Economic impact of farmer-driven vertical integration: the case of safe vegetable chains in northern Vietnam

Huaiyu Wang, IRRI, DAPO Box 7777, Metro Manila 1301, Philippines; h.wang@irri.org

Paule Moustier, CIRAD, UMR MOISA, Montpellier, F-34398, France; moustier@cirad.fr

Nguyen Thi Tan Loc, VAAS-FAVRI, Hanoi, Vietnam; nguyen.thi.tan.loc@gmail.com

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Summary

The paper investigates the respective profitability of contractual arrangements, direct sales and spot marketing for "safe vegetable" farmers in northern Vietnam. It is based on a survey of 137 peri-urban vegetable farmers, with a minimum of 30 farmers in each category. Selection biases are corrected using propensity score matching methods. The results show that direct sales and contractual arrangements have a significant positive impact on income compared to spot marketing when selection biases are corrected. Contractual arrangements have less impact on income compared with the direct sales after correction of selection bias. This may be due to the still limited involvement of purchasers in the production process. The paper illustrates that direct relations between farmers and consumers, often described in literature as efficient in the development of consumer confidence in terms of quality, can indeed translate into higher income than anonymous exchange or sales under contractual arrangements with retailing companies. Some limitations of the research are given in the conclusion, along with policy recommendations.

Key words

Contracts, direct sales, vegetables, Vietnam.

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Introduction

It is increasingly acknowledged that access to high-value chains has a positive impact on farmer incomes and poverty alleviation (World Bank, 2008). Rising incomes and fast urbanization are driving up the demand for high-value produce, including fruit, vegetables and meat, as well as heightening consumer concern for food safety. This, combined with the liberalization of foreign direct investment, led to the mushrooming of supermarkets in developing countries starting in the mid-1980s in Latin America and then rapidly spreading to Asia and Africa in the 1990s (Reardon et al., 2003).

Like many countries of Southeast Asia, Vietnam is characterized by fast economic development and urban growth. The GDP growth rate was 8.5 percent in 2007 (7.5 for Laos and 4.8 for Thailand). In 2005, the urbanization rate was 26.4 percent, while the urban growth rate stood at 3.13 percent (Wup, 2009). Food safety and food freshness have become of primary importance to urban consumers, especially for vegetables, fruit and meat (Figuié et al., 2004). It is estimated that the value of the retail trade in USD grew at a rate of 10 percent per year for the period from 2001 to 2006, and that of modern trade at 20 percent per year in the same period. The share of supermarkets in retail food marketing is nevertheless still limited (around 14 percent) (USDA, 2009). Most foodstuffs are still sold in retail wet markets, both planned and spontaneous.

On the supply side, Vietnam is characterized by a dynamic agricultural sector which still faces structural constraints. Most vegetables available in Hanoi are produced in peri-urban zones where the limited size of land plots, generally under 500 m², and property speculation result in farmers using increased quantities of fertilizer and pesticides to maximize productivity per hectare. All farmers in Hanoi belong to cooperatives, which are mostly active in the area of infrastructure, e.g. irrigation, while some of them are involved in input and output marketing, as well as organization of trainings. In 1995, public interest in the safety of vegetable produce led the Vietnam Ministry of Agriculture to implement an ambitious program called "safe vegetables." The program educated farmers in the reasonable use of fertilizer and pesticides, based on IPM principles, as well as in the use of water from wells and non-polluted rivers. Similar programs were organized by NGOs.

Some cooperatives received support under such programs to get access to retailing points or to enter into contracts with distribution companies, canteens, schools, shops or supermarkets, and to have their vegetable output labeled as "safe," including indication of the place of production. All of these outlets charge premium prices for "safe vegetables," although these are highly inconsistent. Shops and market stalls may be run by intermediate traders or by farmer groups themselves. Supermarkets commonly sign contracts with safe vegetable groups or buy from distribution companies that contract out their supply to farmer groups. These contracts specify the frequency of delivery, quality requirements (including visual criteria and the provision of certification) and terms of payment (cash, 15 to 30 days after delivery). Safe vegetable production certificates are awarded by the Plant Protection Department of Hanoi municipality. In 2008, Hanoi had 27 cooperatives holding safe vegetable production certificates, accounting for around 2 percent of the Hanoi vegetable growing area (while the safe vegetable program covers approximately 20 per cent of the area).

Despite the growing demand for safe food, farmers frequently complain about the low profitability of vegetable production and the strong inconsistency of their income. Not all farmers are successful in finding traders offering to buy their vegetables at premium prices. In this paper, we address the following issue: What kind of vertical coordination is the most beneficial for farmers involved in quality efforts?

Changes in consumer demand and in the retailing sector are creating new market opportunities, but are also thrusting new challenges on small-scale farmers, as the new markets have special requirements in terms of quality and delivery deadlines. Contractual arrangements between farmers or farmer groups and buyers, and more generally vertical integration in the chain, have been documented as efficient ways to overcome these challenges and increase farmer incomes. Vertical integration involves the participation of one firm in two adjacent stages in the vertical marketing channel from producer to consumer, in terms of decisions and/or ownership (Carlton and Perloff, 1994). The role of vertical integration in reducing transaction costs was brought to the fore by Williamson (1987). Transaction costs means all indirect costs occurred in setting up, conducting and monitoring the transaction, i.e. the cost of searching out, selecting, agreeing to, implementing and enforcing contracts (North, 1990). Measurement costs of quality characteristics are specific types of transaction costs. The safety of food produce is a quality attribute that is especially difficult to observe and measure. The consequences of quality measurement constraints on the supply of low-quality produce (as good quality produce does not get a quality premium) and even disappearance of market transactions have been demonstrated by Akerlov (1970). Increased vertical integration is a response to a greater number of quality measurement errors (Barzel, 1982).

A typology of forms of coordination according to degree of vertical integration can be found in various papers on transaction costs economics, including Williamson (1987) and Jaffee (1993). At the two extremes lie market coordination and hierarchy (or the firm). Market coordination generally refers to coordination of the selling and purchasing operations through the fixing and publicizing of prices, i.e. price incentives. The firm is typically a centralized, hierarchical organization, which stands in contrast to classical market contracting. Hierarchy refers to the centralization of decisions, command-and-control approaches with coercive power translated into regulations. Hybrid forms are intermediary forms between markets and hierarchies, with some sharing in decision making between the two partners in the transaction. These include different types of contracts. A contract can be defined as a set of commitments on the conditions of transactions, e.g. prices, volumes, quantities, input provision. Vertical integration increases from spot markets and market reciprocity to contracts and hierarchy. Vertical integration reduces transaction costs, but, on the other hand, it increases governance costs, that is, the costs of ensuring that the arrangements are complied with.

Numerous empirical tests have been conducted showing that contractual arrangements reduce transaction costs. (See in particular Shelanski and Klein, 1995 for a review.) Further, in the last ten years, studies measuring the benefits of contractual arrangements for farmers have developed. A review of existing studies was recently made by Miyata and al. (2009), showing the positive impact of contracts on farmer incomes. Yet, most existing studies compare incomes of farmers with and without contracts, and do not provide for selection biases related to differences in characteristics (observable and unobservable) between farmers that enter into contracts and those who do not. These selection biases can be reduced by various econometric methods, including propensity score matching (PSM). (Rosenbaum and Rubin, 1983) This technique was used by Miyata et al. (2009) in their study of contracts for marketing apples and green onions in Shandong province, China. Their conclusion is that contract farmers earn more than their neighbors growing the same crops even after controlling for observable and

unobservable characteristics. Another rigorous evaluation (based on PSM techniques) of the economic impact of different modes of coordination in food chains was conducted by Maertens and Swinnen (2009) in the case of vegetable exports in Senegal. A comparison of incomes was conducted between farmers under contract with export companies, farmers employed by exporter estate farms and independent farmers. The study showed that contract farmers earn more than vertically integrated farmers who themselves earn more than farmers outside export schemes (neither contracted nor vertically integrated).

Yet, it is difficult to conclude from the latter study that contractual arrangements bring additional income when compared to spot marketing. Incomes from green beans exported (through contracts) are compared with incomes of farmers not involved in contracts. Thus, it is the introduction of a new crop rather than the form of coordination that generates additional incomes. Besides, even when the same crops are considered, as is the case in the study by Miyata et al. (2009), the quality characteristics are different between farmers selling under contract and those without a contract. It is therefore difficult to come to a conclusion regarding the impact of the contract versus the impact of quality upgrading. Finally, it would be interesting to compare the effect of contractual arrangements with other ways of coordinating transactions in a chain where specific quality attributes are involved, generating high transaction costs. Existing studies focus mainly on vertical integration driven by the buyer, who provides inputs in exchange for the product purchase. Another possible situation of vertical integration is when farmers engage in retailing, which can be termed as farmer-driven vertical integration. The case of safe vegetables in Vietnam provides a good basis for evaluating the impact of different types of vertical coordination.

In this paper, we evaluate the impact on incomes of three different types of intra-chain coordination observed to market "safe" vegetables (defined as vegetables produced according to IPM methods, whether certified or not): spot marketing, corresponding to marketing to collectors without commitments in terms of inputs or outputs; contractual arrangements with supermarkets; direct sales to consumers. The next section details the methodology used. Then the results of the survey and data analysis will be presented and discussed. Finally, the conclusion will summarize the main results and their implications in terms of new research and policy recommendations.

Method

We will first present the characteristics of the survey, followed by the way the data was processed and analyzed.

Data collection

From August to December 2008, we conducted a survey of 137 peri-urban vegetable farmers in safe vegetable production areas. They market their vegetables in three ways: (1) selling to collectors in spot markets (66 farmers); (2) selling directly to consumers in rented shops or market stalls (30 farmers); (3) selling to supermarkets or to companies through contracts (41 farmers). We then conducted interviews with the leaders of the nine farmer cooperatives to which the contract farmers belonged or sold directly to better understand the contract specifications and the strategies of the group as regards marketing.

It should be noted that farmers frequently combine different marketing strategies. We selected farmers selling more than half of their vegetables through one channel in order to define which of the three respective market coordination groups they belonged to (spot marketing, direct sales or contract). This explains the smaller size of the sample for the second and third situations.

Moreover, supermarkets and companies contract with farmer organizations rather than with individual farmers. But the interviews with the co-op leaders show that the contracts are filled by a small number of farmers in the group (two to five) who sell their own produce plus that of some neighboring farmers. Likewise, the farmer co-op shops are run by a small group of farmers who sell their vegetables and act as collectors for the rest of the group. Hence, the marketing strategies are individual rather than collective. The collective pattern of the farmer organizations relates mostly to quality development and labeling (Moustier et al., 2010).

The questionnaire gathered details on household characteristics: age, number of persons in the labor force (aged between 15 and 65), level of education of the head of the household; landholdings; planting cycle; vegetable production; marketing strategies; distance to markets and roads; household income; agricultural income from vegetable and non-vegetable production. As stated by Miyata and al. (2009), household income is a better indicator than vegetable income regarding the effect of the contract on well-being because the contract may draw labor or land away from other activities.

Data analysis

Descriptive analysis was used to show and compare the basic household characteristics. To estimate the impact of different forms of coordination in vegetable chains, regression and matching techniques taken from average treatment effects literature were applied to correct the selection bias resulting from the stakeholders' decision and output (Jalan and Ravallion, 2003; Maertens and Swinnen, 2009). Taking farmers under contract or selling directly to consumers as treatment groups and farmers selling in spot market as a control group in the study, the value of average treatment effects (ATE) is defined as the average difference between household income with and without treatment for those who actually participated in treatment. Two treatments were considered: contracts with companies and direct sales. These treatments were applied to farmers independently from their characteristics: cooperatives were selected from what can be approximated to a "queuing list," because market stalls, shops, canteens and supermarkets are limited in supply. Y_1 and Y_2 represent the income with treatment and Y_0 the income without treatment.

$ATE_1 = E(Y_1 - Y_0)$ for $T_1 = 1$: with contract

$ATE_2 = E(Y_2 - Y_0)$ for $T_2 = 1$: selling directly

The hypothesis is that vertical coordination, whether in the form of contracts or direct sales, has a positive impact on household income and therefore both ATEs are significantly positive. Observable covariates related to participation and family income as output were selected from the survey for the selection bias adjustment. (Maertens and Swinnen, 2009; Caliendo and Kopeinig, 2008; Dehejia and Wahba, 1999) The result is shown in Table 1. The covariates are farmer access to resources (including landholdings, labor and distance from nearest market), , age, education and family size. The number of motorbikes was not selected because of this being a potential endogenous problem, although it is a typical variable in Vietnam to indicate family assets. The number of motorbikes could be an endogenous variable related to income because it is difficult to identify whether farmers with a higher income buy more motorbikes or whether more motorbikes help farmers increase their income because they facilitate the transportation and sale of produce.

Three components in the econometric analysis enable comparison of the impact of the different forms of coordination and identification of the selection bias. First, we use the covariate matching method to implement the regression on household income and the selection bias is controlled by including observable covariates. Farmer participation is

included in the covariates to estimate the average treatment effects. The ATEs can be estimated as the coefficients of covariates for treatment in the ordinary least squares (OLS) regression (Imbens, 2004; Wooldridge, 2002). Model I is specified as:

$$For(T_1 = 1): Y_i = \varphi + \alpha_1 T_1 + \beta X_i + \varepsilon_i$$

$$For(T_2 = 1): Y_i = \varphi + \alpha_2 T_2 + \beta X_i + \varepsilon_i$$

Secondly, a probit model is used to estimate the probability of a given household participating in the treatment and the estimated marginal probabilities are included as an additional propensity score correction function in the regression. (Maertens and Swinnen, 2009) This is to control the participation bias correlated to unobservable characteristics. And the ATEs can be estimated using ordinary least squares (OLS) regression (Maertens and Swinnen, 2009; Imbens, 2004; Wooldridge, 2002).

Model II is specified as:

$$For(T_1 = 1): Y_i = \varphi + \alpha_1 T_1 + \theta P_1 + \beta X_i + \varepsilon_i$$

$$For(T_2 = 1): Y_i = \varphi + \alpha_2 T_2 + \theta P_2 + \beta X_i + \varepsilon_i$$

with $P_i = \hat{p}(T_i = 1 | X)$

The third econometric analysis is to estimate ATEs using the propensity score matching method because the counterfactuals are not directly observed. Non-experimental studies differ from randomized experiments in that the probability of participating in coordination is not a fixed constant but influenced by unobserved and observed characteristics due to self-selection and selection made by related stakeholders (Aakvik, 2001). Selection bias due to correlation between observed variables and household participation is solved by either matching techniques or by including these covariates in the regression analysis (Aakvik, 2001).

As regards the model to be used for the estimation, there is little advice on functional form. Logit and probit models usually yield similar results for bivariate estimation (Caliendo and Kopeinig, 2008) A probit model was used in the propensity score matching analysis. We use the single nearest neighbor algorithm to identify the best match for each treated farmer, which is the most straightforward matching method and reduces bias. We also employ radius and kernel-based matching The radius matching draws on all the comparison members within the caliper which can avoid the risk of bad matches. The kernel-based matching uses weighted averages of all individuals in the control group to construct the counterfactual outcome and the major advantage is with lower variance while using more information (Caliendo and Kopeinig, 2008; Dehejia and Wahba, 2002) The propensity score matching method estimates ATEs and is specified as Model III:

$$ATE_1 = \frac{1}{N_1} \sum (Y_{1i} - Y_j)$$

$$ATE_2 = \frac{1}{N_2} \sum (Y_{2i} - Y_j)$$

The average treatment effects on the treated can be estimated as follows:

$$ATT = E(E(Y_{i,treatment} | T_i = 1, p(X)) - E(Y_{i,control} | T_i = 0, p(X)) | T = 1)$$

The estimator that yields the statistically identical covariates means for treatment and control groups is preferred. To assess the matching quality, several indicators were reviewed

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and used to check if the matching procedure is able to balance the distribution of the relevant variables in both treatment and control group, i.e., there should not be systematic significant differences remaining after conditioning on the propensity score (Caliendo and Keopeinig, 2008). They include the significant lower standardized bias (Rosenbaum and Rubin, 1985), statistically insignificant likelihood ratio test on the joint significance of all regressors (Smith and Todd, 2005), and fairly low pseudo-R^2 (Sianesi, 2004) after matching.

Non experimental studies differ from randomized experiments in that the probability of participating in technology adoption is not a fixed constant but influenced by unobserved and observed characteristics due to self-selection and selection made by related stakeholders (Aakvik, 2001). Rosenbaum (2002) suggested sensitivity analysis to check the hidden bias because of unobserved variables that simultaneously affect adoption and household income. This is based on the assessment of the region of common support as well as Rosenbaum bounds which we will present in the results section on robustness.

All the data were entered and processed using the STATA software. We now turn to the results of the data analysis.

Results

We first present the results of the descriptive statistical analysis in terms of farm characteristics and incomes. Then, the results of the econometric analysis will be outlined, followed by the outcomes of some robustness tests.

Descriptive analysis

Farm characteristics

Characteristics of households selling directly to consumers and contracted by supermarkets or firms are compared to those selling their vegetables in spot markets using the T test (Table 2). The significant differences between the three groups relate to the following characteristics: land area (largest for spot market, followed by contracts and direct sales); distance from the nearest market (higher for direct sales than for the other groups); number of persons in the labor force (highest for spot market); age (lower for contract farmers than for the other groups); education level (highest for contract farmers).

Incomes

The survey shows that the highest incomes are obtained by farmers selling directly to consumers, both as regards vegetable income and total household income. Second come incomes of contract farmers, followed by farmers selling in spot markets.—See Figure 1.

Vegetable production is an important income source for farmers, especially for the contract and direct sales farmer groups (more than half of the overall income), compared with less than one third of the household income for those selling in spot markets.

The following section investigates whether the differences in income result from the resource or location characteristics of households or from their participation in contract and vertical integration after correcting selection bias.

Econometric analysis

In table 3 we show the result of Model I, covariate matching method, by implementing OLS regression to estimate the ATEs. The estimate effects for direct sales and contracts are significantly positive at the 1-percent level. Household yearly income could be raised by 29.25 million VND (US$1,827) by selling directly to consumers compared to selling to

traditional collectors through the spot market. The impact of a contract on household income is 14.4 million VND (US$899) which is less than half of the direct sales effect.

Taking into account the probability that a given household participated in the treatment, Table 4 shows the results of Model II. Similar to the results of Model I, the estimated effect for direct sales and contracts are significant at the 1-percent level. And the extent of income increase is 27.26 million VND (US$1,703), which is quite close to that of Model I. This confirms the hypothesis that vertical integration in the form of selling directly to consumers or contracts can help raise farmer incomes. Although the estimated effect of a contract is significantly positive, 14.8 million VND (US$924), it is much less than the direct sales.

The result of the bivariate probit in Table 5 shows that selling directly to consumers and selling under contract are biased towards households with less land. There is no significant effect of demographic characteristics on the probability of different forms of coordination.

After implementing the propensity score matching method to correct the bias, Table 6 shows the comparison of estimated treatment effect. Matching means that similar treatment and control units are paired in terms of their observable characteristics. (Maertens and Swinnen, 2009; Abadie and Imbens, 2002; Dehejia and Wahba, 2002) The result of the estimated effect of nearest neighbor matching method for direct sales and contract is still significantly positive at the 5-percent level, with the difference of about 33 million VND (US$2,071) and 17 million VND (US$1,057) for direct sales and contract respectively, which is higher than figures obtained in Models I and II.We present the results of a comparison between before and after matching in Table 7, which indicates the possibility of a selection bias before matching.

Robustness tests

To estimate average treatment effects requires sufficient overlap and an area of common support between the treatment and control groups. (Caliendo and Kopeinig, 2008; Dehejia and Wahba, 2002; Imbens, 2004) ATE is difficult to estimate by matching techniques if households with and without coordination differ substantially in observable characteristics. (Maertens and Swinnen, 2009) There are two methods to check the overlap and common support. One is by comparing the minima and maxima of the propensity score and the other is based on estimating density distribution (Caliendo and Kopeinig, 2008). We use the first and Figure 2 shows the comparison. It indicates sufficient overlap and common support where the propensity score of the treated group is not higher than the maximum propensity score of the control group or is less than that of the minimum one. Besides, the results of Table 8 show that there is a strong bias for most covariates. And the matching eliminates the bias so that there is a good balance of covariate distribution between treated and matched control units.

To test robustness and unmeasured bias, we also calculated the Rosenbaum bounds for average treatment effects on the treated group in the presence of unobserved heterogeneity (hidden bias) between treatment and control units; and the critical level of gamma was shown in Table 7.

Discussion

The results show the profitability of farmer direct sales compared to selling to collectors in spot markets, and even to having contracts with supermarkets. Contracts with supermarkets show higher profitability than spot markets, but its effect is much smaller than direct sales. Direct sales provide economic benefits to farmers in the form of higher income, because they enable farmers to better promote their efforts in the realm of vegetable quality, especially

safety. Food safety generates a number of information deficiencies and opportunism risks, which are reduced by cutting out intermediary stages between farmers and consumers. This also benefits consumers who are reassured in terms of the way food is produced, in addition to getting access to fresher and more affordable food. (Prigent-Simonin and Hérault-Fournier, 2005) Yet, direct sales may be constraining in terms of access to a market stall or store, which is becoming more and more difficult in a context of strong pressure on urban land (Moustier et Nguyen, 2010).

The results are original because they show the profitability of vertical integration of retailing stages based on producers, while many papers investigate vertical integration of producing stages based on traders. Yet, some qualification is needed. The contracts observed in the safe vegetable chains have limited features of vertical integration. They are mostly systems to guarantee purchase and sale, rather than to get the purchaser involved in the production stages. Purchasers do not provide inputs or technical advice, and the extent of quality control is limited.

The direction of covariates requires some explanation. We found that farmers involved in direct selling have a lower labor input than the others, while it might be anticipated that they are the ones more apt to provide labor, to spend time and effort in marketing activities. We can explain this finding by the fact that farmers involved in direct selling have less land, have less produce to sell and are more specialized than the other farmers: the share of vegetable income in total household income is 54 percent, while it is 33 percent for farmers involved in spot markets (see Figure 1) Hence, the smaller labor input is somehow compensated by less time spent in production (because of less land available) and due to the higher profitability of time spent per unit of land.

Conclusion

The paper is an original contribution to the few available studies investigating the impact on farmer incomes of alternative marketing strategies and chain coordination using robust econometric methods, with correction of selection biases. The paper demonstrates the positive impact on farmer incomes of direct sales between farmers and consumers, compared to sales to collectors in spot markets and to contracts with “modern” buyers of commodities with the same quality characteristics, i.e. chemical-limited vegetables. A number of studies on the benefits of direct sales are available, but they are mostly in the field of sociology and geography, in developed countries, and the quantitative data are very limited (for reviews, see Deverre and Lamine, 2010, and Cadilhon, 2007).

In terms of policy recommendations, our results indicate that if public support was given to farmers to enable them to sell their products directly, this could have a beneficial impact on their incomes. This could involve micro-credit programs, as well as facilitating the protection of areas available for direct farmer sales, including farmer retail markets, which still do not exist in Vietnam, in contrast with other countries. Besides, public food safety control needs to be improved to make the “safe vegetable” label more credible. Currently, there is no strict control by an external authority regarding the origin of vegetables sold in the stalls and shops; the latter may well indiscriminately mix vegetables from various production areas and vegetables with inadequate certification. This could jeopardize the reputation—and hence the incomes—of farmers involved in quality efforts.

The paper has some limitations and additional research is required. The issue of unobservable characteristics should be further investigated. Further explanation should be sought and confirmed as regards the unexpected direction of covariates. Besides, it would be worthwhile to carry out similar analyses with larger samples per treatment, which would imply extending

the research to other regions of Vietnam. It would be worthwhile to carry out a comparison of farmer-driven integration with retailer-driven integration in cases where there is more active involvement on the part of retailers in the production process, which may be more frequent in southern Vietnam than in northern Vietnam. Another situation is that of retailing companies involved in production through salaried workers. The profitability of salaried work could be compared with that of farmers under contract and independent farmers—provided that a significant number of farmers in a situation of salaried work can be found.

References

Akerlov, G.A., 1970. The market for "lemons": quality uncertainty and the market mechanism. In: Quaterly Journal of Economics, LXXXIV (3), pp. 488-500.

Aakvik, A., 2001. Bounding a matching estimator: the case of a Norwegian training program In: Oxford Bulletin of Economics and Statistics 63, p. 115.

Barzel, Y., 1982. Measurement cost and the organization of markets In: Journal of Law and Economics, XXV, pp. 27-50.

Cadilhon, J.-J., 2007. Grower direct marketing systems. In: Stewart Postharvest Review, 3, pp. 1-7.

Carlton, D.W., Perloff, J.M., 1994. Modern Industrial Organization. HarperCollins, New York.

Caliendo, M., and S. Kopeinig, 2008. Some practical guidance for the implementation of propensity score matching. In:Journal of Economic Surveys 22, pp. 31-72.

Dehejia, R. H., and S. Wahba, 1999. Causal effects in, nonexperimental studies: Reevaluating the evaluation of training programs. In:Journal of the American Statistical Association 94, pp. 1053-1062.

Dehejia, R. H., and S. Wahba, 2002. Propensity score-matching methods for nonexperimental causal studies. In:Review of Economics and Statistics 84, pp. 151-161.

Deverre, C., Lamine, C., 2010. Les systèmes agroalimentaires alternatifs. Une revue de travaux anglophones en sciences sociales. In: Economie Rurale, 317, pp. 57-73.

Figuié, M., Bricas, N., Than, V.P.N., Truyen, N.D., 2004. Hanoi consumers' point of view regarding food safety risks: an approach in terms of social representation. In: Vietnam Social Sciences, 3 (101), pp. 63-72.

Imbens, G. W., 2004. Nonparametric estimation of average treatment effects under exogeneity: A review. In: Review of Economics and Statistics 86, pp. 4-29.

Jaffee, S., 1993. Exporting high-value food commodities. Success stories from developing countries. World Bank Discussion Paper.

Jalan, J., and M. Ravallion, 2003. Estimating the benefit incidence of an antipoverty program by propensity-score matching. In: Journal of Business & Economic Statistics 21, pp. 19-30.

Maertens, M., Swinnen, J.F.M., 2009. Trade, standards and poverty: evidence from Senegal. In: World Development, 37 (1), pp. 161-178.

Miyata, S., Minot, N., Dinghuan, H., 2009. Impact of contract farming on income: linking small farmers, packers and supermarkets in China. In: World Development, 37 (11), pp. 1781-1790.

Moustier, P., Nguyen, T.T.L., 2010. Direct sales suit producer and farmer interests in Vietnam, in: Bonanno, A., Bakker, H., Jussaume, R., Kawamura, Y., Shucksmith, M. (Eds.), From Community to Consumption: New and Classical Themes in Rural Sociological Research. Emerald Publishing, Bingley, pp. 185-197.

Moustier, P., Phan, T.G.T., Dao, T.A., Vu, T.B., Nguyen, T.T.L., 2010. The Role of Farmer Organisations Supplying Supermarkets with Quality Food in Vietnam. In: Food Policy, 35, pp. 69-78.

North, D.C., 1990. Institutions, institutional change and economic performance. Cambridge University Press, Cambridge.

Prigent-Simonin, A.-H., Hérault-Fournier, C., 2005. The role of trust in the perception of the quality of local food products: with particular reference to direct relationships between producer and consumer. In: Anthropology of food.

Reardon, T., Timmer, C.P., Barrett, C.B., Berdegue, J., 2003. The rise of supermarkets in Africa, Asia, and Latin America. In: American Journal of Agricultural Economics, 85 (5), pp. 1140-1146.

Rosenbaum, P.R., Rubin, B.D., 1983. The central role of the propensity score in observational studies for causal effects. In: Biometrika, 70 (1), pp. 41-55.

Rosenbaum, P. R., and D. B. Rubin, 1985. Constructing a control-group using multivariate matched sampling methods that incorporate the propensity score. In: American Statistician 39, pp. 33-38.

Rosenbaum, P. R., 2002. Covariance adjustment in randomized experiments and observational studies. In:Statistical Science 17, pp. 286-304.

Shelanski, H.A., Klein, P.G., 1995. Empirical Research in Transaction Cost Economics: A Review and Assessment. In: Journal of Law, Economics, and Organization, 11 (2), pp. 335-361.

Sianesi, B., 2004. An evaluation of the Swedish system of active labor market programs in the 1990s. In: Review of Economics and Statistics 86, pp. 133-155.

Smith, J. A., and P. E. Todd, 2005. Does matching overcome LaLonde's critique of nonexperimental estimators?In: Journal of Econometrics 125, pp. 305-353.

USDA, 2009. Vietnam retail food sector report. Gain report. USDA foreign agricultural report. USDA.

Williamson, O.E., 1987. The economic institutions of capitalism. The Free Press, Collier Macmillan Publishers, New York.

Wooldridge, JM. 2002. Econometric analysis of cross section and panel data. The MIT Press.

World Bank, 2008. World Development Report 2008. World Bank, Washington.

Wup, 2009. World Urbanization prospects. The 2009 revision population database.

Table 1. Observable covariates for selection bias adjustment of ATEs

Covariate	Description	T1: Direct sales/ Spot		T2: Contract/ Spot	
		Income	Treatment	Income	Treatment
hhsize	Household size (persons)	0.445***	-0.166	0.459***	-0.146
agehead	Age of household head	0.036	-0.207**	0.065	-0.162*
labor[a]	Household labor endowments	0.366***	-0.277	0.434***	-0.272***
eduhead	Education of household head	0.292***	0.001	0.080	0.198**
land	Arable land area (ha)	0.062	-0.387***	0.169*	-0.312***
market	Distance from nearest market (km)	0.053	0.239**		
geodum	Region dummy	-0.192*	-0.337		

[a] People aged from 15 to 65 were considered as being in the labor market.

Table 2 Comparison of household characteristics for different coordination forms

	Total	Selling in spot markets	Selling directly to consumers[c]	Contracted by supermarkets or company
Number of households	137	66	30	41
Household income (million VND)	64.24	57.93	81.42**	62.16
Vegetable income (million VND)	29.38	19.03	44.32***	35.09***
Share of vegetable income (%)	45.96	36.23	56.22***	54.27***
Agriculture income [a] (million VND)	31.63	21.91	44.72***	37.62***
Agri. income per hectare (million VND/ha)	185.13	102.90	292.47***	238.09***
Household size (persons)	4.47	4.71	4.17	4.29
Male (persons)	2.31	2.47	2.13	2.20
Female (persons)	2.15	2.24	2.03	2.10
Number of persons in the labor market [b]	3.48	3.86	3.07***	3.17***
Share of labor input in the family	80%	85%	75%	75%
Age of household head (years old)	34.58	36.22	34.32	32.13**
Average education of family members (years)	8.36	8.76	8.10	7.84**
Education of head (years)				
Arable land area (ha)	0.22	0.26	0.16***	0.18***
Distance from nearest market (km)	0.94	0.88	1.26**	0.81
Distance from nearest road (km)	0.25	0.27	0.24	0.21

[a] Agriculture income only refers to farming on the arable land, not including livestock raising.

[b] Person in the labor market refers to a person aged from 15 to 65.

[c] Characteristics of farmers selling directly to consumers and those contracted by supermarkets or companies are compared to those selling their vegetables in spot markets using the T test. Significant differences are indicated with *p<0.1, **p<0.05, ***p<0.01.

Table 3. Regression on covariates by implementing OLS regression to estimate ATEs

	T1: Direct sales /Spot		T2: Contract /Spot	
	Coef.	Std.Err	Coef.	Std.Err
Contract (0= spot market)	29.246***	9.976	14.403*	7.582
household size(persons)	14.301***	4.082	7.706**	3.485
agehead	1.101	0.673	0.320	0.400
labors by age of [15,65]	2.161	4.854	7.817*	4.108
eduhead	5.492***	1.838	1.297	1.571
total land area (ha)	31.689	42.272	-0.979	35.716
distance to nearest market(km)	4.068	5.254		
_cons	-109.944***	39.101	-34.646	28.606

Note: *** p<0.01, ** p<0.05, * p<0.1

The region dummies are omitted.

Table 4. Regression on propensity score to estimate ATEs

	T1: Direct sales /Spot		T2: Contract /Spot	
	Coef.	Std.Err	Coef.	Std.Err
Contract (0= spot market)	27.260**	11.342	14.838*	7.600
PS	415.711	266.006	-187.380	197.335
Household size(persons)	-6.328	15.798	15.130*	8.561
Agehead	4.053**	1.930	-0.244	0.716
Labours by age of [15,65]	12.979	11.295	-9.330	18.520
Eduhead	0.069	4.624	7.359	6.574
Total land area (ha)	657.717*	365.555	-164.328	175.699
Distance to nearest market(km)	-34.110	27.006		
_cons	-425.721**	186.936	75.165	119.134

Note: *** p<0.01, ** p<0.05, * p<0.1

The region dummies are omitted.

Table 5. Propensity score estimated using a bivariate probit model

Treatment	T1: Direct sales /Spot		T2: Contract /Spot	
	Coef.	Std.Err	Coef.	Std.Err
household size(persons)	0.160	0.175	0.107	0.142
agehead	-0.015	0.026	-0.008	0.016
labors by age of [15,65]	-0.097	0.223	-0.257	0.170
eduhead	0.043	0.077	0.088	0.061
total land area (ha)	-4.367*	2.410	-2.557**	1.201
distance to nearest market(km)	0.281	0.200		
_cons	0.469	1.461	0.306	1.017

Note: *** p<0.01, ** p<0.05, * p<0.1

The region dummies are omitted.

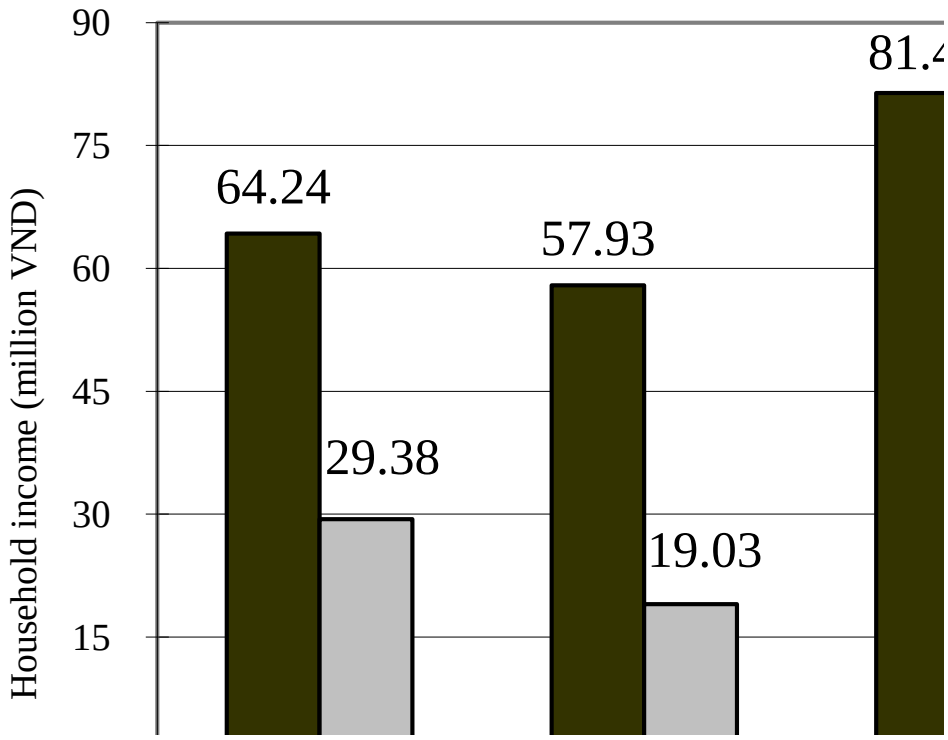
Table 6. Average treatment effects (ATT) and results of sensitivity analysis

Matching Algorithm	ATT (million VND)	Critical level of gamma	Number of treated	Number of control
T1: Direct sales / Spot				
Nearest neighbor matching	33.15**	1.65 – 1.70	21	21
Kernel-based matching	26.69*	1.30 – 1.35	23	21
Radius matching	27.58*	1.25 – 1.30	23	21
T2: Contract / Spot				
Nearest neighbor matching	16.92**	1.30 – 1.35	36	45
Kernel-based matching	17.96**	1.65 – 1.70	34	45
Radius matching	17.37**	1.70 – 1.75	36	45

Table 7. PSM quality indicators before and after matching and sensitivity analysis

	Pseudo R^2 before matching	Pseudo R^2 after matching	p > Chi 2 before matching	p < Chi 2 after matching	Mean SB before matching	Mean SB after matching	% |bias| reduction
T1: Direct sales /Spot							
Nearest neighbor matching	0.177	0.072	0.044	0.754	39.29	20.28	48
Kernel-based matching	0.177	0.019	0.044	0.990	39.29	8.66	78
Radius matching	0.177	0.023	0.044	0.983	39.29	7.14	82
T2: Contract /Spot							
Nearest neighbor matching	0.205	0.042	0.000	0.520	54.92	19.06	65
Kernel-based matching	0.205	0.025	0.000	0.805	54.92	16.05	71
Radius matching	0.205	0.023	0.000	0.814	54.92	15.22	72

Note: SB is the standardized bias.



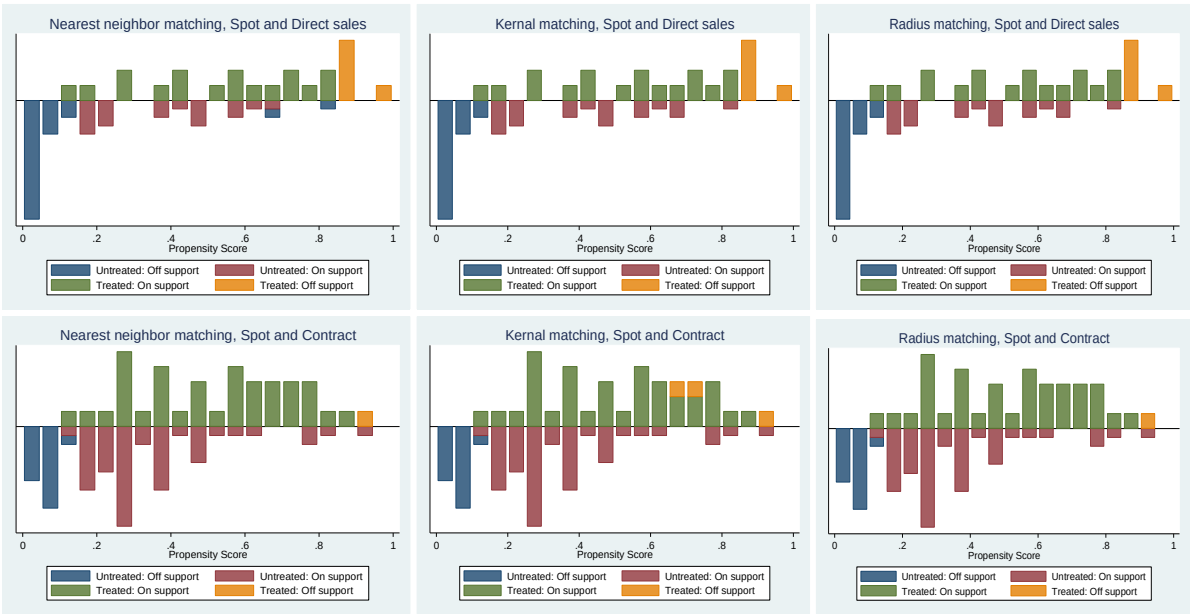


Figure 2. Propensity score distribution and common support for propensity score estimation

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