition of peer effects is provided by Bursztyn et al. (2014), who examined how individuals' decisions to purchase a financial asset affect their peers' decisions. In particular, they distinguished between two channels of peer effects: (1) social learning due to learning from peers' choices and (2) social utility due to the mutual possession of the same asset. However, because our study focuses on decisions to participate in information dissemination seminars that involve the possibility of free riding on others' information, peers' participation may negatively affect the actor's participation. This possible negative effect through free riding is not considered by Bursztyn et al. (2014).

To preview our results, we find a positive, statistically significant, and quantitatively large effect of the number of invited peers on the managers' decision to participate in the seminar. Further, the positive peer effect is due mostly to the reduction of the psychological costs of participation due to the possible joint participation with multiple peers. Moreover, the sum of the positive effect due to information confirmation and the negative effect due to free riding is not statistically significant, although we cannot further distinguish between the two.

Our results supporting positive peer effects imply multiple equilibria due to strategic complementarity. In other words, the rate of firms' participation in the seminars may vary across firm clusters, depending on the cluster characteristics that determine firms' beliefs about their peers' participation. We find evidence that supports this argument of multiple equilibria: there was no participation among a few of the 16 clusters in our sample, while the take-up rate was quite high in others. This argument is also consistent with the

literature. For example, Bursztyn et al. (2014) reported that the peer effects they found would result in herd behaviors in decisions to purchase financial assets. Blume et al. (2011) theoretically showed that in the presence of peer effects or social interactions, a new technology's rate of adoption increases dramatically when it is adopted by a "critical mass" of users. Furthermore, Durlauf (2006) proposed that poverty traps may arise when group membership affects individual decisions.

Our results provide important implications for organizers and policymakers of business seminars and social programs. As we mentioned earlier, the take-up ratio of business and social programs is often low despite these programs' potential benefits. This study suggests that program organizers should spatially focus their interventions and invite dense cliques of firms and individuals together to lower the psychological costs of their involvement and to encourage their participation.

## 2. Methodology

### *2.1. Conceptual framework*

The recently developed network game theory helps to theoretically explain how peers can affect players' actions (Jackson and Zenou, 2015). In this study, as we will later explain in detail, firms are invited to business seminars and decide whether to participate. If firms' expected payoffs are positively affected by their peers' participation, they are more likely to participate in seminars when their peers participate. This strategic complementarity can arise from two sources. First, the costs of or psychological barriers to participation may decrease when their peers participate. Second, the invited individuals may consider that their participation would be more useful if they confirmed the information that they learned in the seminars with one another in order to increase their understanding of the information. This second channel of peer effects is related to the findings of Centola (2010) based on a social experiment that showed that people are more likely to adopt new health behaviors when a group's online social network is dense, i.e., when most of a group's members know one another. Centola interpreted this finding to indicate that the reinforcement of the same knowledge by multiple peers results in a deeper understanding of the knowledge and thus promotes its adoption. By contrast, if the information obtained in seminars is easily diffused among peers, actors can free ride on the information

obtained by their peer participants. This situation leads to strategic substitution and a negative correlation between an individual's participation and their peers' participation.

A unique feature of our experiment enables us to separate positive peer effects that result from the reduction of the psychological costs of participation from the two other effects (information confirmation and free riding). We held one-day seminars on three consecutive days and invited each firm to the seminar on a particular day; they were not allowed to participate in the seminars to which they were not invited. Thus, from a participant's viewpoint, there are two types of peers: (1) those invited to the same seminar and (2) those invited to a seminar on a different day. Although the content of the three seminars differed slightly from each other for the purposes of the impact evaluation of the different types of seminars (Kim et al., 2016), the invited firms did not know these differences at the time of invitation. Thus, regardless of whether they participated, the firms assumed that the three seminars were the same.

[Table 1]

Given this structure of our experiment, we can separately examine the effects of peers invited on the same day and of those invited on different days. Specifically, the peers who were invited on the same day could affect the focal firm through all three channels described above, i.e., reducing the psychological costs of participation, confirming information, and free riding. However, peers who were invited to seminars on different days could influence the decision maker only in terms of information confirmation and free riding. Firms can confirm the information they obtain in seminars with peers who participate on any day and free ride on information from any peer. However, peers who participate on the same day lower the psychological costs of participation (Table 1). Therefore, the effect of peers invited on other days equals the sum of a positive peer effect due to information confirmation and a negative effect through free riding. The difference between the effect of peers invited on the same day and the effect of peers invited on other days indicates a positive peer effect due to the reduction of the psychological costs of participation.

*2.2. Estimation equation*

In the empirical analysis, an important issue concerns whether we should measure peer effects using the number of peers who were invited to the seminars or the number of peers who participated in them. Theoretically, it is often assumed that players make decisions simultaneously without observing others' decisions. If this is the case, a firm's decision is affected by its invited peers rather than by the participating peers, as participation is not observed at the time of the decision. Thus, theory suggests using the number of invited peers to estimate peer effects. In our study, we use the number of invited peers to identify the peer effects because the invited firms are randomly selected, and thus, the number of invited peers is exogenous, given the total number of peers for each firm.

We thus consider the following linear probability model:

(1) $PAR_i = \beta_0 + \beta_1 INV\_SAME_i + \beta_2 INV\_OTHER_i + \boldsymbol{\gamma}\mathbf{X_i} + \varepsilon_i,$

where $PAR_i$ is a dummy variable for firm *i*'s participation in the invited seminar. $INV\_SAME_i$ is the number of firm *i*'s peers that are invited to the same seminar to which firm *i* is invited, whereas $INV\_OTHER_i$ represents the number of firm *i*'s peers that are invited to a seminar on one of the other two days. As we will explain later in the data section, *i*'s peers are defined as the firms that firm *i* reported as information exchange partners or those that reported firm *i* as an information exchange partner. $\mathbf{X_i}$ is a vector of attributes of firm *i* and its representative, including the total number of peers (i.e., degree centrality). It is important to include the total number of peers because the number of invited peers tends to be larger when the total number of peers is larger. By including the total number of peers, we can distinguish between the effect of firms' attributes and the effect of peers.

According to the discussion in Section 2.1, which is summarized in Table 1, $\beta_1$ indicates the sum of a positive peer effect due to information confirmation and a negative peer effect due to free riding. In addition to the two effects, $\beta_2$ includes a positive peer effect as a result of reducing the psychological costs of participation. Therefore, the difference between $\beta_1$ and $\beta_2$ signifies the peer effect through reducing the psychological costs of participation.

## 3. Data and Randomized Experiment

### *3.1. Sampling and survey*

In this study, we focus on SMEs in village-based apparel and textile industrial clusters in the Red River Delta surrounding Hanoi, the capital city of Vietnam. Village industry clusters are traditionally developed agglomerations of SMEs, including micro enterprises in a particular industry, such as the apparel, wood furniture, and ceramic industries, within the village boundary. We focus on village industrial clusters because it is possible to observe all networks within the village through which firms exchange business information. We have a substantial interest in export promotion through information seminars, and therefore, we target SMEs in the apparel and textile industry; most have yet to export their products but have a high potential to export once adequately informed. Approximately 10 percent of firms in the sample have exported their products.

We identified the village clusters using data from the Vietnam Enterprise Survey (VES), which was conducted by the General Statistical Office of Vietnam (GSO) in 2010. We chose villages or communes, which are the smallest administrative units, with more than five registered firms in the textile and apparel industries (industry codes 13 and 14 in the Vietnamese system of industry classifications) in the 10 provinces in the Red River Delta. Because not all of the firms are formally registered and because smaller firms in the VES are randomly selected,[2] villages with more than five registered firms in the apparel and textile industry in the VES data are most likely to be industrial clusters of a specific industry. Through this process, we initially identified 19 villages in six provinces. We visited the selected villages and found that two villages among the 19 are not apparel and textile clusters in the sense that most manufacturing firms in the villages do not necessarily engage in apparel or textile production. We also omitted one village from our sample because it had already received business management training through another RCT and because it had been surveyed several times for impact evaluation (Higuchi et al., 2015). We assumed that firms in this village were already systematically different from firms in other villages.

Our study targeted registered firms in the remaining 16 apparel and textile village clusters. For each of the 16 villages, we obtained the full updated list of registered firms

[2] The VES targets all firms with 30 employees or more and randomly selects 10 percent of firms with 10-29 employees.

from the municipal governments. The total number of all registered firms in the target villages was 354. In December 2014 and January 2015, we requested face-to-face interviews with the owners, managing directors, and top-level managers of the 354 firms and obtained responses from 296, for a response rate of 84 percent. The questionnaire comprises questions on standard firm characteristics, such as sales, the number of workers, main products, and ownership. In addition, to identify firm networks within a cluster, we presented to a representative of each firm the full list of registered firms in the village and asked him or her to list the firms with which the firm regularly exchanged business information.[3] Because we surveyed most of the registered firms within a village, we identified a nearly complete network of registered firms within each village.

*3.2. Seminars on export promotion*

We conducted an RCT in which we randomly selected approximately half of the 296 firms that were surveyed and invited each of the selected firms to one of the three one-day seminars on export promotion held from March 14 to March 16, 2015. The seminars consisted of four common classes on the following topics: introduction to the development of the global economy (delivered by a business school professor); basic exporting procedures (delivered by an official from the Vietnam export promotion agency); advice for exporting to Japan (delivered by officials from the Hanoi office of the Japan External Trade Organization, JETRO); and finally, sharing the experiences of current exporters. The content of the seminars was slightly different across the three days: there was an additional class on e-customs on the second and third days, and there was a reception dinner after the seminar on the third day. However, we can disregard these differences when we estimate peer effects because the invitees were not informed about such differences upon invitation, and therefore, their decision to participate could not have been

[3] The firms identified as the main business information exchange partners may depend on the respondent. All the respondents were responsible decision makers of the surveyed firms, including owners, managing directors, and top-level managers. Admittedly, a top-level manager may not always know exactly who the owner informally consults in business matters. However, given that most of the surveyed firms were family-run businesses, owners, managing directors and top-level managers are likely to be members of the same family who know each other well and have similar networks. To test this assumption, we separately interviewed one company owner and his wife, who was a top-level manager in the company, and their responses were identical.

affected by the differences among the seminars.

The venue of the seminars was a three-star hotel located at the center of Hanoi. We chose a three-star hotel to attract participants. It took a minimum of 30 minutes by motorbike to a maximum of 2 hours by bus to travel from the sample villages to the hotel. For several villages located far from the hotel, we chartered buses for the participants' transportation. We reimbursed the actual cost of travel to those who used their own means of transportation, such as public buses or motorbikes. Except for the transportation cost reimbursement, no compensation was provided for participation except for meals at the hotel. We did not collect any participation fees from the participants.

### *3.3. Selection and participation of firms*

We randomly selected 50 or 51 firms for each day (151 firms in total) using a stratified sampling strategy at the village level. Then, we sent an enumerator of the firm-level survey to personally invite each firm to the seminars and to deliver a formal letter that explained the details of the seminar. In the letter, we noted that only the owner, the managing director, or a top-level manager could participate in the seminars, although the seminar participants and respondents to our surveys may have differed. A few days before the seminars, we made phone calls for further invitation. If the firms were not willing to participate at the time of the first phone call, we made another phone call a day before the seminar.

No firms were allowed to participate in the seminars unless they were invited, so there was no participant who were not invited. We were forced to drop 20 firms that failed to report the necessary information for the estimations in the survey. Consequently, our baseline sample consists of 131 invited firms. Note that although we held three one-day seminars, the invited firms were not allowed to participate in a seminar that was different from the seminar to which they were invited. However, five invited firms attended a seminar to which they were not invited. For ethical reason, we ultimately had to allow them to participate. In the analysis, we kept the five firms in the sample since the number of invited peers remains exogenous, given the number of peers.

Among the invited firms, a small number of the invited firms participated in our seminars. Among the 50 firms that were invited on the first day, only 9 participated, 15 among 50 participated on the second day, and 14 among 51 participated on the last day. In total, of the 151 invited firms, 38 firms participated; thus, the participation rate is 25.2

percent. This low participation rate is comparable to that of the business and financial literacy program conducted by Bruhn and Zia (2013) in Bosnia and Herzegovina.

### *3.4. Construction of variables*

As we mentioned in Section 2.2, the dependent variable is a dummy variable that takes a value of one if firm *i* participated in one of the three seminars, and zero otherwise. The key independent variables are *INV_SAME* and *INV_OTHER*, i.e., the number of firm *i*'s peers invited to the seminar on the same day and the number of its peers invited to the seminar on other days, respectively. Firm *i*'s peers are defined as the firms that were reported by the survey respondent of firm *i* as information-sharing partners or those that reported firm *i* as information-sharing partners. In network terms, this study utilizes undirected network data. Although our estimations are based on 131 invited firms with complete information, the number of peers is defined based on the information exchange partners of all of the registered firms within each village, including those who did not respond, those who were not invited, and those who were dropped due to missing information.

The control variables include firm attributes that contain the log of the total number of workers, the share of exports in total sales, the log of the firm age, and the attributes of the top-level manager of each firm – such as the president or the owner – including the log of his or her age, the log of his or her years of education, and a dummy that indicates whether the respondent was female. In addition, we experimented with alternative specifications incorporating the averages of firm and manager attributes of the invited peers of each firm to control for the exogenous effects discussed by Manski (1993) or possible effects of the group attributes on participation decisions. Finally, we control for village attributes such as number of registered firms in the village and the log of distance from a village to the seminar venue.

### *3.5. Descriptive statistics*

[Table 2]

Table 2 analyzes whether we succeeded in randomizing the invitations we sent to the firms by conducting *t* tests for systematic differences between the invited and non-invited

firms in terms of the control variables for the firm and manager attributes used in the estimation. None of the variables shows a statistically significant difference between the two groups. Therefore, there should be no correlation between the number of invited peers and the error term in equation (1), and the identification strategy utilizing the RCT that is described in Section 2.3 is appropriate.

[Table 3]

Table 3 shows the descriptive statistics of the variables that are used in the later estimations for the sample of 131 firms. The average number of peers is 4.02, of which approximately one half, i.e., 1.98, were invited to one of the three seminars. The average number of peers participating in any of the seminars is 0.62. Because the target firms are in traditional garment and textile clusters, the average number of workers, 25.99, is relatively small. On average, the share of exports in total sales is 19.0 percent, the firm age is 6.57 years, the age of managers is 42.9 years, and their years of education are 13.8 years. We also found that 19.8 percent of the managers are female. The average number of registered firms within the village is 39.1, and the average distance from the villages to the seminar venue is 33.1 km.

## 4. Results

### *4.1. Total peer effects*

[Table 4]

We begin by estimating a simpler version of equation (1) in which we use the total number of invited peers so that the two types of peers are not distinguished. We experimented with several sets of independent variables by incorporating averages of firm and manager characteristics of the invited peers and village attributes, such as the number of registered firms and the log of the distance from a village to the seminar venue. The results are shown in Table 4. In all of the specifications, the effect of the number of invited peers is positive and significant at the 10-percent level at least.

[Table 5]

A possible concern in our specifications is that firms with no peers may behave differently from firms with peers; for example, they may participate in the seminars in order to connect with other participants. As a robustness check, we added the dummy variable that represents no peers to the set of control variables used in column (1) in Table 4. The estimated results are shown in column (1) in Table 5. The effect of the number of invited peers holds even when we control for the effect of having no peers.

Another concern is that in our surveyed villages, some firms share information with firms that are not listed in the full list of registered firms in the village. The unlisted firms may be informal or unregistered firms within the village, such as micro subcontractors, or firms outside the village. Firms' exchange of information on exporting activity with unlisted firms, may also affect their decision to participate in the seminar. As an additional robustness check, we tested whether the effects of invited peers hold when we control for the effect of the number of unregistered peers. The estimated result is shown in column (2) in Table 5. The effect of the number of invited peers is still positive and statistically significant even when we control for the effect of peers outside the official roster.

*4.2. Decomposing peer effects*

[Table 6]

Subsequently, we decompose the peer effects as discussed in Section 2. That is, we isolate the effect of the reduction of the psychological costs of participation from the effect of information confirmation and free riding by disaggregating the firms' peers invited to the seminar on the same day and those invited to the seminars on other days. We experimented with the same four alternative sets of control variables as we did in Table 4, and the results are shown in Table 6. In all the specifications, the results demonstrate a positive and statistically significant effect of peers invited to the seminar to which the firm was invited but no significant effect of peers invited to other seminars.

[Table 7]

As a robustness check, we tested whether the results above remain valid if we control for the effect of no peers or the effect of peers outside the list of registered firms. The

results are shown in Table 7. The coefficients for the number of peers invited to the seminar on the same day and the number of peers invited on other days are very similar to those in Table 6.

Based on the argument in Section 2.2 and summarized in Table 1, the difference between the coefficients for the two types of invited peers demonstrates the peer effect due to the reduction of the psychological costs of participation. The coefficient on the number of invited peers on other days indicates the sum of positive peer effects due to information confirmation and the negative effect due to free riding. We conducted Wald tests to examine the null hypothesis that the difference between the two coefficients is zero, i.e., that there is no peer effect due to the reduction of the psychological costs of participation. The bottom row shows *p* values associated with the Wald tests. The null hypothesis is not rejected in all specifications in Tables 6 and 7. However, it should be emphasized that these results are likely caused by a lack of statistical power since the number of observations is 131 and that the effect of peers invited on the same day is statistically significant and large, while the effect of peers invited on other days is not.

### *4.3. Alternative channels of peer effects*

Other channels may also be involved in the peer effects found above. For example, if firm managers can reduce travel time to the seminar venue by sharing a ride with their peers, reduced time costs can be another possible channel of peer effects. Because we provided free chartered buses to distant firms in our experiment, this channel may not matter in this study. However, to double-check if our results are affected by this alternative channel, we incorporate the interaction term between the number of invited peers on the same day and the log of the distance to the venue, hypothesizing that the interaction term has a positive effect – i.e., the effect of invited peers is larger when the distance is longer – if the reduction of travel costs is another channel. According to the results shown in Table 8, the previous results remain the same, while the effect of the interaction term is not statistically significant. Thus, a reduction in time costs may not be a source of peer effects.

[Table 8]

Another possible channel of peer effects is word-of-mouth. If participating firms can share their assessment of the seminar with their peers afterwards, this word-of-mouth

effect could encourage other firms to participate or discourage them from participating on the following days. The participation rate on the first day is lower than that of on the other days, which may indicate this word-of-mouth effect. To investigate this channel, we further separate each firm's peers invited to the seminars on the other days into two – those invited to the seminar before and after the firm – and run the same regressions as in Table 6. If the word-of-mouth effect is present, the estimated coefficient on the number of each firm's peers invited to an earlier seminar than the firm represents the sum of the effect through word-of-mouth, information confirmation, and free riding, whereas the coefficient on the number of peers invited to later seminars represents the sum of the latter two effects. Therefore, the difference between the two coefficients indicates the word-of-mouth effect.

The results are shown in Table 9. In all the specifications, neither the number of peers invited to earlier seminars nor the number of peers invited to later seminars is statistically significant. In addition, Wald tests to examine the null hypothesis that the difference between the two coefficients is zero show that the hypothesis cannot be rejected. Thus, we confirm that word-of-mouth did not generate peer effects in our case. A possible reason for the lack of the word-of-mouth effect is that participants had no time to spread information about the seminars because the seminars were held on three consecutive days and ended at 4:00 p.m. or 4:30 p.m.

[Table 9]

## 5. Discussion and Conclusion

By utilizing an RCT in traditional clusters of apparel and textile SMEs in Vietnam, we investigate peer effects on firms' participation in seminars focused on export promotion. We use the number of randomly invited peers to identify such peer effects. We further distinguish peers invited to the seminar on the same day from peers invited to seminars on other days. In this way, we can isolate the peer effects caused by a reduction in the psychological costs of participation from the positive effect of information confirmation and the negative effect of free riding on peers' information.

The results in Tables 4 through 9 can be summarized as follows. First, the identified peer effects are large: an additional invited peer increases a firm's probability of participation in the seminar by 6.4 percentage points (column [1] of Table 4), whereas the

average participation rate is only 25.2 percent (Table 3). Second, theoretically, there may be two other types of peer effects: a positive effect due to information confirmation among peers and a negative effect due to free riding on peers' information. Our empirical results suggest that the two opposing effects may cancel each other out or may both be negligible.

Third, the number of peers invited to seminars on the same day increase a firm's probability of participation, while peers invited to seminars on other days do not. Given that we found no effects of peers invited to the seminars on different days, our results imply that the peer effects arise mostly due to reducing the psychological costs of participation.

[Figure 1]

The positive peer effects found in this study indicate strategic complementarity in firms' participation decisions; therefore, it is theoretically likely that there are multiple equilibria across the groups, as argued in Card and Giuliano (2013): firms are better off by participating in a seminar if many peers participate, but they are worse off if only a few peers participate. This situation is similar to the majority game, for which there are two equilibria: one in which all firms participate and the other in which no firm participates, depending on the firms' beliefs (Jackson and Zenou, 2015). In our experiment, we indeed found some villages in which most of the invited firms did not participate in any seminar (Panel A of Figure 1), while most of the invited firms participated in some seminars (Panel B).

The actual situation in this study is more complicated, however, as we found positive effects of peers invited to the seminar on the same day, while there was no effect of peers invited to the seminars on other days. In the latter case, depending on how many firms in the village were invited to the seminar on each of the three days, the participation rate within the village may vary. Suppose, for example, that three firms that are linked to each other in a village were invited to the seminar on the first day but that only one firm in the same village was invited on each of the other two days. Then, depending on their beliefs about their peers' behaviors, all or none of the former three firms would participate. However, the last two might not participate, which leads to a participation rate of either 60 percent or 0 percent.

[Figure 2]

Based on this conjecture, we expect that the take-up rate among invited firms varies substantially across villages, although it may skew toward zero. Panel A of Figure 2 shows the distribution of the take-up rate among the invited firms in each village. The dominant take-up rate is approximately 0-10 percent, but there are many firms and villages with rates of 50-70, 70-90, and 90-100 percent. Panel B shows the take-up rate among invited firms in the ego network of each invited firm, i.e., the invited firm and its invited peers. The distribution at the firm level is similar to that at the village level, and these dispersed distributions are consistent with the argument that multiple equilibria exist as a result of peer effects.

Based on the argument above, our results provide implications for organizers and policymakers of social and policy programs. As we mentioned in Section 1, in practice, the participation rate in policy and social programs is often found to be low. Our results suggest that the low participation rate is due partly to peer effects. In other words, actors hesitate to participate in such programs because of the high psychological costs of participation. Peer participation can reduce such costs, but if peers are not informed about or invited to the program or if actors believe that their peers will not participate, they will not participate either. Therefore, to raise participation rates, organizers of social and business programs should target actors that are closely linked and invite them together.

Although our results imply that peer effects arise from reducing the psychological costs of participation, we cannot distinguish between the two other possible channels of peer effects, namely, information confirmation and free riding. However, whether actors avoid participation in social and policy programs because they can free ride and, if so, how this negative peer effect affects the overall performance of actors remain topics for further analysis.

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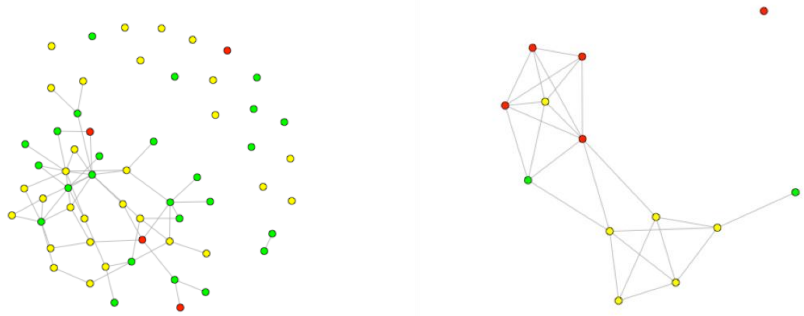
Figure 1. Inter-firm social network and participation in the seminars

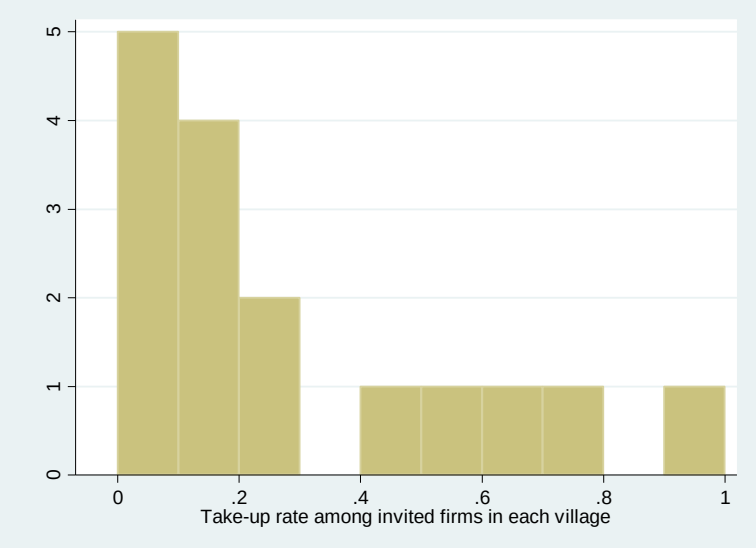
Panel (A) Panel (B)



Notes: The red, green, and yellow circles indicate firms that participated in a seminar, those that were invited but did not participate in any seminar, and those that were not invited to any seminar, respectively.

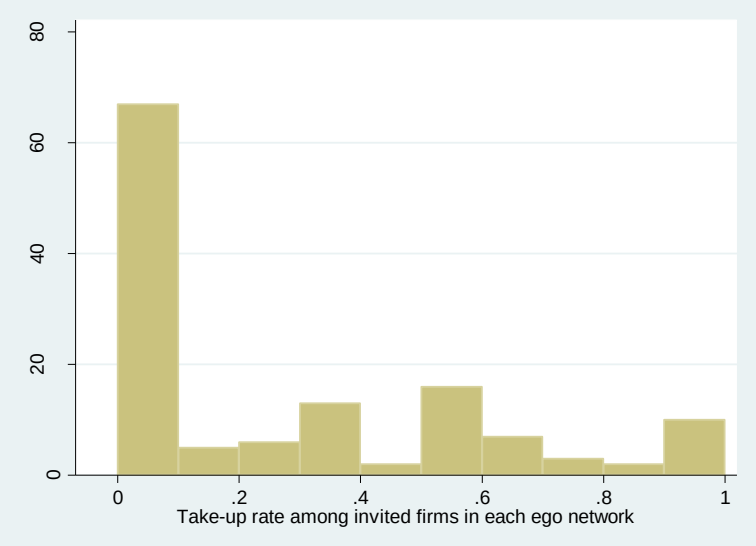
Figure 2. Distribution of the take-up rate

Panel (A): Village level




Notes: This figure shows the distribution of the take-up rate among the invited firms in each of the 16 villages studied in this paper.

Panel (B): Firm level




Notes: This figure shows the distribution of the take-up rate among the invited firms in the ego network of each of the 131 invited firms studied in the regressions, i.e., an invited firm and its invited peers.

Table 1. Channels of peer effects by day of invitation

| | Peers invited to the seminar | |
|---|---|---|
| | On the same day that a particular firm is invited | On a different day from that on which a particular firm is invited |
| Reduction of the psychological cost (+) | ✓ | |
| Information confirmation (+) | ✓ | ✓ |
| Free rides (-) | ✓ | ✓ |

Table 2. Differences between invited and non-invited firms

| Variable | Invited firms | | | Non-invited firms | | | Difference | |
|---|---|---|---|---|---|---|---|---|
| | *N* | Mean | S.D. | *N* | Mean | S.D. | Invited – non-invited | p-value |
| Firm attributes | | | | | | | | |
| Total number of peers | 140 | 3.979 | 3.492 | 135 | 3.948 | 3.293 | 0.03 | 0.941 |
| Number of workers | 142 | 29.51 | 59 | 132 | 76.38 | 410.41 | -46.87 | 0.1794 |
| Share of exports in total sales | 146 | 19.58 | 37.75 | 136 | 14.74 | 32.38 | 4.84 | 0.250 |
| Firm age | 144 | 8.681 | 5.467 | 136 | 8.61 | 6.01 | 0.07 | 0.9185 |
| Manager attributes | | | | | | | | |
| Age | 142 | 43.268 | 9.922 | 130 | 44.492 | 10.28 | -1.225 | 0.3185 |
| Female dummy | 146 | 0.192 | 0.395 | 138 | 0.217 | 0.414 | -0.026 | 0.5941 |
| Years of schooling | 142 | 13.831 | 2.134 | 133 | 14.083 | 2.306 | -0.252 | 0.348 |

Notes: N and S.D. represent the number of observations and standard deviation, respectively.

Table 3. Descriptive statistics

| Variable | Mean | S.D. | Min. | Max. |
|---|---|---|---|---|
| Participation dummy | 0.252 | 0.436 | 0.000 | 1.000 |
| Number of peers | 4.015 | 3.517 | 0.000 | 16.000 |
| Number of participating peers | 0.618 | 1.026 | 0.000 | 4.000 |
| -- on the same day | 0.221 | 0.611 | 0.000 | 3.000 |
| -- on different days | 0.435 | 0.842 | 0.000 | 4.000 |
| Number of invited peers | 1.977 | 1.895 | 0.000 | 7.000 |
| -- on the same day | 0.649 | 0.793 | 0.000 | 3.000 |
| -- on different days | 1.328 | 1.378 | 0.000 | 6.000 |
| Firm attributes | | | | |
| Number of workers | 25.985 | 56.466 | 0.000 | 500.000 |
| -- in logs | 3.003 | 1.407 | 0.000 | 6.908 |
| Share of exports in total sales | 19.031 | 37.370 | 0.000 | 100.000 |
| Firm age | 8.695 | 5.368 | 1.000 | 26.000 |
| -- in logs | 2.660 | 0.671 | 0.881 | 3.952 |
| Manager attributes | | | | |
| Age | 42.878 | 9.794 | 25.000 | 69.000 |
| -- in logs | 4.426 | 0.230 | 3.912 | 4.927 |
| Female dummy | 0.198 | 0.400 | 0.000 | 1.000 |
| Years of education | 13.832 | 2.131 | 9.000 | 18.000 |
| -- in logs | 3.310 | 0.148 | 2.893 | 3.584 |
| Which day a firm is invited | | | | |
| first day | 0.313 | 0.465 | 0.000 | 1.000 |
| second day | 0.351 | 0.479 | 0.000 | 1.000 |
| third day | 0.336 | 0.474 | 0.000 | 1.000 |
| Invited peers' average firm attributes | | | | |
| Average number of peers | 22.467 | 34.380 | 0.000 | 185.194 |
| Number of workers | 2.622 | 1.831 | 0.000 | 5.915 |
| -- in logs | 2.174 | 1.564 | 0.000 | 5.227 |
| Share of exports in total sales | 12.359 | 29.978 | 0.000 | 100.000 |
| Firm age | 6.572 | 5.245 | 0.000 | 21.000 |
| -- in logs | 2.030 | 1.321 | 0.000 | 3.738 |
| Invited peers' average manager attributes | | | | |
| Age | 32.050 | 20.946 | 0.000 | 65.000 |
| -- in logs | 3.238 | 2.007 | 0.000 | 4.868 |
| Female dummy | 0.103 | 0.216 | 0.000 | 1.000 |
| Years of education | 9.997 | 6.308 | 0.000 | 18.000 |
| -- in logs | 2.402 | 1.487 | 0.000 | 3.584 |
| Village attributes | | | | |
| Number of registered firms | 39.053 | 21.623 | 11.000 | 64.000 |
| Distance from village to the venue | 33.146 | 21.260 | 5.060 | 70.712 |
| -- in logs | 3.926 | 0.810 | 2.324 | 4.952 |

Notes: N=131. S.D. represents standard deviation.

Table 4. Estimation results for aggregate peer effects
The dependent variable is a dummy for participation in the seminar.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Number of invited peers | 0.0644** | 0.0628* | 0.0728** | 0.0646* |
| | (0.0310) | (0.0379) | (0.0351) | (0.0335) |
| Firm attributes | | | | |
| Number of peers | -0.0275* | -0.0358*** | -0.0268* | -0.0359*** |
| | (0.0147) | (0.0133) | (0.0139) | (0.0122) |
| Number of workers (log) | 0.0328 | 0.0345 | 0.0325 | 0.0336 |
| | (0.0295) | (0.0265) | (0.0365) | (0.0284) |
| Share of exports | 0.00203** | 0.00140 | 0.00206 | 0.00133 |
| | (0.000957) | (0.00162) | (0.00155) | (0.00215) |
| Firm age (log) | 0.0330 | 0.0320 | 0.0352 | 0.0390 |
| | (0.0919) | (0.0816) | (0.0808) | (0.0641) |
| Manager attributes | | | | |
| Age (log) | -0.0336 | -0.0806 | -0.0778 | -0.139 |
| | (0.222) | (0.145) | (0.148) | (0.127) |
| Female dummy | 0.167 | 0.148 | 0.144 | 0.118 |
| | (0.156) | (0.151) | (0.151) | (0.153) |
| Years of education (log) | -0.404 | -0.372 | -0.478 | -0.407 |
| | (0.280) | (0.381) | (0.322) | (0.342) |
| Average peers' firm attributes | | | | |
| Number of peers | | 0.00999 | | 0.0164 |
| | | (0.0211) | | (0.0392) |
| Number of workers (log) | | -0.0427 | | -0.0291 |
| | | (0.0859) | | (0.0984) |
| Share of exports | | 0.00156 | | 0.00169 |
| | | (0.00297) | | (0.00240) |
| Firm age (log) | | 0.0447 | | 0.0830 |
| | | (1.484) | | (0.212) |
| Average peers' manager attributes | | | | |
| Age (log) | | 0.226 | | 0.141 |
| | | (0.208) | | (0.175) |
| Female dummy | | -0.0627 | | -0.119* |
| | | (0.111) | | (0.0676) |
| Years of education (log) | | -0.296 | | -0.223 |
| | | (0.268) | | (0.176) |
| Village attributes | | | | |
| Number of registered firms | | | -0.00319 | -0.00364 |
| | | | (0.00344) | (0.00341) |
| Distance from village to the venue (log) | | | -0.0317 | -0.0527 |
| | | | (0.0692) | (0.0662) |
| Observations | 131 | 131 | 131 | 131 |
| R-squared | 0.109 | 0.132 | 0.195 | 0.208 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 5. Robustness check: estimation results for aggregate peer effects
The dependent variable is a dummy for participation in the seminar.

| | (1) | (2) |
|---|---|---|
| Number of invited peers | 0.0633* | 0.0639* |
| | (0.0323) | (0.0347) |
| No-peer dummy | -0.106 | |
| | (0.103) | |
| Number of unregistered peers and peers outside the cluster | | 0.00924 |
| | | (0.0611) |
| Firm attributes | YES | YES |
| Manager attributes | YES | YES |
| Average peers' firm attributes | NO | YES |
| Average peers' manager attributes | NO | YES |
| Village attributes | NO | NO |
| Observations | 131 | 131 |
| R-squared | 0.115 | 0.109 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 6. Estimation results of the decomposition of peer effects
The dependent variable is a dummy for participation in the seminar.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Number of peers invited on the same day | 0.114** | 0.139** | 0.127* | 0.150* |
| | (0.0538) | (0.0639) | (0.0747) | (0.0883) |
| Number of peers invited on other days | 0.0501 | 0.0417 | 0.0576 | 0.0411 |
| | (0.0364) | (0.0332) | (0.0355) | (0.0360) |
| Ho: No peer effect due to a reduction of psychological costs | 0.3267 | 0.1808 | 0.4038 | 0.2553 |
| Firm attributes | YES | YES | YES | YES |
| Manager attributes | YES | YES | YES | YES |
| Average peers' firm attributes | NO | YES | NO | YES |
| Average peers' manager attributes | NO | YES | NO | YES |
| Village attributes | NO | NO | YES | YES |
| Observations | 131 | 131 | 131 | 131 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 7. Robustness check: estimation results of the decomposition of peer effects
The dependent variable is a dummy for participation in the seminar.

| | (1) | (2) |
|---|---|---|
| Number of peers invited on the same day | 0.117** | 0.114** |
| | (0.0575) | (0.0538) |
| Number of peers invited on other days | 0.0477 | 0.0491 |
| | (0.0440) | (0.0378) |
| No-peer dummy | -0.113 | |
| | (0.107) | |
| Number of unregistered peers and peers outside the cluster | | 0.0129 |
| | | (0.0731) |
| Ho: No peer effect due to a reduction of psychological costs | 0.3466 | 0.3242 |
| Firm attributes | YES | YES |
| Manager attributes | YES | YES |
| Average peer firm attributes | NO | NO |
| Average peer manager attributes | NO | NO |
| Village attributes | NO | NO |
| Observations | 131 | 131 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

Table 8. Other mechanism: reduction of time costs
Dependent variable is dummy for participation in the seminar

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Number of invited peers on same days | 0.113* | 0.141** | 0.126* | 0.155** |
| | (0.0577) | (0.0677) | (0.0720) | (0.0744) |
| Number of invited peers on same days | 0.00444 | -0.00851 | 0.00883 | -0.0202 |
| * Distance from village to venue (log) | (0.0284) | (0.154) | (0.0649) | (0.0810) |
| Number of invited peers on other days | 0.0502 | 0.0415 | 0.0579 | 0.0406 |
| | (0.0379) | (0.0358) | (0.0358) | (0.0362) |
| Firm attributes | YES | YES | YES | YES |
| Manager attributes | YES | YES | YES | YES |
| Invited peers' average firm attributes | NO | YES | NO | YES |
| Invited peers' average manager attributes | NO | YES | NO | YES |
| Village attributes | NO | NO | YES | YES |
| Observations | 131 | 131 | 131 | 131 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify the statistical significance at the 10, 5, and 1 percent level.

Table 9. Another mechanism: word-of-mouth

The dependent variable is a dummy for participation in the seminar.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Number of peers invited on earlier days | 0.0483 | 0.0363 | 0.0560 | 0.0352 |
| | (0.0391) | (0.0289) | (0.0373) | (0.0336) |
| Number of peers invited on the same day | 0.115* | 0.141* | 0.128* | 0.152* |
| | (0.0595) | (0.0752) | (0.0769) | (0.0862) |
| Number of peers invited on later days | 0.0523 | 0.0480 | 0.0594 | 0.0478 |
| | (0.0593) | (0.0549) | (0.0543) | (0.0561) |
| Ho: No peer effect due to word-of-mouth | 0.9559 | 0.8824 | 0.9620 | 0.8475 |
| Firm attributes | YES | YES | YES | YES |
| Manager attributes | YES | YES | YES | YES |
| Average peer firm attributes | NO | YES | NO | YES |
| Average peer manager attributes | NO | YES | NO | YES |
| Village attributes | NO | NO | YES | YES |
| Observations | 131 | 131 | 131 | 131 |

Notes: The robust standard errors are in parentheses, clustered at the village level and calculated by the wild-bootstrapped method with 500 replications. *, **, and *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.