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Smallholder Farmers' Preferences for Certification Standards: A Randomized Conjoint Analysis in Vietnam

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Abstract

This study aims to elicit smallholder farmers' preferences for the design of certification standards. We conducted a randomized conjoint analysis (RCA) with 745 green smallholder tea farmers in Vietnam. This method enables us to estimate the causal impacts of design attributes on farmers' participation, which is a knowledge gap addressed by few empirical studies. Our results revealed that compared to the price premium, certification fee has a much stronger impact on farmers' participation. Further, we find the potential to incorporate the application of organic fertilizer, a widely recommended sustainable input, into the certification schemes. Based on our causal findings, we suggest policies for improving the coverage of certification standards.

Keywords– certification standards, smallholder farmers, green tea, Vietnam, conjoint analysis

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1 Introduction

Various certification standards – e.g., Fairtrade, Organic, UTZ & Rainforest Alliance, and Good Agricultural Practice (GAP) certificates – have been initiated for smallholder farmers[1] in developing countries (ITC, 2018). These standards require farmers to follow a set of safe and sustainable agricultural practices. In return, farmers receive price premiums due to consumers' higher willingness to pay for certified foods and beverages (Marette et al., 2012; Rousseau and Vranken, 2013). With this market-based mechanism, certification standards offer a promising path towards sustainable agriculture in developing countries.

Vietnam, a developing country in the Southeast Asia, has also witnessed the development of certification standards for smallholder farmers in recent years. International standards, such as GlobalGAP, Organic, and Hazard Analysis and Critical Control Points (HACCP), are implemented for a few food products (My et al., 2017). Importantly, the government has developed a domestic certification standard named VietGAP, which covers many agricultural commodities, including rice, tea, vegetables, and livestock. VietGAP is regulated by the Ministry of Agriculture and Rural Development (MARD), and the certificate is issued to voluntary groups of farmers by either private companies or state agencies.

However, despite active promotion by the government and non-government organizations (NGOs), the coverage of VietGAP remains very low. For example, only 5.5% of around 34,000 registered agricultural farms nationwide in 2017 (10 years after the introduction) were VietGAP certified. Further, the certified planted area for a focused commodity of VietGAP like tea was merely 3% in 2017[2].

Reasons for the low adoption rate of farmers still remain ambiguous, as empirical studies often report either neutral or positive impacts of certification standards on farm income (see DeFries et al., 2017 and Oya et al., 2018 for reviews about impacts of certification standards, and see Tran and Goto, 2019 and Bac et al., 2018 for par-

[1] Smallholder farms hereby refer to farms less than 2 *ha*, a broad definition proposed by the Food and Agricultural Organization of the United Nation (FAO).

[2] The statistics were collected from MARD and the Vietnam General Statistics Office and computed by the author.

ticular case studies in Vietnam). Some studies attempt to shed light on the issue by exploring factors – mainly farm, household and contextual characteristics – correlated with farmers' participation decision(e.g., Kersting and Wollni, 2012; Handschuch et al., 2013). However, because causal interpretations are hardly be inferred from those correlation findings, policy implications are often limited.

In this study, we take another approach to examine reasons as well as solutions to the low coverage. Our study investigates, quantitatively, how much design attributes of the certification standards affect farmers' participation decisions. Certification programs, like VietGAP, encompass two types of design attribute. The first type is about the requirements including certification fee and radical changes in farming practice (e.g., constrained use of agrochemicals, and keeping records of farm inputs and harvests). The second is tangible benefits in terms of price premiums, technical training, and subsidized inputs. Quantitative knowledge of how much the requirements discourage and how much the benefits encourage farmers' participation could suggest which overall design of certification programs is attractive (or not attractive) to smallholder farmers. As such, governmental policy-makers and NGOs can have effective tools to improve the coverage of certification programs.

Researchers have examined the importance of design attributes for other programs involving smallholder farmers, such as contract farming and soil conservation (e.g., Abebe et al., 2013; Ochieng et al., 2017; Marenya et al., 2014). Similar studies for certification are scarce. Meemken et al. (2017) is one of the only few studies to examine the impacts of design attributes on farmers' participation in certification standards. However, since their study used a conventional choice experiment with d-optimal design, the unbiased causal impacts of the design attributes could not be estimated.

To address this knowledge gap, we adopt new design of RCA – one type of choice experiment – from Hainmueller et al. (2014) to evaluate the causal effects of certification design on farmers' participation. From June to July 2018, we conducted the RCA with 745 Vietnamese households (i.e., family farms) which produce green tea on a small-scale. Tea is a major agricultural product of Vietnam, and small farmers own up to 70% of the plantation area. The specific study site was in a northern province

with the largest green tea planting area in Vietnam named Thai Nguyen. The active development of certification programs for small tea farmers in Thai Nguyen, as we will explain in section 2, offers contextual validity for our experiment.

The rest of this paper is organized as follows. Section 2 gives detailed justification for our selected study sites. Methods for data sampling, choice experiment procedure, and data analysis are explained in detail in section 3. Section 4 presents results from the randomized conjoint analyses, and a discussion of the results is provided in section 5. Section 6 concludes and gives policy implications based on our key findings.

2 The study site

Thai Nguyen, a province in the northern mountainous region of Vietnam, is our chosen study site for conducting RCA to elicit farmers' preferences for certification standards.

There are already several studies about certification standards for smallholder green tea farmers conducted in Thai Nguyen (e.g., Tran and Goto, 2019; Bac et al., 2018) due to the compelling characteristics of the province. As mentioned in those studies, Vietnam is a top tea producing country, and about 70% of the plantation area is under small-scale farms. Thai Nguyen is biggest center for green tea production in Vietnam. Tran and Goto (2019) further describe the recent development of certification programs for tea in Vietnam and Thai Nguyen. Accordingly, as of March 2018, there were 68 VietGAP tea groups in operation in Vietnam, whereas there was only one UTZ tea cooperative. Thai Nguyen was then home for 40 out of the 68 VietGAP tea groups and the only UTZ tea cooperative. Thus, a large number of smallholder tea farmers and the active development of tea certification standards make Thai Nguyen a favourable site for our study.

We conducted our RCA with smallholder tea farmers in Dai Tu district of Thai Nguyen province. Dai Tu district, accounting for about 30 percent of Thai Nguyen's planted tea area, owns the largest green tea farming area in the province. As of December 2017, 16 VietGAP groups were newly established in the district, owing to subsidy for certification fee from the local government. In total, Dai Tu had 20 VietGAP

groups, the largest number of VietGAP groups in Thai Nguyen. It was also evident from our survey that most of tea farmers are aware of the VietGAP certification, potentially because of the training programs implemented by the local agricultural extension agencies. Given the high exposure of local farmers to VietGAP, the district offers an ideal study site to investigate farmers' preferences for the certification programs.

3 Methods

3.1 Sampling methods

This study is a part of a project with three following objectives: (i) to evaluate the impacts of information provision and subsidy on farmers' adoption of organic fertilizer by a randomized control trial (RCT), (ii) to elicit farmers' preferences for the design of VietGAP certification programs by an RCA, (iii) to evaluate the socio-economic impacts of VietGAP on small-scale farmers. The RCA was conducted in a sub-sample of the project's full sample.

Data collection of the whole project followed a two-step procedure, village sampling and household sampling, to obtain data of 1287 tea-farming households. In the first step, nine communes were selected in Dai Tu district which had newly established VietGAP groups in December 2017[3]. In each commune, we chose all villages with active VietGAP groups and their neighboring villages without active VietGAP groups [4]. In total, 30 villages were selected: four for a pilot survey and 26 for our main survey.

In the second step, tea-farming households were randomly selected using villager lists and VietGAP member lists provided by local officers. In each village, the survey team visited 45 households during the main survey and 36 households during the pilot

[3]The purpose of this commune selection was to collect farm information before the intervention, which was fundamental for the third objective of the project. We initially chose 10 communes, but only obtained permission to conduct the project in nine communes (namely, Binh Thuan, Tien Hoi, Khoi Ky, Phu Xuyen, Van Yen, My Yen, Phu Cuong, Hoang Nong, and La Bang).

[4]In Hoang Nong Commune, we conducted the project only in villages with VietGAP tea groups following a request from the local government.

survey[5]. In villages with an active VietGAP group (hereafter, VietGAP villages), the survey included all VietGAP members group due to their relatively small numbers. The remaining households, if any, were randomly selected from the VietGAP non-members. In villages without any active VietGAP groups (hereafter non-VietGAP villages), 45 tea-farming households were selected.

Based on the list of 1287 households for the whole project, we further selected a sub-sample of 750 households to conduct the RCA[6]. Due to the small number of the VietGAP members, compared to the non-members, we prioritized the sampling of the former whenever possible. In detail, in VietGAP village, we randomly chose 35 VietGAP members from the member lists if possible. If the certified group size was less than or equal to 35, all members joint the RCA. Further, we selected around 40 percent of the VietGAP non-members on the project list in both VietGAP and non-VietGAP villages. As a result, we chose 750 households for the RCA, including 301 VietGAP members and 449 non-members.

All selected households, regardless of their participation in the RCA, were home-visited by our investigators[7]. The household representatives must be family members who regularly made main decisions regarding tea farm production. If the household representatives were not available during the visiting day, alternative households, which were prepared in advance on the list, was selected as substitutes[8].

[5]The number of sampled households in each village was not always as planned due to the availability of the selected households or the insufficient number of tea farming households.

[6]We did not conduct the conjoint experiment on the whole project sample because of our resource constraints. One important constraint was that in each village the survey must be finished within one day. This was to prevent information spillover, a requirement of the RCT.

[7]12 investigators who were students and staff in the Thai Nguyen University of Agriculture and Forestry got engaged in the survey. In a two-day training, they were carefully instructed about how to carry out the RCT, the RCA and the household survey using smartphone-based questionnaires. Before the main survey, a pilot survey was conducted in 4 villages when the investigators were practically trained. The investigators were always divided into two teams of six. The two teams operated in two neighboring villages simultaneously on a working day.

[8]The lists of alternative households included non-selected households in the village were sorted randomly.

3.2 Randomized conjoint analysis

3.2.1 Selection of design attributes

A certification scheme is a package of requirements and benefits. Changes in those attributes might significantly improve (or hinder) the uptake of the program. We select five attributes of the certification program and tested their impacts on the participation of the small-scale tea farmers. Table 1 shows a list of the chosen attributes and their definitions. The levels of each attribute are demonstrated in Table 2, where Level 1 – the baseline level – corresponds to the status quo of the current VietGAP program in the study sites. This section justifies our choice of the five attributes.

The first attribute is *certification fee*. Payments from the farmers are necessary to cover a third-party's costs such as initial farm inspection, training, and monitoring. An increase in the fee, obviously, reduces the outreach of the scheme. However, very few studies investigated the sensitivity of small farmers to this very tangible cost. Such negligence could be because the certification fee is heavily subsidized by NGOs or governments in many cases. The certification costs of the active VietGAP groups in the study sites were also fully supported by the local government. Nonetheless, it is still crucial to examine how farmers react to different fee levels to design better subsidy and fee-sharing programs.

The second attribute is a requirement of *record keeping*. Documentation of used inputs, harvests and sales is a foundation for traceability of the certified products, which in turn might improve consumers' trust in the labels. Farmers may also believe that record-keeping is conducive to the effective management of their production. Meemken et al. (2017) indeed found a positive effect of record-keeping on the participation rate. However, keeping a sufficient and credible record is notoriously challenging, even for highly educated farmers. Hence, the impact of this attribute remains ambiguous.

The next three are hypothetical attributes related to organic fertilizer. Soil degradation due to the overuse of chemical fertilizer is prevalent in tea and other crops farming in Vietnam (Nguyen, 2017). A combination of organic fertilizer with the chemical one is recommended to mitigate the environmental damage caused by the

latter and sustain soil fertility (Duan et al., 2016; Ji et al., 2018). Sustainability certification scheme has a potential role to play in escalating the proper utilization of fertilizer[9]. Hence, we additionally include new hypothetical attributes related to the application and purchase of organic fertilizer. The first is a requirement of *organic fertilizer application*. We specified three levels as shown in Table 2. The second level is a usual recommendation from producers of organic fertilizer, while the third one is an extreme case where farmers can only use organic fertilizers for tea farming. The other two are benefits that farmers can obtain when purchasing organic fertilizers from their certification group, namely *free shipping* and *delayed payment*. Although those services are rarely provided in reality, there are rooms for the incorporation. Certification always relies on the establishment of farmer organizations (FOs). Hence, in addition to quality assurance, the FOs can introduce services related input purchases to make the best use of their collective action (Poulton et al., 2010). We expect that those new services attract more farmers into the certification program.

Lastly, although it is not included in Table 1 and 2, we also test the impact of price premium on farmers' participation. The price premium is the most tangible benefit for farmers to join a certification program. Hence, the elasticity of farmers to premium levels is often examined in literature (Meemken et al., 2017; Ochieng et al., 2017). We specified five levels of premium per one kilogram of certified dried tea: 0 VND; 5,000 VND; 10,000 VND; 20,000 VND; and 40,000 VND. Those levels are decided based on the results of the previous studies about the impacts of the certification on tea selling price. It is noteworthy that the premium levels were not randomized at choice task level but at the respondent level. The premium levels were assigned randomly to respondents joining the choice experiment and were fixed across all choice tasks of a respondent. As such, the price premium could be regarded a scenario treatment for the choice experiment[10].

[9]International certification schemes, such as GlobalGAP and UTZ, have stringent guidelines for the application of fertilizers. In its official document, VietGAP also recommends farmers to limit the use of chemical fertilizer while increase using organic fertilizer.

[10]Certification fees and price premiums are both pecuniary attributes. If both of them are randomly assigned at the choice task level, the respondents might get confused easily. Therefore, we randomized the levels of the certification fee at the choice task level, while the levels of the price premium were randomized at the household level and remained unchanged

3.2.2 Experiment procedure

Households joining in the randomized conjoint experiment followed a three-step procedure:

(1) an RCT on household purchase of organic fertilizer,

(2) an RCA on preferences for hypothetical VietGAP scheme,

(3) a questionnaire-based interview for information on household tea production and other income sources in 2017.

Elaboration of the RCT is skipped because it is out of the scope of this study. In brief, households were assigned randomly to three groups: a control group, an information treatment group and a subsidy group. The outcome of interest is the respondents' immediate decision on purchasing an organic fertilizer product offered by the project. After this decision-making, they continued to the randomized conjoint experiment.

This study constructed a scenario where one household decided whether to join hypothetical VietGAP programs. First, to maintain the respondent's full understanding of VietGAP, the investigators briefly introduced the purpose and main requirements of VietGAP[11]. The respondent was then asked: *"If there are hypothetical VietGAP programs with the following features, we would like to know whether your household wants to join the programs or not"*. The choice tasks, as an example is shown in Figure 1, were then presented to the respondent.

Each choice task contained 3 alternatives: A and B were to join hypothetical VietGAP programs with corresponding attributes, while C meant not to join the program. The investigators explained thoroughly the meaning of each attribute in the alternatives A and B. Importantly, hypothetical levels of the price premium for participation in VietGAP programs were introduced. If the respondent chose either A

across all choice tasks of a household. Before each choice task, the investigators were required to mention the price premium again.

[11] In all selected communes, there were active VietGAP groups, and VietGAP training was also conducted by local officers. Hence, the respondents usually had a decent knowledge of the program. Before the introduction, the investigators confirmed whether a household was a member of any VietGAP group. The non-members were given a more detailed introduction of the program.

or B, their certified tea would be purchased at the market unit price of the non-certified tea plus the premium.

In every choice task, the levels of the five attributes in alternative A and B were fully randomized following Hainmueller et al. (2014). The order of the attributes was also randomized by households to eliminate any ordering effects. However, for one household, the level of the price premium was fixed across all choice tasks.

After confirming the respondent's complete understanding of the scenario, the investigators asked him/her to rank the three options. The investigators first asked the respondent to name the alternative s/he liked the most, which is numbered 1. After that, among the rest two options, the respondent was asked to choose which s/he preferred, numbered 2. The rest option was numbered 3. Each respondent repeated the choice task five times.

3.3 Estimation of causal impacts

We adopt a framework proposed by Hainmueller et al. (2014) to estimate causal the impacts of the attributes on farmers' decisions. The causal quantity estimated from the new RCA design is the average marginal component effect (AMCE). AMCE of an attribute level measures the marginal impact of that attribute level, compared to a baseline level of the attribute, on choice probability of a hypothetical alternative. In this section, we use notations from Hainmueller et al. (2014) to demonstrate how AMCE is estimated.

Consider a scenario where each respondent i in a sample of N completes K choice tasks. In each choice task $k^{th} \in K$, respondent i choose from or ranks J hypothetical alternatives. A hypothetical alternative (a profile) consists of L attributes, and attribute l has D_l levels. The alternative faced by respondent i in alternative j^{th} of k^{th} choice task is denoted as T_{ijk}, and T_{ijkl} represent l^{th} attribute of the alternative. Y_{ijk} denotes choice outcome of respondent i for alternative j^{th} of choice task k^{th}

The AMCE is estimated based on two assumptions. The first assumption is no effects of the round of choice tasks and the order of alternatives on choice outcomes[12].

[12]Under this assumption, Y_{ijk} and T_{ijkl} can be simply referred as Y_{ij} and T_{ijl}

The second is full randomization. Under these two assumptions, AMCE of a change in the level of attribute l from t_0 to t_1 is defined by the following equation

$$\hat{\bar{\pi}}(t_1, t_0) = \bar{Y}_{ij|T_{ijl}=t_1} - \bar{Y}_{ij|T_{ijl}=t_0} \tag{1}$$

where $\bar{Y}_{ij|T_{ijk}=t_1}$ and $\bar{Y}_{ij|T_{ijk}=t_0}$ are the conditional average of observed choice outcomes.

Nonparametric estimators of the AMCE of attribute levels can be obtained by linearly regressing observed outcome Y_{ij} on dummy variables for the levels of T_{ijl}. The linear regression model is as follows:

$$Y_{ij} = \beta_0 + \sum_{l=1}^{L} \sum_{d=1}^{D_l - 1} \beta_{ld} W_{ijl} + u \tag{2}$$

where W_{ijl} is the vectors of $D_l - 1$ dummy variables for the levels of T_{ijl} excluding the one for $T_{ijl} = t_0$. β_{ld} is the AMCE estimator of a change in attribute l from t_0 to t_d. A robust standard error of the AMCE, also estimated from the regression model, is clustered at the respondent level to correct for correlations between choice outcome within one respondent. Since the two assumptions of the new RCA design can be easily satisfied, this method offers a powerful tool to study the causal impacts of design attributes on choice probability[13].

Because there are three alternatives in total in each choice task, there are two choice results. In external choice, the choice outcome takes on the value 1 ($Y_{ijk} = 1$) if a hypothetical VietGAP program (alternative A or B) is preferred to no-participation (alternative C), and 0 otherwise. In internal choice, $Y_{ijk} = 1$ if a hypothetical VietGAP program is preferred to the other VietGAP alternative in the same choice task, and 0 otherwise. Since the main objective is to examine how the design attributes affect the participation in VietGAP programs, this section only reports results of external choice. Results for internal choice are shown in Figure A.1 in the Appendix.

In addition to design attributes, this study also estimates the impacts of the price

[13] Many recent studies have applied this method to measure the causal effects of program attributes in different contexts (e.g., Gampfer et al., 2014; Hninn et al., 2017; Sydavong et al., 2019).

premium on the choice outcome. Because the levels of the price premium is a random scenario for all choice tasks, their impact on the choice probability of VietGAP can be estimated by a similar linear regression. Standard errors of these estimators are also clustered by respondents as the premium levels are randomly assigned at the respondent level. We then compare the impacts of price premium and that of the certification fee.

Finally, we estimate conditional AMCEs see heterogeneity in the impacts of the attributes. In detail, we first estimate AMCEs conditional of VietGAP membership. VietGAP members and non-members are different in their experience of the certification program as well as other background characteristics. Hence, it is compelling to investigate if there are differences in the preferences between the two groups. Further, because the RCA was conducted after the RCT in the first step, one may concern that AMCEs estimators are affected by the treatments of the RCT. The two treatments, i.e., information provision and subsidy, are designed to support the trial purchase of an organic fertilizer product. Therefore, they might affect treated farmers' preferences of attributes related to organic fertilizer. We estimate AMCEs conditional on RCT treatments to investigate such interactions.

4 Results

4.1 Descriptive statistics

Of 750 household representatives participated in the RCA, five did not completed all the choice tasks. These five are excluded from our analysis, leaving a final sample of 745 households.

Table 3 indicates mean comparisons in household characteristics between the collected sample of this study and that of Tran and Goto (2019) – a study conducted in four tea-producing centers of Thai Nguyen province. First, there are some statistically significant differences in demographic variables. Households in the new sample have a slightly smaller size and are less likely to be female-headed. Differences in the education level of household head and market distance are only marginally significant.

Second, landholdings are very similar between the two samples, while asset holdings reveal considerable differences. Households in the recent data are worse off regarding all indicators of asset holdings, including motorbike ratio, computer dummy, and car dummy. This is reasonable since Dai Tu is an economically disadvantaged district in Thai Nguyen province.

Due to the above differences, the sample might not well represent the population of smallholder tea farmers in Thai Nguyen province but are more specific to tea farmers in Dai Tu district.

4.2 AMCEs of the design attributes

Results of AMCEs for the external choice analyses are illustrated in Figure 2[14]. Specifically, the certification fee has a strong and negative effect on VietGAP participation. An increase in the fee from zero to 1 million/ ha reduces joining likelihood by nearly 7 percentage points on average ($p < 0.01$). From that level, every doubling of the fee additionally leads to an average drop of around 6 percentage points in the choice probability of the VietGAP program ($p < 0.01$). Removal of mandatory record-keeping has an insignificant impact on joining VietGAP, which indicates record keeping does not necessarily prevent smallholder farmers from producing certified products

In addition, attributes related to organic fertilizer reveal statistically significant effects on VietGAP choice. Although harvest-based application combined with chemical fertilizer does not lead to any significant changes in the external choice, it has a marginally positive impact of about 2.5 percentage points in the internal choice ($p < 0.1$). By contrast, the extreme requirement of only using organic fertilizer for tea farming strongly reduces the choice likelihood of VietGAP by 15 percentage points or so ($p < 0.01$). Moreover, free shipping for organic fertilizer purchased through VietGAP groups does not significantly make VietGAP more attractive than the opt-out. Whereas, delayed payment options do have a positive impact of around 3.5 percentage points ($p < 0.05$).

Figure 3 demonstrates a comparison between the impact of the certification fee

[14]Values of estimated coefficients are shown in table A.1 in the Appendix

and that of the price premium on external choice. The average productivity of tea farmers in the sample is approximately 1.8 dried ton/ha/year[15]. Therefore, a minimum premium of 5,000 VND/ dried kg would be more than enough to cover a fee of 8 Million/ ha over a 2-year period of the certificate. However, insignificant impacts of the price premium levels can be seen from the figure. Only when the premium rises to 40,000 VND/ dried kg that it has a positive impact of about 8 percentage points ($p < 0.05$). Meanwhile, as explained above, farmers' choice of VietGAP is highly sensitive to increases in VietGAP fee. A fee level of 8 Million VND/ha reduces participation probability by nearly 26 percent ($p < 0.01$). Thus, the results highlight a considerable gap between the impacts of the two pecuniary attributes.

4.3 Conditional AMCEs

External AMCEs of the certification attributes conditional on VietGAP membership are indicated in Figure 4. Overall, the impacts are almost similar between the two groups. The only significant difference is in the impact of delayed payment for organic fertilizer purchased through VietGAP group. For the current VietGAP members, impacts of 30-day and 60-day delays are close to zero. Meanwhile, for the nonmembers, both levels show positive impacts of 6 and 5 percentage points respectively. We also ran a regression model incorporating interaction terms between levels of delayed payment and VietGAP membership to confirm the statistical significance of the differences. The results of the regression model are shown in Table A.2 in the Appendix.

Lastly, Figure 5 describes AMCEs conditional on RCT treatment status for external choice. The requirement of applying organic fertilizer is the attribute which shows significant interactions with the RCT treatments. The direction of the interaction effects, however, contradicts our expectation. Since RCT treatments increase the order of the organic fertilizers[16], We anticipated them to have positive interactions with the VietGAP requirement of applying organic fertilizer. Nonetheless, while harvest-

[15]This is roughly equivalent to fresh productivity of 9 ton/ha since it usually takes 5 kg of fresh tea to produce 1 kg of dried one.

[16]We confirmed the positive impacts of both RCT treatments on the order probability and order amount of the organic fertilizer using statistical tests and regression models.

based application increases the choice of VietGAP by about 7 percentage points in the control group, its positive impact significantly diminishes and becomes indifferent from zero in both subsidy and information treatment groups. Likewise, compared to the control group, sole application organic of fertilizer has a more negative impact on VietGAP participation in the two treatment groups[17].

5 Discussion

The results show significant impacts of the selected attributes on VietGAP participation. This section discusses the interpretation of the estimated results and justifies their relative magnitudes.

It can be easily recognized that the certification fee is the most influential factor. This finding partially helps explain a very high dropout rate of certified members once the local government ceases subsidy for the VietGAP fee. Although there were no available statistics at either provincial or national level, during the survey, few VietGAP groups renewed their license after the end of their subsidized period. The large gap in the impacts between the certification fee and the price premium further emphasizes the problem. Farmers usually have to pay for the fee at the beginning of the certification process. Even the hypothetical profit gain from the premium can fully cover the initial payment, it generally cannot compensate for the negative impacts of the former. Strict budget constraints and heavily discounted future benefits of small farmers are possible interpretations. Another reason might come from farmers' skepticism about a guaranteed premium that did not exist in reality.

In addition, there is potential to incorporate attributes related to organic fertilizer in VietGAP scheme. While an extreme requirement of using only organic fertilizer is obviously not acceptable, a harvest-based application combined with chemical fertilizers may not deprive the participation. The latter even shows positive effects in some analyses. It is understandable since many respondents had partly realized the damages

[17]Significant and negative coefficients of the interaction terms with harvest-based application, shown in Table A.3 in the Appendix , are found for both subsidy treatment ($p < 0.05$) and information treatment ($p < 0.1$) The negative interaction term between only-organic-fertilizer and information treatment is also statically significant ($p < 0.01$).

of overusing synthetic fertilizers by the time of the survey. Supplementation of organic fertilizer was also widely recommended. VietGAP, with a principal goal of achieving sustainable agriculture, can provide a systematic motivation for the combined application of fertilizers. Moreover, higher participation can be achieved through benefits related to group purchase of organic fertilizer. Delayed payment tends to have more consistent positive effects than free shipping. Due to significant improvement in road systems and fertilizer outlets, shipping fee might not constitute a significant part of the fertilizer price. However, rescheduled payment is reasonably preferred by farmers with restricted budgets.

Finally, this section explores the reasons behind the heterogeneity in the estimation of the AMCEs. Compared to the nonmembers, VietGAP members only differ significantly in their preference for delayed payment for organic fertilizers. However, such a difference could not be solely attributed to the membership itself. Because the VietGAP participation is self-selected by a household, there are various confounders of the membership status[18]. For example, the negative interactions are possibly due to the better wealth status of the members.

In contrast, the RCT treatments are completely randomized, so causal interpretation is plausible. Findings from marketing studies could explain the unexpected negative interactions between the RCT treatments and the hypothetical requirement of applying organic fertilizers. Accordingly, although both information and subsidy treatments successfully encouraged the trial purchase of organic fertilizer, their promotional effects on choice of VietGAP scheme with mandatory application of organic fertilizer subject to unfavorable conditions. In particular, a regular application of organic fertilizer in a 2-year period of VietGAP is a strict requirement for farmers, and there is no certainty about its efficiency. Promotions on a feature for which consumers have an uncertain preference can hurt the choice probability of a product (Simonson et al., 1994). Similarly, Darke and Chung (2005) argued a negative perception of the product caused by price promotion when its quality is not assured. Moreover, the

[18]Using the current sample, we ran t-tests to examine differences in background characteristics between the VietGAP members and the non-members. We found significant differences in demographics, land holdings and asset holdings between the two groups.

procedure of the experiments might have probabilized negative interactions. Immediately after receiving the treatments and making a decision on trial purchase, the respondents were asked to choose VietGAP plans with the potential obligation of using organic fertilizer. This might unexpectedly provoke a misunderstanding among the treated groups that the investigators strategically enforced them to buy the organic fertilizer in the long-term. As a result, they avoided VietGAP plans with organic fertilizer application required.

6 Conclusions

To conclude, this study investigates smallholder farmers' preferences of a certification program. A randomized conjoint experiment was conducted on 745 small-scale green tea farmers in Thai Nguyen, Vietnam. The experiment requires farmers to decide whether to participate in hypothetical VietGAP programs for tea production. Attributes were randomly assigned to each option (profile), consisting of *certification fee, record keeping, application of organic fertilizer, free shipping for organic fertilizer, and delayed payment for organic fertilizer. Price premiums* of the certification scheme were randomly assigned at the household level. The study shows two important findings. First, the certification fee has a very strong negative impact on participation decisions. Second, harvest-based application of organic fertilizer does not reduce the participation probability, while delayed payment for organic fertilizer can slightly enhance participation.

The findings of this study could give policy-makers and certification entities insightful implications for the design of certification schemes for groups of small-scale farmers in general.

From the second findings, certification entities could possibly include supplementation of organic fertilizer in the scheme with payment benefits for the members. Combined application of organic and synthetic fertilizer, a sustainable farming practice, can be incorporated into the protocol for certified production. As it is required in well-known international standards, such as GlobalGAP, fertilizer application must

be based on soil conditions and in consultation with experts. Therefore, certification bodies may collaborate with agricultural experts to prescribe a proper mixture ratio of organic and non-organic fertilizers based on local soil conditions, before requiring compliance from the farmers. At the same time, delayed payment for group purchase of organic fertilizers can be introduced by certification parties. Agreements on input purchase with input suppliers are one of the plausible services offered farmer groups (Poulton et al., 2010). Such collective purchase of agricultural inputs was emerging in the study sites, where government bodies acted as a facilitator for the connection between farmer groups and input providers. Certification parties also have the capacity to substitute the governments' role in such multilateral agreements.

However, based on the first findings, policies dealing with certification fees are crucially important. The large initial fee could heavily prevent small farmers from joining the certification programs which, although, might improve selling prices and farm income later. Low demand caused by large initial costs is also seen for other agricultural services such as crop insurance (Casaburi and Willis, 2018). To reduce the cost burden, a prevalent approach is subsidies from governments or NGOs. Nonetheless, this could make a sustainability certification program itself become unsustainable and distort the production of certified commodities. Other sustainable solutions to the problem caused by the certification fee are highly necessary. Agreements on the sharing of certification fees with wholesale buyers or a combination of public and private financing of certification are also promising alternatives (OECD, 2018). In addition, based on the findings of a positive impact of delayed payment for the purchase of organic fertilizer, the same implication could be applied for the certification fee. For instance, rescheduled payment of certification fee, such as monthly or annual installment payment, could reduce the financial burden effectively for the participants.

One major shortcoming of this study is the validity of farmers' stated preference. There are a range of causes for the biased choice in the survey, such as hypothetical bias, social desirability bias, and other cognitive bias (Krosnick and Judd, 2014; Schwarz, 1999). As such, their stated preference in the survey might differ from the revealed preference when they make the actual choice in reality. However, the recent

work of Hainmueller et al. (2015) demonstrated that conjoint analyses have the possibility to reflect real-world behavior. This study also followed their recommendation in using paired conjoint design to maintain the credibility of the stated choice. The study sites – 9 communes in Dai Tu district – also have favorable conditions for the conjoint experiment due to the high familiarity of farmers with VietGAP program. Therefore, the reliability of the stated preference could not be a severe issue of the experimental results.

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Appendix

Table A.1

Table A.2

Table A.3

Figure A.1

Figure A.2

References

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No.	Attributes	Explanation
1	Certification fee	Fee for a two-year certification period (VND/Sao or VND/ha)
2	Record keeping	Whether keeping record of purchasing and using input materials, harvest and sales is mandatory or not
3	Application of organic fertilizer	A requirement for applying bio-compost on tea farm
4	Free shipping for organic fertilizer	Whether household have free shipping of bio-compost or not for their VietGAP group purchase
5	Delayed payment for organic fertilizer	How many days household can delay payment of bio-compost for their VietGAP group purchase

Table 1: Definitions of selected attributes

No.	Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
1	Certification fee	0	VND 36,000 /Sao (VND 1 Mil./Ha)	VND 72,000 /Sao (VND 2 Mil./Ha)	VND 144,000 /Sao (VND 4 Mil./Ha)	VND 288,000 /Sao (VND 8 Mil./Ha)
2	Record keeping	Mandatory	No			
3	Application of organic fertilizer	Not mandatory	Harvest-based with chemical fertilizers combinable	Only organic fertilizer allowed		
4	Free shipping for organic fertilizer	No	Yes			
5	Delayed payment for organic fertilizer	No	30 days	60 days		

Table 2: Levels of selected attributes

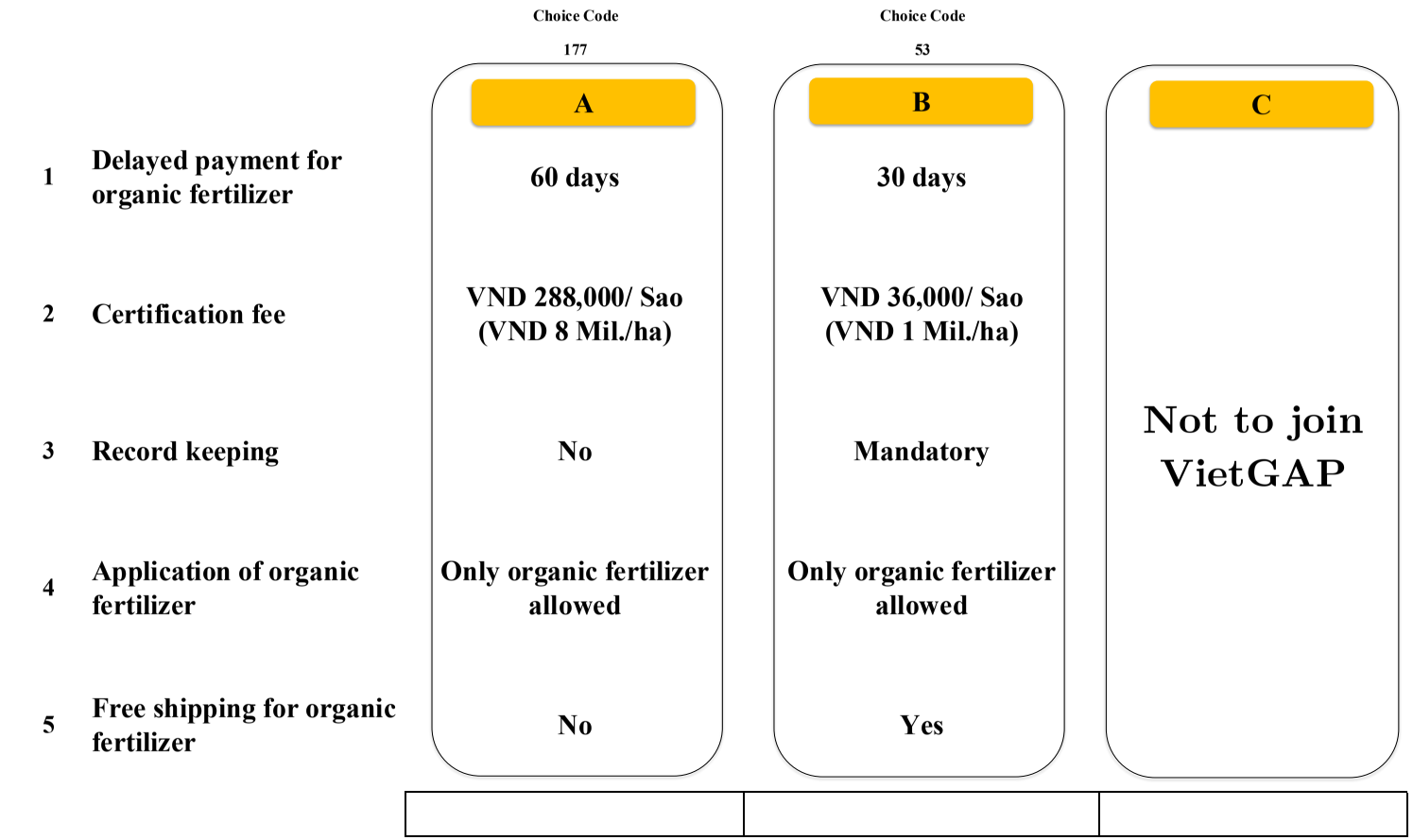

Figure 1: An example of a choice task

Variable	Survey 2018 (n = 745)		Survey 2017 (n = 476)		Mean diference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Subsidy dummy	0.34	0.48				
Information dummy	0.34	0.48				
Current VietGAP member dummy	0.40	0.49				
Age of the respondent	47.03	10.74				
Education level of the respondent (years)	7.52	2.32				
Female respondent dummy	0.49	0.50				
Head dummy	0.56	0.50				
Distance to the nearest market (km)	1.89	1.20	2.02	1.27	-0.13*	0.07
Family size	3.84	1.37	4.06	1.30	-0.22***	0.08
Age of the household head	49.99	10.90	49.07	11.00	0.93	0.64
Education level of the household head (years)	7.18	2.36	7.42	2.46	-0.24*	0.14
Female-headed dummy	0.12	0.33	0.19	0.39	-0.06***	0.02
Annual cropland holding (ha)	0.09	0.10	0.09	0.10	-0.01	0.01
Perennial cropland holding (ha)	0.35	0.27	0.36	0.25	0.00	0.02
Tea farm size (ha)	0.33	0.24	0.34	0.23	-0.01	0.01
Motorbike ratio	0.51	0.30	0.55	0.27	-0.05***	0.02
Computer dummy	0.10	0.30	0.28	0.45	-0.18***	0.02
Car dummy	0.03	0.17	0.05	0.22	-0.02***	0.01

** 10% significant level, ** 5% significant level, *** 1% significant level*

Table 3: Mean difference in household characteristics of the two samples

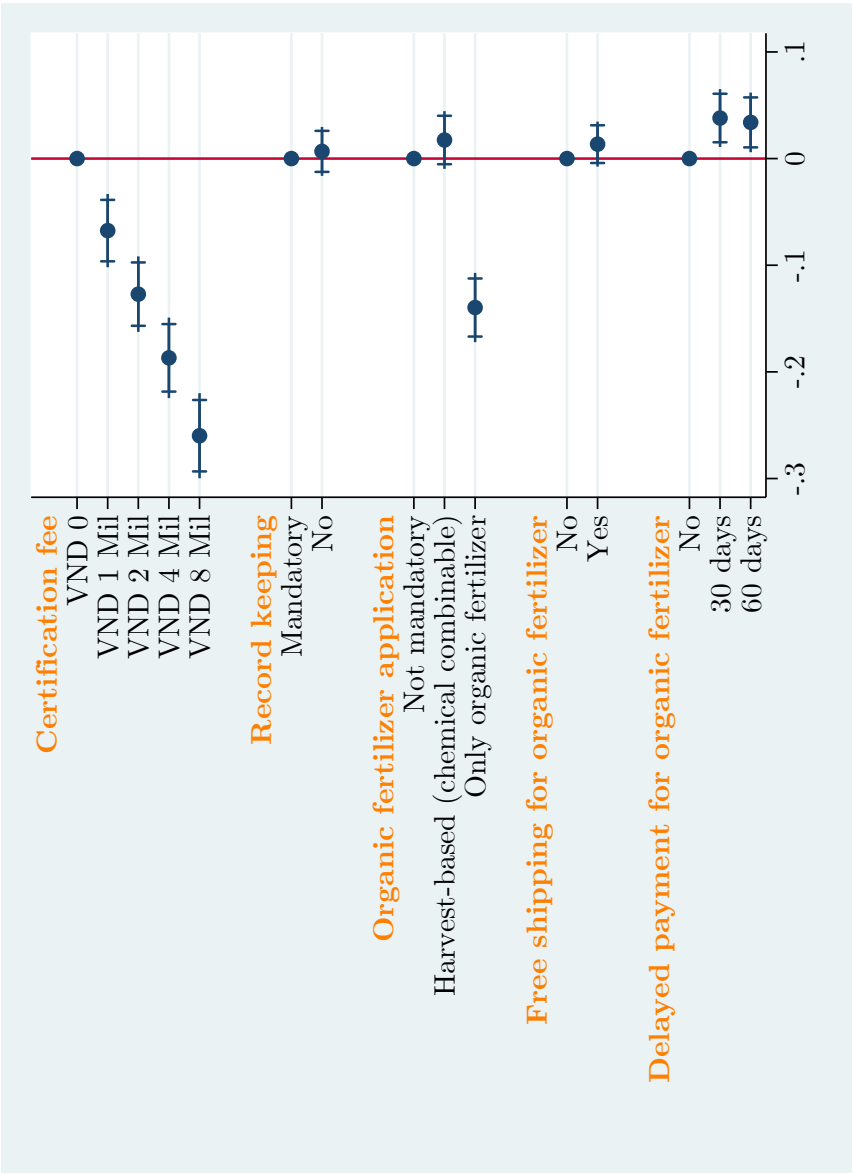

Figure 2: AMCEs for external choice

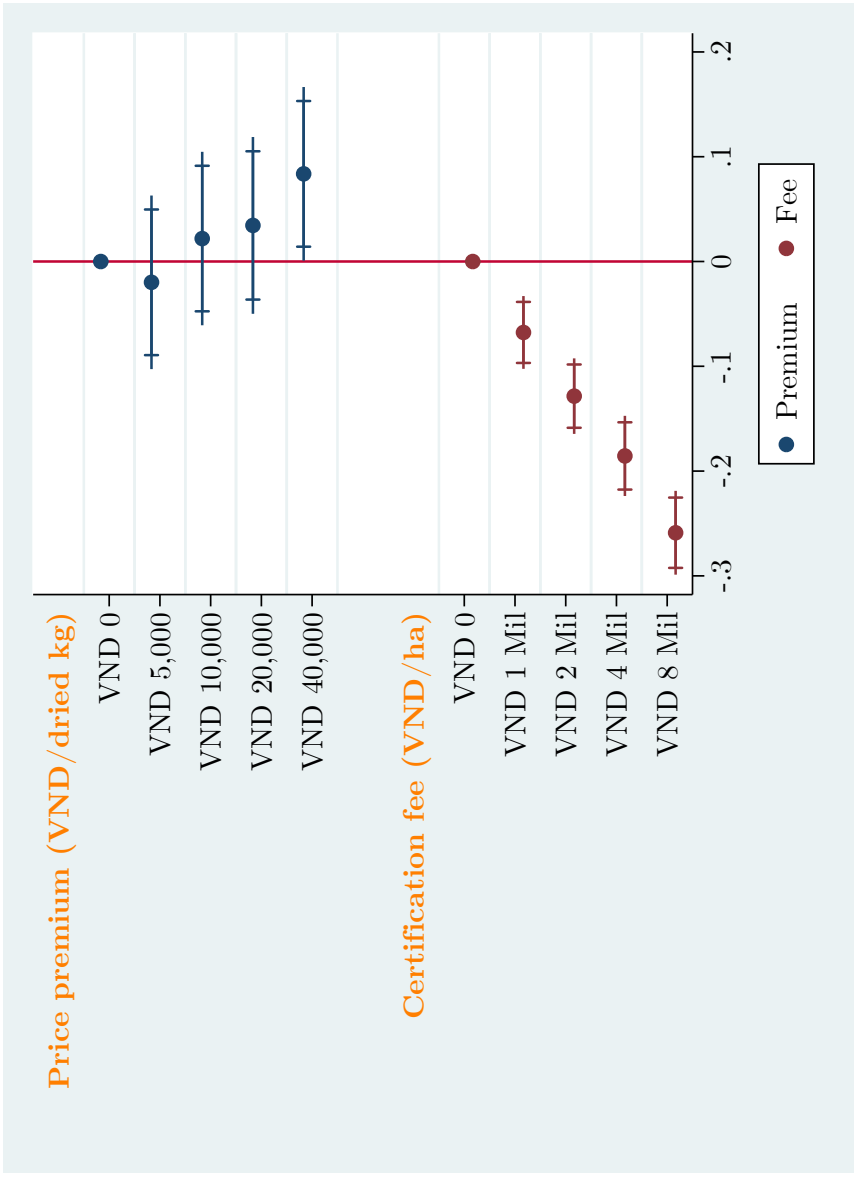

Figure 3: External AMCEs: Price premium vs. Certification fee

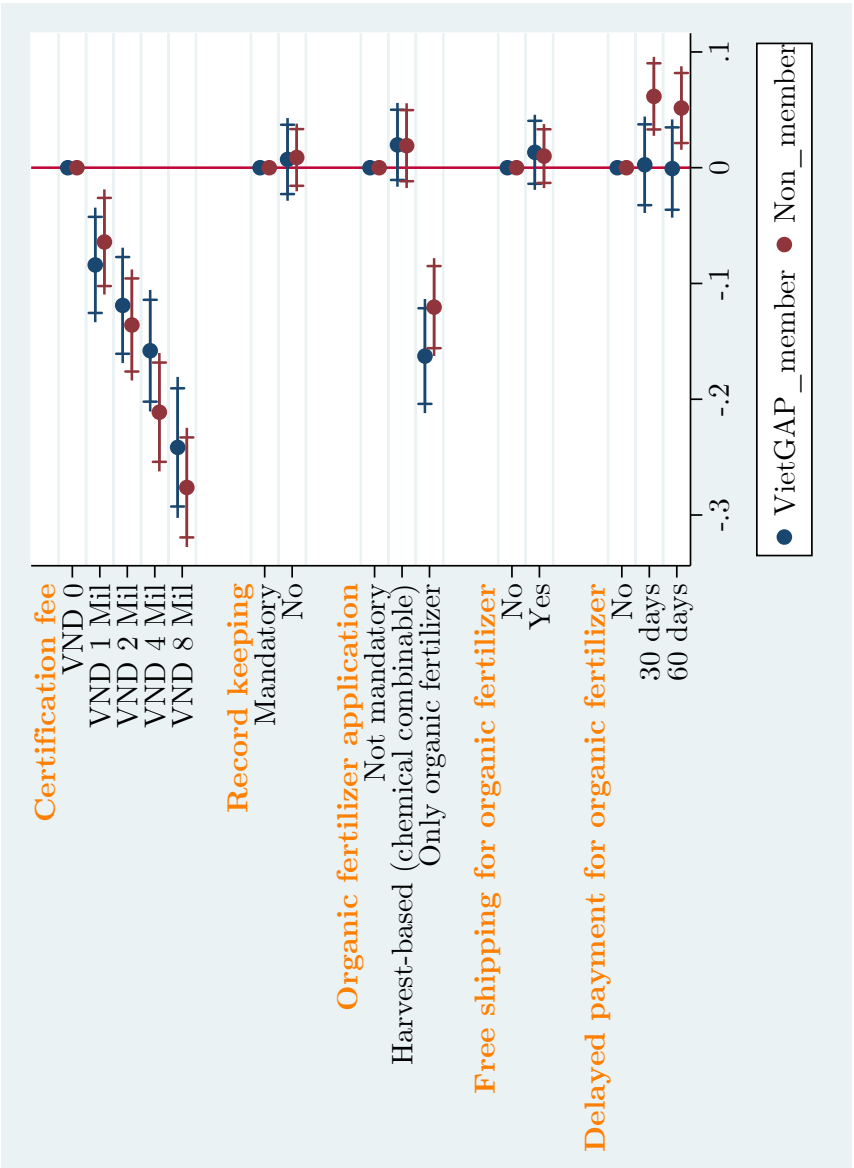

Figure 4: Conditional AMCEs on VietGAP membership

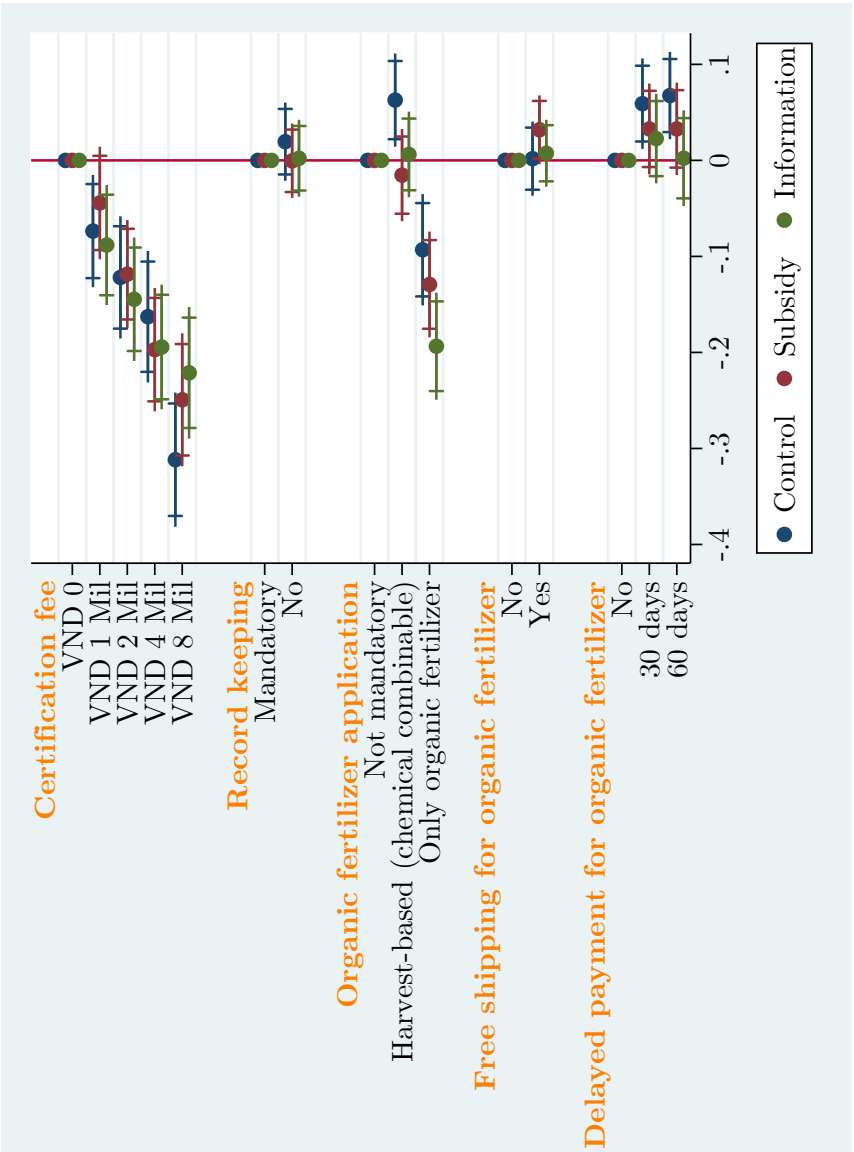

Figure 5: Conditional AMCEs on RCT treatments

	Coef.	S.E
Certification fee		
VND 1 Mil	-0.07***	0.02
VND 2 Mil	-0.13***	0.02
VND 4 Mil	-0.19***	0.02
VND 8 Mil	-0.26***	0.02
Record keeping		
No	0.01	0.01
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.02	0.01
Only organic fertilizer	-0.14***	0.02
Free shipping for organic fertilizer		
Yes	0.01	0.01
Delayed payment for organic fertilizer		
30 days	0.04***	0.01
60 days	0.03**	0.01
Constant	0.71	0.02
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

Table A.1: Regression coefficients of AMCEs for external choice

	Coef.	S.E.
VietGAP dummy		
yes	0.23***	0.04
Certification fee		
VND 1 Mil	-0.06***	0.02
VND 2 Mil	-0.14***	0.02
VND 4 Mil	-0.21***	0.03
VND 8 Mil	-0.28***	0.03
Certification fee # VietGAP dummy		
VND 1 Mil#yes	-0.02	0.03
VND 2 Mil#yes	0.02	0.04
VND 4 Mil#yes	0.05	0.04
VND 8 Mil#yes	0.03	0.04
Record keeping		
No	0.01	0.01
Record keeping # VietGAP dummy		
No#yes	0.00	0.02
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.02	0.02
Only organic fertilizer	-0.12***	0.02
Application of organic fertilizer # VietGAP dummy		
Harvest-based (chemical combinable)#yes	0.00	0.03
Only organic fertilizer#yes	-0.04	0.03
Free shipping		
Yes	0.01	0.01
Free shipping # VietGAP dummy		
Yes#yes	0.00	0.02
Delayed payment		
30 days	0.06***	0.02
60 days	0.05***	0.02
Delayed payment # VietGAP dummy		
30 days#yes	-0.06**	0.03
60 days#yes	-0.05*	0.03
Constant	0.62	0.03
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

Table A.2: Heterogenous effects by VietGAP membership

	Coef.	S.E.
RCT treatment		
Information	0.04	0.05
Subsidy	0.05	0.05
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.07***	0.02
Only organic fertilizer	-0.08***	0.03
Application of organic fertilizer # RCT treatments		
Information#Harvest-based (chemical combinable)	-0.09	0.04
Information#Only organic fertilizer	-0.05	0.04
Subsidy#Harvest-based (chemical combinable)	-0.06*	0.03
Subsidy#Only organic fertilizer	-0.11***	0.04
Free shipping		
Yes	0.00	0.02
Free shipping # RCT treatments		
Information#Yes	0.04	0.03
Subsidy#Yes	0.01	0.03
Delayed payment		
30 days	0.06**	0.02
60 days	0.07***	0.02
Delayed payment # RCT treatments		
Information#30 days	-0.03	0.03
Information#60 days	-0.03	0.03
Subsidy#30 days	-0.04	0.03
Subsidy#60 days	-0.07*	0.04
Constant	0.55	0.03
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

Table A.3: Heterogenous effects by RCT treatments

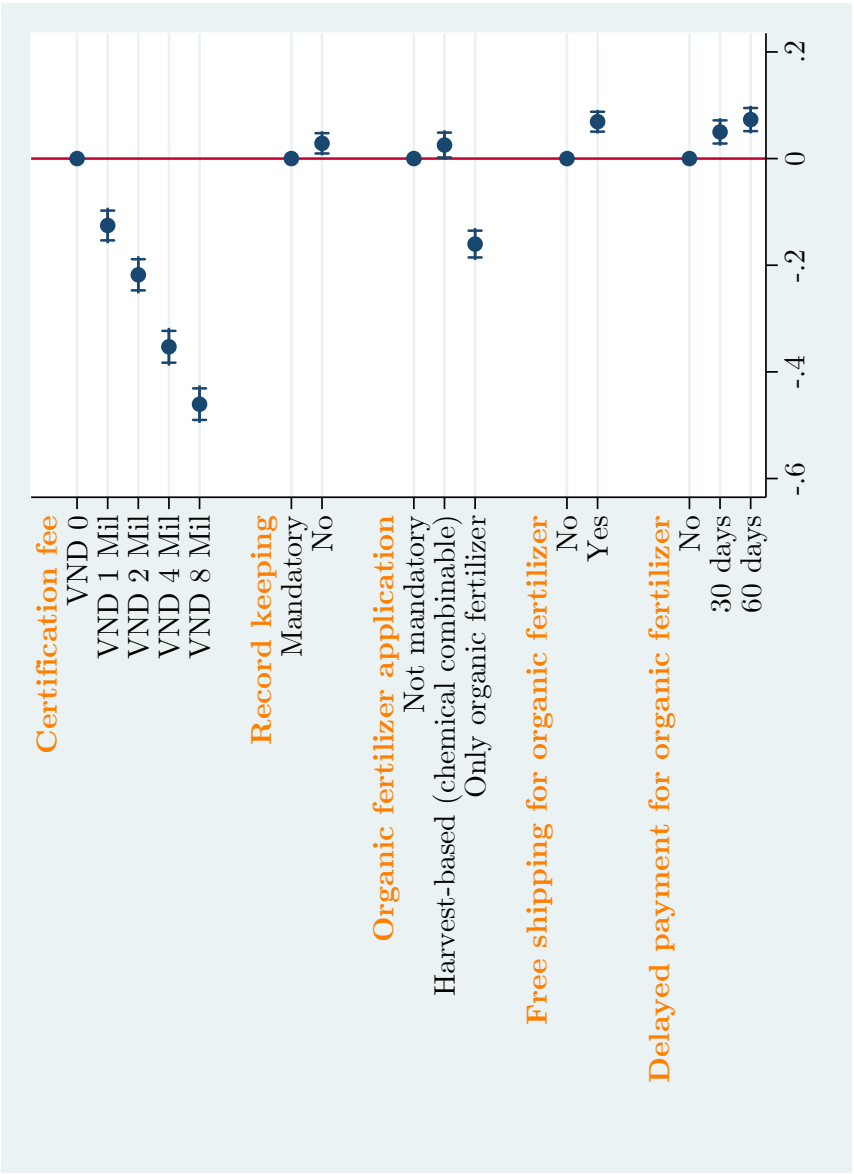

Figure A.1: AMCEs for internal choice

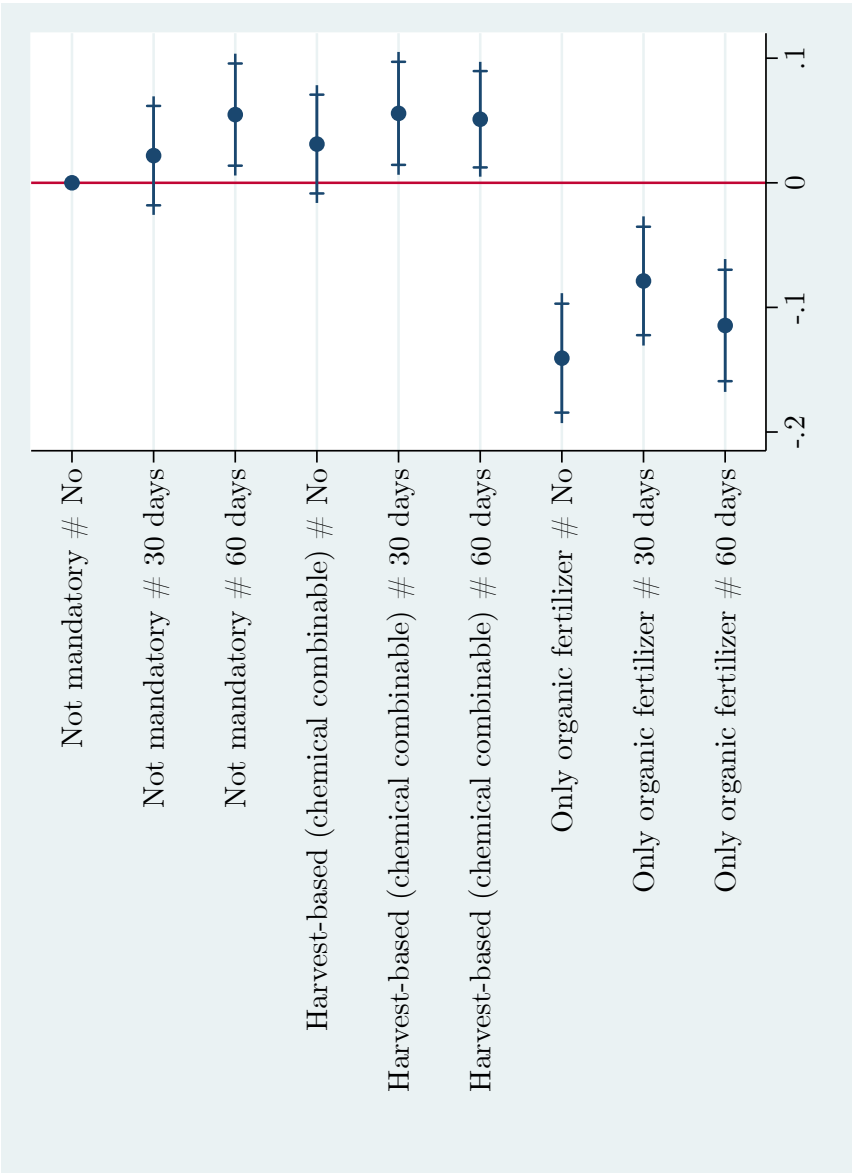

Figure A.2: Interactions between application of organic fertilizer and delayed payment