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Rice market participation and channels of sale in rural Vietnam

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Abstract:

This paper contributes to the existing literature on agricultural commercialisation by focussing on the channels through which households sell their crops, as well as considering the determinants of their participation behaviour. An important innovation of this paper is to look at both the type of purchaser households use (trader or other household) and the location of sale (farmgate or not). We study these issues for the case of Vietnam, which over time has achieved an impressive success in agricultural commercialisation, and in relation to rice, drawing on data from a detailed rural panel survey for 2006, 2008 and 2010. We find that household asset endowments significantly increase the probability of selling rice. We also find that larger scale of production and low transport costs are significant determinants of the probability of using more established channels of sale, such as traders or enterprises. Wealthier farmers are more likely to sell via this channel, but not if the quantity they produce is large, which is consistent with their better ability to meet costs for reaching more remunerative marketing opportunities. With respect to location of sales, we find that wealthier households with access to phones and own means of transport, but also households located in areas where transport infrastructure is less developed, are less likely to sell at the farmgate.

Keywords: Agriculture; Market participation; Rice; Transactions costs; Vietnam.
JEL: O13, Q12, Q13

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1. Introduction

Agricultural commercialisation is an indispensable pathway towards economic growth and development for most developing countries relying on the agricultural sector (Pingali and Rosegrant 1995; von Braun 1995; Timmer 1997). For almost all countries which have achieved successful agricultural development, commercialisation has played a key role in this.

Commercialisation can be conceived of and measured in a number of ways, and many different concepts have been used in the literature. It is often understood in terms of market participation; in turn this can be participation in markets for sales of output or for purchased inputs. The focus in this paper is on sales of output, specifically of crops. In particular, we focus on the decision by a household to sell some of its food crop production, rather than retaining it all for its own consumption.

We focus on a relatively unexplored aspect of market participation, the channel through which households sell their output, and we study not just who households sell to (traders or households) but also the location of sales (farmgate or distant). We study market participation as a two-step decision process, where the household first decides whether or not to participate in the market, and then chooses channel of sale. Availability of, and producers' decisions with respect to, channels of sale are important dimensions of possible constraints to agricultural commercialisation and of its welfare impacts. There is evidence that crop prices received by farmers vary between channels of sale, and this has implications for the welfare impact of commercialisation (Fafchamps and Vargas Hill 2005). Selling to traders or enterprises is often less remunerative, but may be the only option for farmers who cannot afford carrying their crop to the market or who may be time constrained and thus prefer to conduct a single transaction with a trader or enterprise, instead of several transactions with other households purchasing for own-consumption. Selling at the farmgate may be more convenient for the household, but may entail a more limited choice of buyers.

We examine the question of market participation and channel of sales for the case of Vietnam, a good example for analysing these questions because of the impressive increase in agricultural commercialisation it has experienced over the past twenty-five years in. Since the late 1980s, Vietnam has experienced remarkable economic growth and an impressive reduction in poverty. Agricultural commercialisation has in fact been an important component of this success story: as a result of the Doi Moi reforms, agricultural production and commercialisation achieved remarkable advances which led to substantial improvement of farmers' income.¹ Rice production increased dramatically and transformed Vietnam from being a net rice importer to being one of the world's largest rice exporters. Agricultural production at the national level also became more diversified - a very typical result of the commercialisation process in agriculture - with increased production of cash and industrial crops (especially coffee) and aquaculture. Two thirds of farmers previously primarily engaged in subsistence farming are estimated to have entered the market following the process of agricultural liberalization (World Bank 2008). Moreover, between 1993 and 1998, real incomes of rural households increased by almost 60 percent, an unusually rapid growth for rural

¹ The Doi Moi reforms, introduced in the late 1980s, included de-collectivization of land and improvements in land titling, removal of price controls on many goods (including rice and fertilizers), provision of greater autonomy to the private sector, and liberalization of agricultural markets, including removal or reduction of restrictions to exports and to internal trade.

communities, and more than half of this growth in rural areas was driven by growth in agricultural incomes (Isik-Dikmelik 2006; Aksoy and Isik-Dikmelik 2007).

In this paper we focus specifically on the case of rice, which remains the dominant food crop cultivated in Vietnam, and a fundamental part of the commercialisation story. We use data on twelve Vietnamese provinces covering the period from 2006 to 2010. Participation in the rice market increased substantially over this period: there are more households selling rice in 2010 than there were in 2006, and over time the proportion of output sold has also increased. However, the degree of commercialisation at the household level varies greatly by region and by socio-economic group. Some households may not have fully realised the benefits that commercialisation can bring, but others might be experiencing difficulties in accessing markets for sale.

Most households participating in the rice market sell either to traders and enterprises, i.e. more established channel of sales, or to other households and individuals, which means sales in the village or commune market and to neighbours. These are the two channels on which we focus our analysis.² In our sample, between 41 and 62% of households selling rice do so via a trader or enterprise, and the unit price they receive is about 8% lower than what farmers selling to other households receive. However, the standard deviation of the price when selling to other households is also larger, suggesting that this may be more subject to seasonal price fluctuations. If farmers receive a lower price because traders or enterprises exercise monopsonistic power, because of low competition among them and/or lack of village or commune markets within affordable distance, farmers' welfare could be raised by offering institutional alternatives to selling via traders, for instance marketing associations, which could also increase competition, or by enhancing local transport and market infrastructure.

Overall, the literature suggests that wealthier and more favourably located households are much more likely to sell their crops. However, Stephens and Barrett (2006) find that a certain amount of gross sales also occurs among poorer households, who use the commodity market as a form of *de-facto* seasonal credit, and then buy the same commodity back later, as a result of credit market imperfections. Agricultural commercialisation seems to be performing different roles for different socio-economic groups also in Vietnam: survival strategy to meet liquidity constraints in the absence of other income sources for poorer households; and one of several diversification strategies adopted by richer and better endowed households. This implies that the returns and welfare impacts of market participation may vary between richer and poorer households. In turn, if market access and returns to participation depend fundamentally on households' initial endowments, rural development strategies focussing on commercialisation of agriculture may favour initially wealthier households, unless policy interventions simultaneously or previously provide asset transfers to poorer households.

In our sample, households are more likely to sell rice if they lack alternative income sources, and especially wage income and income from farm household enterprises. Our results show that household asset endowments, especially land and irrigation, but

² Only very few households in our sample sell to either state enterprises or cooperatives.

also union membership and access to extension and training services, are strongly positively associated with rice market participation.

With respect to type of purchasers used, the data shows that in some cases households do not have access to traders, while in others they have no available market facilities within reach, e.g. at commune or village level. We find that larger scale of production and low transport costs significantly increase the probability of selling to a trader or to an enterprise. Wealthier households are more likely to sell to traders, possibly because the shadow value of their time is higher; however, as the quantity sold increases, they become less likely to sell through this channel (as also found in a similar study by Fafchamps and Vargas Hill (2005)), possibly because they are better able to pay for transportation costs in order to sell through more remunerative channels of sales. Moreover, our results show that availability of marketing infrastructure within the commune strongly decreases the probability of selling to traders, suggesting that households may prefer this slightly more remunerative channel when the option exists.

With respect to the decision to travel or to sell at the farmgate, results suggest the existence of a dual process, where the likelihood of travelling increases for wealthier and better connected households (with access to phones and own means of transport), but also for those located in areas where transport infrastructure is worse. In addition, local availability of market infrastructure appears to facilitate sales at the farmgate.

The paper is organised as follows. The next section briefly reviews the literature this paper relates to, and presents our conceptual framework. The data used is discussed in section 3 along with a brief examination of patterns and trends in rice market participation over the survey period. A descriptive profile of the characteristics of households participating in the rice market is presented in section 4, which includes a discussion of the characteristics more strongly associated with mobility in market participation over time and with use of different channels of sales. Section 5 presents our econometric strategy and discusses the results, while section 6 concludes.

2. Literature review and conceptual framework

This paper relates to the growing literature that examines the determinants of small farmer participation in markets in agrarian economies. This literature has focused primarily on understanding the role of transactions costs and market failure in smallholder decision making. Differential asset endowments, together with differential access to those public goods and services that facilitate market participation, are identified as important factors underlying heterogeneous market participation among smallholders (Key, Sadoulet et al. 2000; Barrett 2008). Differences in transaction costs across households are also important: each household faces some fixed time and monetary costs in searching for available marketing options, i.e. costs that are invariant to the quantity transacted, and if high enough may prevent market participation altogether. According to Goetz (1992), transaction costs affect market participation behaviour through the labour-leisure choice: where markets are thin it is costly (i.e. time consuming) to discover trading opportunities; similarly, poor market access due to lack of transport, distance, and/or barriers such as

ethnicity or language increase a household's cost of observing market prices to make transaction decisions, thus reducing the household's leisure time (Goetz 1992). For staple food markets in particular, another important factor influencing the participation decision is risk, and household attitudes towards risk: households concerned about their own food security and facing a high degree of price and non-price risk, especially in the presence of missing or imperfect credit and insurance markets, may choose not to sell in the attempt to ensure that own consumption requirements can be met. On the other hand, lack of liquidity from absence of alternative income sources and credit may also lead to the decision to sell rice for subsistence reasons, in order to meet other non-food expenditures.

The determinants of smallholder participation in agricultural markets have been investigated empirically especially in the context of Sub-Saharan Africa. This literature identifies strong positive associations between market participation and (a) household assets (especially land, but also livestock, labour and equipment) and income (Nyoro, Kiiru et al. 1999; Cadot, Dutoit et al. 2006; Stephens and Barrett 2006; Boughton, Mather et al. 2007; Levinsohn and McMillan 2007); (b) access to credit and insurance (Cadot, Dutoit et al. 2006; Stephens and Barrett 2006); (c) input use and access to extension services (Alene, Manyong et al. 2008); and (d) low levels of transactions costs, including transport costs and information costs (Heltberg and Tarp 2002; Alene, Manyong et al. 2008; Ouma, Jagwe et al. 2010). With respect to Vietnam, Rios et al (2008) find that households with higher productivity tend to participate in agricultural markets regardless of market access factors (e.g. distance to roads or quality of transport networks), suggesting that programs targeted at improving poorer households' productive capital and other assets have the potential to increase both productivity and market participation, while investments in market access infrastructure seem to be relatively less of a priority (Rios, Masters et al. 2009). This might reflect the fact that already in the early 1990s Vietnam had a much better coverage of basic rural infrastructure in most regions compared to countries with similar levels of income (Aksoy and Isik-Dikmelik 2007).

This literature informs our analysis of the determinants of households' decision about whether or not to sell rice. We model the participation decision as a function of (i) factors that affect farm scale of production; (ii) characteristics that influence households' attitudes towards risk and concerns for food security; and (iii) fixed transaction costs entailed in searching for marketing options. With respect to the latter, transaction costs are only partly observable at best. No direct measurement of transaction cost is available in the data set we use, as in most other data sets of this kind. Instead, we have to use observable variables that are expected to influence the size of transaction costs for households. For instance, fixed search and information costs may depend on both public goods and services (e.g. media or distance to roads) and household-specific characteristics (e.g. educational attainment, gender and language spoken).

We also study the process of selling for those who participate, with respect to both who people sell to (whether a trader or another household), and where (whether travelling or selling at the farmgate). The paper that is most closely related to this part of our analysis, but which does not separate out these two dimensions of the process, is Fafchamps and Vargas Hill (2005). This paper studies the choice between selling at the farmgate and travelling to market for a sample of Ugandan coffee growers, in

order to explain why only 15% of farmers carry their crop to the market, where it fetches a higher price, while the rest wait for an itinerant trader to show up at the farmgate (Fafchamps and Vargas Hill 2005). In their model, when public transport is not available and farmers must walk coffee to the market, wealthier farmers are predicted to sell at the farmgate, especially if quantity sold or distance to the market are large, because the opportunity cost of time is assumed to be higher for wealthier farmers. When cash constraints and public transport are introduced in the model, the predictions are reversed, with wealthier farmers now being more likely to sell to the market, because they can afford to pay for transport. Their empirical analysis shows that the likelihood of selling to the market decreases with quantity sold and increases with proximity to the market. When wealthier farmers have larger quantities to sell, they are more likely to sell it to the market. Wealthier farmers are also more likely to travel to a distant market. Overall, these results suggest that differences in behaviour can be explained, to some extent, by convenience, in terms of the opportunity cost of travelling to the market in order to sell coffee. Credit and liquidity constraints also play a role, as wealthier farmers are better able to pay for transport and therefore more likely to sell to markets.

In the case of our sample, individuals selling to traders do not always sell at the farmgate and those selling to other households do not always travel to the market in order to do so. We are mainly interested in understanding the effect of household wealth and transaction costs on the probability of selling to a trader or enterprise and on the probability of selling at the farmgate.

With respect to wealth, we seek to test similar hypotheses as Fafchamps and Vargas Hill, namely that wealthier farmers are less likely to sell to traders as quantity sold increases, and more likely to travel in order to sell. The opportunity cost of time argument is expected to be relevant also in our case, because quantity sold in each transaction is likely to be smaller when selling to a household that buys for own consumption, compared to selling to an enterprise or a trader. The opportunity cost of time may differ between wealthier and poorer households, suggesting that wealthier households may be more prone to sell to a trader and at the farmgate, unless the quantity becomes so large that it becomes remunerative for a farmer to organise transport to a market where the crop would receive a higher price.

Transaction costs that are particularly relevant in the process of selling are transport costs, which we capture using several proxies for households' relative isolation; and negotiation costs, which might be higher for certain households due to language barrier, age, gender, and educational attainment and which may discourage transacting with a trader or enterprise or travelling in order to sell. Transaction costs incurred by traders and enterprises may also play a role in whether or not they buy from a given household. Unfortunately, information on the behaviour of buyers is not available in our dataset. However, we can hypothesise that, for traders or enterprises, the time and monetary cost entailed in negotiating transactions and, possibly, checking the quality of crops, is lower when dealing with a few large producers than with a large number of small producers, and therefore that they would choose to buy from larger producers. We test this hypothesis by looking at whether a large output quantity increases the probability of selling to a trader or enterprise.

3. Data and basic descriptives of rice cultivation

The data this paper is based on was collected by the Vietnam Access to Resources Household Survey (VARHS) in the rural areas of 12 provinces between July and September 2006, July and September 2008 and July and August 2010.³ The VARHS is a multi-purpose survey collecting a wealth of information at the household level, including demographics, land use and property rights, household assets, time use and sources of income, access to credit and insurance, social capital, as well as household access to input and output markets. The survey also includes a commune-level questionnaire, collecting summary information on the commune with respect to agriculture, employment, infrastructure, irrigation management, credit availability and shocks. The key sampling strategy of the VARHS is to re-interview rural households sampled for the income and expenditure modules of the 2002 and 2004 Vietnam Household Living Standards Survey (VHLSS) in the 12 provinces.⁴ Provinces were selected in order to use the survey as an evaluation tool for Danida supported programs in Vietnam. Therefore, the sample is statistically representative at the provincial but not national level, though it does cover 7 of the 8 regions of Vietnam. It has important coverage in Northern and North-Western provinces and the Central Highlands, as well as in other provinces where agriculture is a major economic activity.

The VARHS survey collects much more information on crop production and market participation than VHLSS, which would not allow us to carry out an analysis of the kind conducted here. An advantage of the VHLSS data is the fact that it collects data on rice purchases, allowing an attempt to be made to distinguish net purchasers and net sellers, something we cannot do with the VARHS data. This is informative for considering the welfare dimension of agricultural commercialisation, but that is not our main focus here.

The 2006 round of the VARHS survey covered 2324 households in 466 communes; the 2008 round interviewed 3269 households in 477 communes; while the 2010 round covered 3208 households in 467 communes. The analysis is based on the panel of 1411 households engaged in rice production, initially interviewed in 2006 and then identified and re-surveyed in both 2008 and 2010. We choose to use a sample that only includes households growing rice, in order to reduce unobservable household-level heterogeneity that might be reflected in crop choices.

We now consider basic characteristics of rice growing households as revealed by the data. Overall, in the period under study, the proportion of households engaged in crop production remained stable, around 86% of the sample.⁵ Around 82% of these sold some output in 2006, a figure which had fallen to 69% by 2010. But focusing on those

³ The sampled provinces are, by region: Red River Delta: Ha Tay. North East: Lao Cai, Phu Tho. North West: Lai Chau, Dien Bien. North Central Coast: Nghe Anh. South Central Coast: Quang Nam, Khanh Hoa. Central Highlands: Dak Lak, Dak Nong, Lam Dong. Mekong River Delta: Long An.

⁴ See CIEM et al. 2009 for further details on the sampling strategy. CIEM, DOE, et al. (2009). Vietnam Access to Resources Household Survey: Characteristics of the Vietnamese Rural Economy (2008 Survey). Hanoi, Statistical Publishing House. CIEM et al. 2009 for further details on the sampling strategy.

⁵ This however shows some variation by province, as, for instance, the share of households growing crops increases markedly in Khan Hoa and Dak Nong, while it declines in Ha Tay and Lai Chau.

that sell some of their crops, the proportion of output sold in fact increases from 52 to 57% between 2006 in 2010. Part of the commercialisation story in Vietnam is about cash cropping, particularly coffee, but also tea, cashews, pepper, rubber and sugar, most of which is concentrated in the Central Highland provinces, where agro-ecological conditions are particularly suitable. But a major component of agricultural commercialisation, and the main focus of this paper, is about Vietnam's dominant crop, rice, which is characterised by both an expansion in participation, and an increase in the rate of commercialisation, measured as the share of rice sold over total quantity produced.

The main trends in relation to participation in the rice market are summarized in Table 1. The proportion of households growing rice declines slightly, from 88 to 85% of all households engaged in crop production. However, there is evidence of continued increase in commercialisation. The proportion of households selling rice increases from 51 to 56% over the period. Further, the share of rice output sold (conditional on selling) increases slightly between 2006 and 2008, and more markedly between 2008 and 2010, with an overall increase from 46 to 54% of produced rice over the period 2006-2010. The quantity of rice produced and sold by rice sellers both increase over the period, by 7% for quantity produced and 11% for quantity sold.

Table 1: Share of households producing and selling rice by province and income quintiles, 2006-2010

	Grow rice			Sell rice			Share of rice sold*		
	2006	2008	2010	2006	2008	2010	2006	2008	2010
Province									
Ha Tay	97%	98%	96%	44%	52%	57%	35%	41%	46%
Lao Cai	93%	93%	90%	55%	46%	57%	37%	24%	35%
Phu Tho	96%	92%	88%	21%	39%	35%	21%	25%	36%
Lai Chau	99%	99%	99%	52%	37%	30%	28%	30%	40%
Dien Bien	100%	100%	98%	88%	40%	51%	40%	43%	41%
Nghe An	92%	90%	89%	53%	46%	35%	35%	38%	52%
QuangNam	93%	94%	91%	48%	64%	80%	46%	43%	58%
Khanh Hoa	81%	81%	76%	53%	71%	50%	54%	30%	67%
Dak Lak	59%	54%	60%	45%	62%	47%	58%	63%	78%
Dak Nong	46%	36%	34%	62%	56%	64%	57%	66%	59%
Lam Dong	28%	31%	31%	25%	61%	56%	34%	81%	71%
Long An	93%	87%	84%	86%	92%	89%	83%	83%	79%
Income quintiles**									
Poorest	95%	95%	95%	48%	49%	51%	37%	42%	50%
2nd poorest	93%	92%	90%	53%	54%	57%	43%	43%	54%
Middle	89%	88%	85%	52%	60%	59%	49%	48%	57%
2 nd richest	84%	83%	81%	51%	58%	59%	54%	52%	53%
Richest	76%	70%	67%	49%	50%	53%	54%	59%	60%
Sample	88%	87%	85%	51%	54%	56%	46%	48%	54%

* Conditional on selling

** Quintile definition: 2006 income quintiles, adjusted for inflation and price differences at province level.

With respect to geographical distribution, rice cultivation is dominant in all provinces except the three Central Highlands provinces, where cash cropping is concentrated. The proportion of households selling rice varies widely across provinces and tends to fluctuate substantially from one year to the next. Overall, however, more people are selling rice in 2010 compared to 2006 in all the provinces except in the two North Western provinces of Lai Chau and Dien Bien, in Nghe An and in Khanh Hoa. The proportion of output sold, conditional on selling, tends to be highest in the Central Highlands provinces and in Long An, but it increases in most provinces over this period.⁶

These patterns are based on the VARHS sample and the provinces it covers, but an analysis of the same variables for the VHLSS samples from 2006 and 2008 (which cover all provinces) shows similar magnitudes for these provinces, and also shows that these provinces are not very different from other provinces in the same regions.

It is also interesting to look at differences in market participation across farm sizes. Mean farm size in the panel, measured as total operated land area, is about a hectare, but farm size seems to be declining over the period. We use median land area for each year as a threshold between smaller and larger farms. Table 2 shows that smaller farms are more likely to grow rice and less likely to sell in all three years, and they sell a smaller proportion of their output when they do so, compared to larger farms. However, while the proportion of large farmers selling rice remains constant over the period, it increases for small farmers. Moreover, over the period 2006-2010 the share of rice sold by smaller farms increases by much more than for larger farms, showing that participation in the rice market is not just a large farm phenomenon.

Table 2: Rice market participation by classes of total operated land area

% of households	Smaller			Larger		
	2006	2008	2010	2006	2008	2010
Grow rice	92%	90%	87%	85%	83%	82%
Sell rice	42%	49%	52%	60%	60%	60%
Share of rice sold	39%	40%	50%	52%	54%	58%

Median values for total operated land area (m²): 2006 = 4412; 2008 = 4238; 2010 = 4100

Overall, we can identify a strong association between agricultural commercialisation and household welfare. Agricultural households selling a higher proportion of their output and/or cultivating cash crops are consistently better off, on average, than those who do not, with respect to both income and food expenditure. Also with respect to the MOLISA definition of poverty, while between 2006 and 2010 the proportion of poor households declines substantially for the whole sample, this decline is faster for households that are selling any of their crops. Focussing on rice, income growth is greater in subsequent periods for those who did sell rice in 2006 than for those who did not, suggesting that the former became significantly better off in subsequent years compared to households not selling in 2006. However, we cannot, at this stage, draw

⁶ The exception is a small decline in Lao Cai and Long An.

any firm conclusions about the impact of commercialisation on household welfare, an important issue which requires more careful investigation that goes beyond the scope of this paper, but which we intend to investigate in future work.

4. Household characteristics and rice market participation: the role of assets, transaction costs and household demographics

The profile of households participating – and not participating – in the rice market shows a largely consistent picture over time and allows distinguishing three broad groups with distinct characteristics: consistent sellers, who sell some of their output consistently in each year (30% of the panel); consistent non-sellers, who are never observed to participate over the whole period (21% of the panel); and households switching in or out of participation. Table 5 in the Appendix provides a break-down of panel mobility in rice market participation for the full sample and by province, and summarises mean scale of production and some welfare characteristics for each group.

Consistent sellers tend to be the largest producers. They were already relatively better off in 2006 and are the group experiencing the most marked improvement in welfare indicators over time. Mobility in and out of rice sales, on the other hand, tends to be related to increases and decreases in quantity produced. These households, and in particular those observed to sell only in 2006, tend to be relatively worse off at the beginning of the period, and improvement in welfare indicators is slowest for them. When they do sell rice, they seem to do so more tentatively, selling relatively small quantities. The group of non-sellers appears to consist of two groups: households who have diversified away from rice production, into other agricultural or non-agricultural activities (for instance, 17% of these households produce cash crops); and households who are less well connected in terms of location but also with respect to language and literacy. All these households however continue producing some rice over the whole period, but probably mostly for own consumption.

In each year under study, households participating in rice sales tend to be wealthier and better endowed in terms of assets. In particular, the role of land, irrigation and access to, as well as use of, inputs, seems to be crucial for rice market participation, and especially so for consistent sellers. Participation also seems to be facilitated by household ownership of a means of transport, literacy and access to extension and training services. Table 6 in the Appendix provides a descriptive profile of participating households in each survey year; Table 7 presents some descriptives related to household mobility in participation, comparing first households observed to participate in both 2006 and 2010 with households no longer participating in 2010; and second households never observed to participate with households not selling in 2006 but selling in 2010.

Participation however also depends on opportunities. In about 40% of communes no sales are observed in 2008 and 2010. These communes tend to be poorer (the share of poor households, according to the MOLISA definition, was 37% in 2006 against 26% in communes where sales were observed in 2008), suggesting also an important role of demand in the participation story. This may be related also to presence and

availability of channels of sales, in particular traders and market facilities. The two may actually be related, because it is quite possible that households use markets also to sell to traders.

Looking only at those communes where at least one household sells, in 2008 no household is selling to a trader in 107 communes and this increases to 151 in 2010. These communes are not systematically poorer, but levels of production tend to be lower there. Moreover, where sales to traders are observed in 2008 but no longer in 2010 the quality of transport infrastructure tends to be lower.⁷ Availability of market facilities in the commune increases over time (from 48% to 52% of communes) and also seems to be related to availability and quality of transport infrastructure, as well as to overall wealth of the commune. Where daily markets are not available, the population is smaller, the commune is more likely to be defined as “remote” and the share of poor households is higher. These communes tend to be less well connected, in terms of share of villages with roads passable by car and distance between the commune centre and the main road, and tend to be located further away from the district centre. Communes where neither sales to traders are observed nor daily markets are available tend to be smaller in terms of population and overall poorer, with 21% of households being poor according to the MOLISA definition, against 10% in communes where both traders and daily markets are available. They also tend to be more remote in terms of overall distances from main centres, road availability and quality of infrastructure, considered problematic in 67% of these communes, against 57% of communes where both daily markets and traders are available. Total land area cultivated with rice is also much smaller where neither channel of sales is available, compared to where both are (Tables not reported here to save space, but available upon request).

Focussing on observed behaviour of participating households, we investigate the decision to sell to a trader (or enterprise) or to sell to another household; and the decision of whether to sell at the farmgate or travel some distance. Data for 2006 do not allow us to distinguish clearly between purchasers for each crop and for this reason we focus here, and in the subsequent econometric analysis, on 2008 and 2010 only. Information on distance travelled in order to sell, which we use to define whether or not sales occur at the farmgate, is only available for 2010.⁸

Households selling to traders receive a slightly lower price, but its standard deviation is also smaller. The majority of households selling rice in 2008 sold to traders (66%), but in 2010 this share had fallen to 44%. This decline is broadly confirmed across provinces.⁹ This is the result of both a process of switching away from selling to traders among more consistent sellers, and of entry of new, smaller scale rice market

⁷ For instance, quality of infrastructure in these communes in 2008 is more likely to be defined problematic than for communes where sales to traders continue in the following year (78% against 61% of communes).

⁸ Households were not directly asked whether or not they sell at the farmgate, but in 2010 they were asked the distance they had to travel in order to sell to their main buyer. We assume households are selling at the farmgate when they report zero distance, as does the vast majority of households.

⁹ However, in 2010, traders are still the most important channel of sales for rice producers in Dien Bien, Dak Nong, Lam Dong and Long An. With the exception of Dien Bien, these are among the most commercialised provinces in our sample. On the other hand, in 2010 sales to households are highly predominant in Ha Tay, Lao Cai and Khanh Hoa.

participants, who at least initially sell to other households. In fact, sales to traders seem to be strongly influenced by quantity produced (as shown in Table 3). More consistent sellers, who also produce larger quantities, mostly sell to traders. Households consistently selling to a trader scale up their production over time, and consistently produce and sell strikingly higher quantities than any of the other groups, as shown in Table 4. Households switching in and out of rice sales, on the other hand, are more likely to sell to another household. There is substantial mobility in channels of sales used, but this is again mostly related to quantity produced, with households scaling down their production often switching from selling to a trader to selling to other households.

Table 3: Rice quantity produced and sold by purchaser (trader or household)

	2008		2010	
	Household	Trader	Household	Trader
Rice quantity produced, previous period (kg)	2596.10	5501.38	2423.33	7483.92
Rice quantity sold, previous period (kg)	921.86	4001.45	975.55	5615.64
Rice quantity produced (kg)	2679.17	5967.18	2505.12	8453.07
Rice quantity sold (kg)	1149.23	4413.56	1392.69	6549.04
Rice price received (000 VND)	5.60	5.34	5.76	5.36

Table 4: Rice quantities produced and sold by mobility in purchaser used (trader or household)

	T – T	H – H	H – T	T – H
Quantity produced in 2006 (kg)	10135.58	2816.24	3424.18	2830.66
Quantity sold in 2006 (kg)	8612.18	1063.82	1502.78	1232.86
Quantity produced in 2010 (kg)	12652.27	2913.06	3718.88	2825.91
Quantity sold in 2010 (kg)	10189.45	1728.62	2374.5	1798.49
Rice price in 2008 (000 VND)	5.22	5.45	6.13	5.23
Rice price in 2010 (000 VND)	5.30	6.00	5.19	5.03
N	208	133	60	177

Overall, however, households selling to traders in either or both years, compared to households who sell to other households, are on average better off in terms of income and assets and less likely to be poor (Table 8 in the Appendix). They operate more land, a larger proportion of which is irrigated, spend more on inputs and hire more labour, and are more likely to have access to credit as well as to extension and training services. These are slightly smaller households, significantly less likely to be of an ethnic minority, and more likely to be literate. Although they live further away from the nearest all-weather road, they are more likely to own a means of transport. They are not consistently more likely to own a telephone, but it is worth noting the sharp increase in phone owners between 2008 and 2010.

While in the literature it is often assumed that selling to traders means selling at the farmgate, and selling to markets means travelling, we are able to separate out these two components of the process of selling for 2010 and find that, in Vietnam, this pattern is not always found. The vast majority of households in the sample sell at the farmgate (70%) and no significant difference in price is observed between selling at the farmgate and selling at a more distant location. Even though the majority of households selling to a trader do sell at the farmgate, actually the majority of households selling at the farmgate are selling to another household. There are also some households who travel some distance in order to sell to a trader, and these represent the majority of households travelling in order to sell. They however tend to travel shorter distances compared to households travelling in order to sell to another household (2.8 km versus 3.4 km respectively). Table 9 in the Appendix presents a breakdown of the sample into four groups depending on channel of sales and distance travelled. Reported characteristics are for 2010 but the picture is substantially unchanged when considering 2008 characteristics.

Households who travel in order to sell to a trader are producing and selling the largest quantities, and are selling the largest share of their production. They receive the highest price, which however, presumably, is gross of transportation costs. They are overall relatively well-off with respect to welfare indicators and are the group who is most likely to own a phone.

By contrast, households who sell to another household after having travelled are the poorest group. These are the households who are most dependent on income from agriculture, but their quantities produced and sold are much smaller than for households selling to traders. They receive a much lower price than households who travel to sell to a trader, and again this price is likely to be gross of transportation costs. Moreover, while they have to travel a larger distance than households travelling to sell to a trader, they are the group who is least likely to own a means of transport or a phone and to be literate, and most likely to be of an ethnic minority. The vast majority of these households are located in communes where the infrastructure is considered problematic.

These households appear to be overall worse off not just compared to households travelling to sell to a trader, but also compared to households selling at the farmgate to other households. The latter produce and sell relatively small quantities of rice, but their incomes depend less from agriculture than for the other groups. They also receive the highest price for their rice, and this is presumably net of transportation costs. These households live closest to a road and, in general, in areas which are relatively better endowed in terms of infrastructure, and are much more likely to own a phone or a means of transport, to be literate and to be of Kinh ethnicity, than households who travel to sell to another household.

Compared to households travelling to sell to a trader, households selling to a trader at the farmgate produce and sell smaller quantities (which are still substantially larger than for any group selling to other households). This suggests that it is worth travelling to sell to a trader when quantity sold is very large. The two groups are very similar with respect to welfare indicators, share of rice sold, and ownership of phone and means of transport. Households selling to traders at the farmgate, however, are located, on average, closer to a road than households who travel to sell to a trader.

Overall, the data shows a substantial increase in commercialisation over the 2006-2010 period, with respect to both the proportion of people selling rice and the extent of participation in terms of share of output sold. Scale of production appears to be strongly positively related both to rice market participation *per se* (and especially so for consistent sellers), and to the decision to sell to a trader. Overall, assets such as land and irrigation, as well as inputs, are crucial for rice market participation and for sustaining it over time. The demand side of the story also seems to be important: rice sales, and presence of traders and markets, tend to be lower in poorer communes and where transport infrastructure is worse. We observe quite a lot of mobility in channels of sales, which again seems to be driven by changes in quantity produced. Many households sell at the farmgate but there is no one-to-one correlation between the choice of channel of sales and where selling takes place: some households travel in order to sell to other household, and they appear to be the poorest group; a relatively large number of households selling to a trader do so at the farmgate, but some travel, and these appear to be producing the largest quantities.

5. Econometric analysis

In this section we discuss our econometric analysis for household decision to participate in the rice market, type of purchaser used (trader or household), and location of sales (at the farmgate or not).

5.1. Participation in the rice market and purchaser used

Because data on channels of sale for 2006 are not disaggregated by crop, we focus on 2008 and 2010. We analyse the process of selling separately for 2010 (i.e. modelling the probability that a household participates in the rice market in 2010, and that, conditional on participation, it sells to a trader in that year) and for 2008. We exploit the panel by modelling the process of selling using previous period characteristics, in order to address concerns about endogeneity. We also model the probability that a household consistently sells rice over the period under study (as a function of 2006 characteristics), and its probability of selling to a trader in 2010, conditional on being a consistent seller.

Household participation in rice sales and choice of purchaser are modelled as a two-step decision process involving two decisions: (1) the household decides whether or not to sell rice; (2) the household decides whether or not to sell to an established channel of sales, i.e. a trader or enterprise. We use a Heckman's sample selection model to correct for households' self-selection into rice-sellers and non-sellers. This is necessary because selling households are a non-random subset of all the sampled households, who may differ in important unmeasured ways from non-sellers, and least squares without selectivity corrections would lead to invalid estimates of the parameters for the full sample. Modelling the decision to sell rice and the decision to sell to a trader as a two-step, sequential process also has the advantage that it allows us to distinguish between the factors that determine whether or not households sell any output in the market at all, and the factors that influence households' decision on where to sell, given that they produce for the market. The estimation process can be

explained using the example of a two-step approach, although in practice a joint likelihood function is estimated.¹⁰

The dependent variable in the selection equation takes the value of 1 if a household sells some rice and 0 otherwise. The dependent variable in the second stage equation takes the value of 1 if a household sells to a trader and 0 otherwise. District dummies are included in all specifications, to control for unobserved differences in environmental and local conditions.¹¹

In the first step, selection of a household into participation in the rice market is estimated using a probit-type equation, as a function of:

(a) Variables related to farm scale of production, including total operated land area¹², the share that is irrigated, inputs use, membership in farmers' and women's unions, access to extension services, and shocks to production at commune level (including whether, over the previous two years period the commune has suffered from drought, flood or pest invasion);

(b) Household diversification of income sources, including whether at least one household member is earning a wage income; whether the household is engaged in non-farm non-wage activities; whether the household earns any revenues from livestock activities, or from aquaculture; and whether the household had access to credit. Households diversifying away from crop production may still be producing rice and investing in high quality production, but mainly for the purpose of own consumption. On the other hand, households with liquidity constraints due to lack of other income sources may be forced to participate in the rice market in order to get the cash needed to meet other expenditures;

(c) Overall household wealth, measured with an asset index and its quadratic term, to control for possible non-linearities in the relationship with rice market participation.¹³

(d) Proxies for fixed transactions costs which, when high enough, may prevent households from selling. We proxy for search and information costs with household distance from the nearest road, overall road quality in the commune (measured as the share of villages in the commune with a road passable by car during the whole year), literacy of the household head, availability of means of communication in the household, such as telephone and media like TV or radio. Thinness of the market is further controlled for with commune characteristics: size of population, share of poor households, and whether a daily market is present.

¹⁰ An alternative approach to the one adopted here could be to model the selling process with a multinomial logit model. This allows to model jointly the decision to sell to a trader and the decision to sell at the farmgate, accounting for household selection into selling. The main drawback of using this model is that its identifying assumption of independence of irrelevant alternatives is likely to be a very strong one in our case, which may invalidate the estimates.

¹¹ A district is the lower administrative unit below a province.

¹² Total operated land area is defined as the area of all the plots operated by the households, except those used for residential purposes. This definition includes annual and perennial cropland, forest land, grassland and pasture, and land used for fishponds.

¹³ The asset index aggregates and weighs different types of household assets. It is estimated by factor analysis based on a range of household assets: productive assets (land, livestock), durable goods, human capital and social/political connections. The factor analysis assigns weights to the different constituent assets, reflecting among other things patterns of correlation in the data. Because the Asset Index assigns different weights to different assets and includes a broad range of assets, it is capturing something different, i.e. overall household wealth, compared to what is captured by the individual assets we also specifically look at in our analysis.

We also control for household demographics, including household size and share of dependents, age, gender, marital status and ethnicity of the household head.

In the second stage, choice of channel of sales is modelled as a function of

(a) Rice quantity produced, which is expected to increase the probability of selling to a trader;

(b) Overall household wealth, measured again with the asset index and its quadratic term. We also include an interaction term between wealth and quantity produced, in order to test the hypothesis that wealthier farmers are less likely to sell to traders as quantity increases;

(c) Proxies for household relative isolation. This includes household and commune distance from roads, road quality, household's ownership of a means of transport and of a phone and presence of a market in the commune. Where transport is more problematic, we expect households to be less likely to sell to traders, possibly because traders are less prone to visit those communities; however, as quantity sold increases we expect distance from main roads to become less important. On the other hand, we expect a lower likelihood of selling to traders where market infrastructure is available and close by, given that rice sold to other households tends to receive higher prices.

We control for household demographics as before, and also include the inverse Mill's ratio generated in the first stage, in order to correct for sample selection bias.

Tables 10 and 11 in the Appendix show the estimation results for the first and second stage, respectively, and report coefficients, standard errors and marginal effects calculated at the sample mean. The standard errors, reported in parenthesis, are based on the Huber-White estimator of variance, and are robust against many types of misspecification of the model. The marginal effects reported for the selection equation represent the marginal effects of the explanatory variables included in the first stage on the univariate probability of selection, i.e. of selling rice. The marginal effects reported for the second stage equation represent the marginal effects of the explanatory variables included in the second stage on the conditional probability of selling to a trader or enterprise, given the decision to participate in the rice market.

The model for the probability of selling rice correctly predicts 67% of observations for 2010, 68% for 2008 and 55% for consistent sellers. Results (Table 10) show that variables affecting farm scale of production are consistently significant determinants of the probability of participating in the rice market. In particular, households with larger operated land area and spending more for inputs are more likely to sell rice. There is also some evidence that irrigation, membership of farmers' union and access to extension services increase the probability of participation. The likelihood of selling rice decreases with overall household wealth, with no evidence of a non-linear relationship; if anything, in 2010 this seems to decrease faster as wealth increases.¹⁴ Households living in poorer communes, and households with a larger share of dependents, are less likely to participate in rice sales. At least in 2010, having a bike also increases the probability of selling, possibly by decreasing households' relative isolation and information costs on market opportunities. The probability of selling rice consistently over the 2006-2010 is also higher for households who, already in 2006,

¹⁴ We also tried an alternative specification, using per capita food expenditures and its quadratic as a measure of household welfare, but they are never significant, while the other results for both first and second stage remain unchanged.

were literate and owned a means of communication such as TV or radio, and lower for households who were diversifying into livestock production.

Overall, this suggests that, while rice market participation seems to be an important livelihood strategy for less wealthy households, lack of assets, such as land, irrigation and social and human capital, as well as market thinness are significant constraints to rice market participation.

The model for the probability of selling to a trader correctly predicts 69% of observations for 2010, 75% for 2008 and 72% for consistent sellers. Results (Table 11) consistently show that households producing larger quantities are more likely to sell to a trader. This is consistent with the hypothesis that traders or enterprises may prefer to deal with larger farmers in order to minimise their own transaction costs. However, at least for 2010, there is some evidence that wealthier households become less likely to sell to a trader as their quantity produced increases, as found also by Fafchamps and Vargas Hill. Wealthier farmers may prefer to look for a more remunerative alternative, even if it entails the transport cost of carrying the crop to an alternative market, given that liquidity is in this case less of a constraint and farmers are more likely to be able to pay for transport.

At least in 2010, household wealth significantly increases the likelihood of selling via a more established channel. This may depend on the higher opportunity cost of time for wealthier farmers. One trader or enterprise may buy at once all the crop households wish to sell; on the other hand, selling to a household buying for own-consumption may take longer, if producers need to wait around for willing buyers to show up, or to conduct more than one transaction in order to sell as much as they wish to. Wealthier households may also be more likely to have better storage facilities, which would enable them to wait for a trader without fear of spoiling the crop. The opportunity cost of time interpretation is also supported by the negative and significant coefficient on household size: *ceteris paribus*, households selling to other households tend to be larger, as this might ease their time constraint, while households with children younger than five or in primary school age are significantly more likely to sell to a trader.

The probability of selling to a trader decreases with household distance from the nearest road, but increases when more isolated households own a means of transport and also where the overall quality of the transport network is better: households located in communes with a larger share of villages with a road passable by car the whole year are more likely to sell to a trader. Presence of a daily market decreases the probability of selling to a trader, suggesting that selling at the market may be a preferred option for households when available.

There is some evidence that younger farmers and female headed households are less likely to sell to traders. Ethnic minorities are more likely to sell to traders in 2010, while this pattern is reversed, and strongly so, in 2008. This may have to do with the difference in ethnic composition of the communes where traders stop going from 2008 to 2010.

Overall, it appears that scale of production, liquidity constraints, opportunity cost of time, and overall household connectedness with respect to transport infrastructure, are the strongest determinants of sales to a trader.

5.2. Travelling or selling at the farmgate?

Because information on distance travelled in order to sell is not available for 2008, we are only able to model the decision of selling at the farmgate in 2010, for households observed to be selling in 2010, and for households who were consistently observed to be selling over the 2006-2010 period. Household decision of whether to travel or to sell at the farmgate is modelled again as the second step of a two-stage probit correcting for sample selection, where the first stage is, as before, the household's decision of whether or not to sell rice, modelled in the same way as in the previous section, and providing the same results. The dependent variable in the second stage equation takes the value of 1 if a household sells at the farmgate and 0 otherwise. All regressions also include district dummies.

The decision of selling at the farmgate is modelled as a function of household demographics, as well as

(a) Household wealth, measured with the asset index and its squared term. Household wealth, by increasing the opportunity cost of time of the farmer, may increase the likelihood of selling at the farmgate; on the other hand, by easing liquidity constraints, household wealth may also encourage farmers to travel in order to reach potentially more remunerative markets;

(b) Quantity sold: in the absence of transportation options, as quantity increases the likelihood of selling at the farmgate is expected to increase, because it may become too costly for households to travel in order to sell. However, if liquidity constraints are not binding, it may become worthwhile for households to travel as their quantity sold increases. This is tested by interacting quantity sold with household wealth;

(c) Household relative isolation: this is measured with characteristics of the local transport infrastructure, including distance between commune centre and nearest bus stop. The probability of selling at the farmgate is expected to be lower for farmers less favourably located with respect to the transport network. We control for household ownership of a means of transport and of a phone, which are expected to lower transportation and search costs and to encourage farmers to travel. We also control for presence of a daily market in the commune. On the one hand, this may favour farmers' decision to travel to the market to sell; on the other, it may reflect the fact that markets in these communes are overall thicker and thus it is easier to sell at the farmgate.

Table 12 the Appendix shows the estimation results for the second stage equation and report coefficients, standard errors (based on the Huber-White estimator of variance) and conditional marginal effects calculated at the sample mean. The model for the probability of selling at the farmgate correctly predicts 68% of observations for 2010 and 75% for consistent sellers. Results show that wealthier households are significantly more likely to travel in order to sell. Travelling is also more likely for more isolated households, that is, those who do not own a means of transport, living in communes where the distance between the commune centre and the main road is larger and where the overall quality of the infrastructure is lower. Having a phone also

increases the probability of travelling in order to sell, while being located in a community where a daily market is available actually facilitates sales at the farmgate, suggesting that the market may be overall thicker there. Ethnic minorities are also significantly more likely to travel, while there is some evidence that female-headed households tend to sell at the farmgate. With respect to quantity sold, its role is barely statistically significant and the story is not consistent across the two groups: for households observed to sell in 2010, larger quantities are associated with a lower probability of selling at the farmgate; for consistent sellers, the probability of selling at the farmgate actually increases with quantity sold. Consistent sellers, however, may have established over time relations with potential buyers and may be better known as sellers, so that also their bargaining power vis-à-vis buyers at the farmgate may be higher both in terms of prices paid and in terms of buyer's willingness to travel to the farmgate.

Overall, the picture suggests that a dual process may well be happening here. On the one hand, travelling in order to look for more remunerative options may be the preferred option of wealthier and more commercialised households, who are potentially able to get information on marketing options by phone. On the other, more isolated households may not have any other option than to transport the product themselves in order to sell.

6. Conclusions

In this paper we studied rice market participation, and in particular the choice of channel of sales, distinguishing between the type of purchaser households used and the location of sales (whether at the farmgate or not). Relatively few people have studied both aspects of agricultural commercialisation, which however are likely to have important implications for household welfare.

Vietnam is a good example for analysing these questions. Agricultural commercialisation has seen an impressive increase over the past twenty-five years in this country, and expansion in household participation in the rice market is an important component of this story. There is also little doubt that those households that sell agricultural output are better off than those that do not, even though at this stage it is not possible for us to draw conclusions on causality based on these observations, which deserve further investigation. It is also interesting to observe an increase in both the proportion of people selling and in the extent of rice market participation among poorer households over time. However, it remains the case that a significant number of households are not selling any of their output, or are only doing so in some years but not others. There are some geographic dimensions to this; commercialisation is well developed in Long An and in the cash crop growing areas of the Central Highlands, whereas the level of commercialisation in some areas of the north, while still substantial, is less. Households located in areas where the extent of commercialisation is greater are also more likely to sell to traders or enterprises.

In this paper we modelled rice market participation as a two-step process where households first decide whether or not to sell part of their rice output, and then choose the channel of sales. With respect to the participation decision, the paper's principal finding is that household asset endowments, especially land and irrigation, are

strongly positively associated with rice market participation. Union membership and access to extension and training also facilitate participation. Enhancing availability and quality of irrigation, as well as access to inputs and to extension and training services, particularly for those households who are initially worse off with respect to these characteristics, is likely to have an important role in encouraging further participation in rice sales. On the other hand, for poorer households whose land endowments are too small to enable rice market participation without endangering consumption requirements, improved household access to off-farm income opportunities, or further diversification of farm activities, may be a more promising policy strategy.

With respect to channel of sales, in some cases households do not have an available choice, either because market facilities are too distant, or because traders or enterprises do not serve a particular area. Our main results are largely consistent with Fafchamps and Vargas Hill's results for Ugandan coffee growers. We find that the probability of selling to a trader or enterprise increases with quantity sold, as this may lower fixed transaction costs for buyers. We also find that wealthier households are more likely to sell to traders or enterprises, possibly because the shadow value of their time is higher. However, richer farmers are less likely to sell through these channels as the quantity sold increases, which suggests that they are better able to meet transport and other costs entailed in selling through more remunerative channels of sales such as markets. Moreover, our results show that availability of market infrastructure within the commune strongly decreases the probability of selling to traders or enterprises, suggesting that households may prefer to sell through these channels when the option exists. On the other hand, poor quality transport infrastructure makes it more difficult for households to sell to traders or enterprises.

With respect to the location of sales, it may be more convenient for households to sell at the farmgate, but they may have a more limited choice of buyers when doing so. Our results suggest that wealthier and better connected households choose not to sell at the farmgate, being better able to meet the costs of searching for other options. Travelling, however, seems to be only option for poorer and more isolated households.

Developing further the availability of channels of sales is likely to have an important effect in both encouraging commercialisation, and improving household welfare as a result. Developing market and transport infrastructure at the level of the commune may be particularly helpful. Where transport costs are high for households and access to a trader is difficult, marketing associations where farmers organise joint transport may represent another promising alternative, in order to reduce transport costs and thus reap higher prices.

Appendix

Table 5: Panel mobility in rice sales, 2006-2010; Y = selling; N = not selling

	YYY	YYN	YNN	YNY	NYY	NNY	NYN	NNN
Total number of households	414	109	107	104	148	132	105	291
% of panel	29%	8%	8%	7%	11%	9%	7%	21%
<i>Rice quantities produced and sold</i>								
Produced, 2006	6914.31	2394.27	2046.94	2198.50	1686.08	1323.13	1347.84	1013.10
Sold, 2006	5288.73	955.44	748.40	893.14				
Produced, 2008	7447.90	2394.62	1502.72	1688.41	2240.11	1301.77	1614.28	1032.74
Sold, 2008	5525.92	929.63			999.98		623.71	
Produced, 2010	8050.31	1800	1343.75	2276.56	2254.85	1732.70	1338	1008.82
Sold, 2010	6216.59			859.38	1240.08	777.92		
<i>Welfare indicators</i>								
PCFE 2006	108.07	85.30	89.63	87.70	102.80	93.85	93.07	102.46
PCFE 2010	237.73	212.26	168.57	181.68	225.58	222.03	217.23	209.05
AI06	0.18	0.23	-0.92	-1.13	0.74	0.26	0.18	0.27
AI10	1.40	1.33	-0.05	0.25	1.36	1.40	1.19	1.54
% MOLISA poor 2006	21.93%	22.02%	41.12%	32.69%	22.30%	31.06%	27.62%	32.99%
% MOLISA poor 2010	9.49%	18.35%	24.76%	19.42%	14.19%	13.74%	17.14%	14.78%

Table 6: Characteristics of participants and non-participants in rice sales

	2006			2008			2010		
	Yes	No	t-test	Yes	No	t-test	Yes	No	t-test
Mean income from agriculture	9486.32	6442.03	-5.739***	17189.92	11523.96	-6.419***	23145.83	17681.5	-4.202***
Mean total income	22431.5	21974.8	-0.259	38106.67	33923.87	-1.670	75256.64	69653.65	-1.126
Share of poor households (MOLISA)	26%	30%	1.706*	21%	31%	3.682***	12%	17%	2.524**
Total operated land area (ha)	13292.2	7999.21	-3.199***	10544.64	6897.66	-4.562***	9993.839	6810.55	-4.564***
Land area for crop production (ha)	9988.73	4864.57	-6.390***	8445.84	4648.06	-5.694***	7709.447	4924.85	-5.518***
Proportion of irrigated land	80%	76%	-2.292**	84%	70%	-7.751***	85%	75%	-5.700
Total input expenditure (000 VND)	6964.51	2597.69	-7.537***	25806.54	7966.17	-7.499***	28612.92	10281.38	-7.822***
Share of hh hiring labour	40%	23%	-7.401***	58%	35%	-9.353***	64%	39%	-10.21***
Share of hh who borrowed something	72%	65%	-2.793***	48%	46%	-0.880	55%	46%	-3.370***
Household size	4.88	4.67	-2.315**	4.70	4.81	1.204	4.458673	4.58529	1.432
Share of hh of Kinh ethnicity	72%	80%	3.316***	78%	70%	-3.514***	79%	69%	-4.592***
Share of hh who speak Vietnamese	96%	97%	1.767*	97%	95%	-1.571	99%	98%	-2.213**
Share of hh with male head	84%	82%	-1.245	82%	82%	0.379	81%	82%	0.375
Share of hh with literate head	88%	90%	1.052	91%	89%	-1.558	92%	89%	-1.541
Mean distance from nearest all-weather road (km)	1.85	0.95	-5.541***	3.58	2.82	-2.358**	3.023632	2.65	-1.203
Share of hh who own a telephone	12%	14%	1.316	42%	40%	-0.861	62%	69%	2.730**
Share of hh who own a means of transport	87%	88%	1.067	94%	91%	-2.379**	94%	91%	-2.447**
Share of hh who had access to extension/training	43%	38%	-2.331**	29%	19%	-4.590***	54%	52%	-0.778
Share of hh members of farmers' union	53%	56%	0.811	41%	39%	-1.032	45%	51%	2.412**
Share of hh members of women's union	66%	73%	2.697***	57%	59%	0.120	63%	65%	0.746
N	774	756		846	711		859	680	

Table 7: Panel mobility in rice sales, 2006-2010: household characteristics

	Always selling	Switching out	t-test	Never selling	Switching in	t-test
Mean income from agriculture	9457.57	8518.67	-1.296	6470.16	6028.93	-0.687
Mean total income	21521.76	18342.88	-0.894	20938.19	22123.15	0.151
Share of poor households (MOLISA)	24%	31%	1.703*	31%	26%	-1.314
Total operated land area (ha)	13030.31	12584.9	-0.143	8573.48	7022.79	-0.729
Land area for crop production (ha)	10281.81	7626.31	-2.726**	4472.29	5183.72	0.871
Proportion of irrigated land	83%	70%	-4.920***	74%	78%	1.570
Total input expenditure (000 VND)	8643.29	2814.29	-7.080***	2483.22	2603.92	0.391
Share of hh hiring labour	44%	26%	-4.799***	20%	26%	1.828*
Share of hh who borrowed something	73%	69%	-0.954	64%	67%	0.660
Household size	4.82	5.05	1.627	4.72	4.73	0.086
Share of hh of Kinh ethnicity	78%	57%	-5.526***	77%	83%	2.095**
Share of hh who speak Vietnamese	97%	93%	-2.014**	97%	99%	1.788*
Share of hh with male head	85%	85%	0.046	83%	82%	-0.667
Share of hh with literate head	91%	80%	-3.563***	88%	91%	1.183
Mean distance from nearest all-weather road (km)	1.89	1.84	-0.124	0.95	0.93	-0.149
Share of hh who own a telephone	11%	10%	-0.802	14%	12%	-0.790
Share of hh who own a means of transport	90%	78%	-3.967***	86%	93%	2.704**
Share of hh who had access to extension/training	46%	40%	-1.342	35%	42%	1.801*
Share of hh members of farmers' union	54%	55%	0.339	54%	60%	1.578
Share of hh members of women's union	66%	68%	0.382	74%	75%	0.253
N	522	220		407	287	

Table 8: Household characteristics by purchaser

	2008		2010	
	Household	Trader	Household	Trader
Mean income from agriculture	15169.87	18321.99	17681.50	23145.83
Mean total income	33614.12	40658.60	69653.65	75256.64
Share of poor households (MOLISA)	0.29	0.17	0.17	0.12
Total operated land area (ha)	9284.48	11168.15	6810.55	9993.84
Land area for crop production (ha)	6751.77	9374.53	4924.85	7709.45
Proportion of irrigated land	0.82	0.86	0.75	0.85
Total input expenditure (000 VND)	11590.15	33599.55	10281.38	28612.92
Share of hh hiring labour	0.48	0.63	0.39	0.64
Share of hh who borrowed something	0.46	0.49	0.46	0.55
Household size	4.86	4.61	4.59	4.46
Share of hh of Kinh ethnicity	0.62	0.87	0.69	0.79
Share of hh who speak Vietnamese	0.96	0.97	0.98	0.99
Share of hh with male head	0.81	0.81	0.82	0.82
Share of hh whose head can read or write or both	0.89	0.92	0.89	0.92
Mean distance from nearest all-weather road (km)	2.66	4.01	2.65	3.02
Share of hh who own a telephone	0.38	0.44	0.69	0.62
Share of hh who own a means of transport	0.91	0.96	0.91	0.94
Share of hh who had access to extension/training	0.22	0.34	0.52	0.54
Share of hh who are member of farmers' union	0.36	0.45	0.51	0.45
Share of hh who are member of women's union	0.54	0.61	0.65	0.63
N	287	545	680	859

Table 10: Sequential Probit model, first stage: probability of selling rice, 2010, 2008 and consistent sellers

Prob. of selling rice (1 st stage)	Sellers 2010		Sellers 2008		Consistent sellers	
	(1) Coeff	(2) Marg. eff.	(3) Coeff	(4) Marg. eff.	(5) Coeff	(6) Marg. eff.
Ln(total land area)	0.127** (0.056)	0.041** (0.018)	0.140** (0.060)	0.045** (0.019)	0.137** (0.063)	0.033** (0.015)
% of irrigated land	0.073 (0.135)	0.024 (0.044)	0.587*** (0.206)	0.190*** (0.066)	0.626*** (0.153)	0.151*** (0.036)
Ln(inputs expenditure)	0.354*** (0.059)	0.115*** (0.018)	0.377*** (0.070)	0.122*** (0.022)	0.451*** (0.067)	0.109*** (0.015)
Hh hires labour (1 = yes)	0.122 (0.085)	0.040 (0.027)	0.018 (0.104)	0.006 (0.034)	0.239** (0.104)	0.058** (0.025)
Hh is member of farmers' union (1 = yes)	-0.123 (0.090)	-0.040 (0.029)	0.193** (0.095)	0.062** (0.031)	0.170* (0.092)	0.041* (0.022)
Hh is member of women's union (1 = yes)	-0.091 (0.082)	-0.029 (0.026)	0.050 (0.096)	0.016 (0.031)	0.045 (0.100)	0.011 (0.024)
Hh had access to extension (1 = yes)	0.139* (0.082)	0.045* (0.027)	0.016 (0.082)	0.005 (0.027)	0.183** (0.085)	0.044** (0.020)
Commune suffered from drought (1 = yes)	-0.018 (0.109)	-0.006 (0.035)	-0.181 (0.116)	-0.059 (0.037)	-0.034 (0.094)	-0.008 (0.023)
Commune suffered from flood (1 = yes)	0.111 (0.082)	0.036 (0.026)	0.036 (0.137)	0.012 (0.044)	0.022 (0.130)	0.005 (0.031)
Commune suffered from pests (1 = yes)	-0.105 (0.085)	-0.034 (0.027)	-0.128 (0.138)	-0.041 (0.045)	0.049 (0.128)	0.012 (0.031)
Wage income in hh (1 = yes)	0.110 (0.074)	0.036 (0.024)	0.049 (0.082)	0.016 (0.027)	-0.018 (0.089)	-0.004 (0.021)
Non-farm non-wage activities in hh (1 = yes)	-0.104 (0.087)	-0.034 (0.028)	0.146 (0.089)	0.047 (0.029)	-0.086 (0.098)	-0.021 (0.024)
Hh earns revenue from livestock (1 = yes)	-0.044 (0.082)	-0.014 (0.026)	-0.036 (0.115)	-0.012 (0.037)	-0.242** (0.116)	-0.058** (0.028)
Hh earns revenue from aquaculture (1 = yes)	0.078 (0.114)	0.025 (0.037)	-0.077 (0.103)	-0.025 (0.033)	-0.071 (0.113)	-0.017 (0.027)
Hh had access to credit (1 = yes)	0.012 (0.069)	0.004 (0.022)	-0.034 (0.086)	-0.011 (0.028)	0.046 (0.092)	0.011 (0.022)
Asset Index	-0.073*** (0.027)	-0.024*** (0.009)	-0.053** (0.025)	-0.017** (0.008)	-0.139*** (0.027)	-0.033*** (0.006)
Asset Index squared	-0.005* (0.003)	-0.002* (0.001)	-0.000 (0.002)	-0.000 (0.001)	0.003 (0.003)	0.001 (0.001)
Hh head is literate (1 = yes)	0.106 (0.142)	0.035 (0.046)	-0.026 (0.150)	-0.008 (0.049)	0.487*** (0.184)	0.117*** (0.044)
Hh owns TV or radio (1 = yes)	0.233 (0.162)	0.075 (0.053)	-0.200 (0.129)	-0.065 (0.042)	0.267* (0.142)	0.064* (0.034)
Hh owns phone (1 = yes)	-0.028 (0.091)	-0.009 (0.029)	-0.119 (0.126)	-0.039 (0.041)	-0.035 (0.146)	-0.009 (0.035)
Hh owns bike (1 = yes)	0.143* (0.082)	0.046* (0.027)	0.066 (0.099)	0.021 (0.032)	-0.083 (0.105)	-0.020 (0.025)
Distance from nearest road (km)	-0.006 (0.006)	-0.002 (0.002)	0.021 (0.014)	0.007 (0.005)	0.019 (0.014)	0.005 (0.003)
Proportion of villages in commune with all – weather road	0.001 (0.001)	0.000 (0.000)	0.018 (0.110)	0.006 (0.036)	0.026 (0.123)	0.006 (0.030)
Daily market in commune (1 = yes)	-0.047 (0.090)	-0.015 (0.029)	0.057 (0.088)	0.018 (0.028)	0.098 (0.091)	0.024 (0.022)
N of households in commune	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
% of poor hh in commune	-0.158 (0.236)	-0.051 (0.076)	-0.529** (0.235)	-0.171** (0.076)	-0.758** (0.303)	-0.183** (0.073)

Household size	0.016 (0.027)	0.005 (0.009)	0.007 (0.028)	0.002 (0.009)	0.023 (0.030)	0.006 (0.007)
Share of dependents	-0.648*** (0.150)	-0.210*** (0.048)	-0.297 (0.201)	-0.096 (0.065)	-0.849*** (0.196)	-0.205*** (0.046)
Age of hh head	0.002 (0.003)	0.001 (0.001)	0.003 (0.003)	0.001 (0.001)	-0.003 (0.004)	-0.001 (0.001)
Gender of hh head (1 = male)	-0.107 (0.108)	-0.035 (0.035)	-0.124 (0.139)	-0.040 (0.045)	0.175 (0.158)	0.042 (0.038)
Hh head is Kinh (1 = yes)	0.206 (0.135)	0.067 (0.044)	-0.016 (0.145)	-0.005 (0.047)	-0.075 (0.152)	-0.018 (0.037)
Hh head is single (1 = yes)	0.239 (0.380)	0.078 (0.123)	0.121 (0.156)	0.039 (0.051)	0.156 (0.167)	0.037 (0.040)
Constant	-4.512*** (0.669)		-4.802*** (0.731)		-6.664*** (0.790)	
Observations	1,376		1,366		1,412	
rho	-0.864		0.0107		-0.645	

Explanatory variables are previous period characteristics. District dummies are included. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 11: Sequential Probit model, second stage: probability of selling to a trader, conditional on selling rice; 2010, 2008 and consistent sellers

Prob. of selling to a trader	Sellers 2010		Sellers 2008		Consistent sellers	
	(1) Coeff	(2) Marg. eff.	(3) Coeff	(4) Marg. eff.	(5) Coeff	(6) Marg. eff.
Ln(rice quantity produced)	0.146 (0.092)	0.060** (0.030)	0.360** (0.180)	0.106** (0.054)	0.300** (0.150)	0.089** (0.036)
Asset Index	0.278** (0.128)	0.098* (0.054)	0.255 (0.171)	0.075 (0.050)	-0.127 (0.308)	-0.037 (0.090)
Asset Index squared	0.001 (0.005)	-0.001 (0.002)	0.003 (0.004)	0.001 (0.001)	-0.011 (0.009)	-0.003 (0.003)
Ln(rice quantity produced)*Asset Index	-0.040** (0.017)	-0.016** (0.007)	-0.035 (0.022)	-0.010 (0.006)	0.007 (0.037)	0.002 (0.011)
Hh owns transport (1 = yes)	-0.032 (0.193)	-0.013 (0.078)	-0.015 (0.234)	-0.005 (0.069)	0.318 (0.521)	0.094 (0.154)
Distance from nearest road (km)	-0.058* (0.030)	-0.025** (0.012)	0.050 (0.045)	0.015 (0.013)	-0.025 (0.046)	-0.007 (0.014)
Distance from road*own transport	0.066** (0.028)	0.027** (0.011)	-0.011 (0.049)	-0.003 (0.014)	0.066 (0.048)	0.019 (0.014)
Distance commune – nearest road (km)	0.037** (0.018)	0.015* (0.008)	0.001 (0.001)	0.000 (0.000)	0.005 (0.010)	0.001 (0.003)
Proportion of villages in commune with all – weather road	0.003* (0.002)	0.002*** (0.001)	0.047 (0.162)	0.014 (0.048)	0.009*** (0.003)	0.003*** (0.001)
Daily market in commune (1 = yes)	-0.251** (0.105)	-0.112*** (0.035)	-0.175 (0.123)	-0.052 (0.035)	-0.050 (0.157)	-0.015 (0.046)
Hh owns phone (1 = yes)	0.098 (0.098)	0.032 (0.036)	-0.078 (0.184)	-0.023 (0.054)	0.248 (0.159)	0.073 (0.047)
Hh head is literate (1 = yes)	0.015 (0.183)	0.027 (0.067)	-0.364 (0.228)	-0.107 (0.067)	-0.146 (0.266)	-0.043 (0.079)
Household size	-0.050 (0.032)	-0.017 (0.011)	-0.079** (0.038)	-0.023** (0.011)	-0.088* (0.048)	-0.026* (0.015)
Age of hh head	-0.004 (0.004)	-0.001 (0.001)	0.014** (0.006)	0.004** (0.002)	-0.002 (0.006)	-0.001 (0.002)
Gender of hh head (1 = male)	0.226* (0.132)	0.067 (0.050)	0.168 (0.200)	0.050 (0.060)	0.156 (0.193)	0.046 (0.056)
Hh head is Kinh (1 = yes)	-0.304** (0.136)	-0.082 (0.051)	0.818*** (0.193)	0.241*** (0.056)	-0.232 (0.260)	-0.068 (0.079)
Hh head is single (1 = yes)	-0.113 (0.383)	0.005 (0.148)	0.042 (0.222)	0.012 (0.064)	0.888 (0.773)	0.263 (0.228)
Child younger than 5 in hh (1 = yes)	0.064 (0.151)	0.026 (0.061)	0.520** (0.205)	0.154** (0.060)	0.437 (0.323)	0.129 (0.093)
Primary school age child in hh (1 = yes)	-0.056 (0.102)	-0.023 (0.041)	0.434*** (0.159)	0.128*** (0.046)	0.051 (0.198)	0.015 (0.059)
Constant	-0.001 (0.949)		-2.138 (2.369)		-1.262 (1.685)	
Observations	1,376		1,366		1,412	
% correctly predicted	69%		75%		72%	

Explanatory variables are previous period characteristics. District dummies are included. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 12: Sequential Probit model, second stage: probability of selling at the farmgate, conditional on selling rice; 2010, 2008 and consistent sellers

Prob. of selling at the farmgate	Sellers 2010		Consistent sellers	
	(1) Coeff	(2) Marg. eff.	(3) Coeff	(4) Marg. eff.
Asset Index	0.203 (0.174)	0.048 (0.044)	0.094 (0.288)	0.023 (0.068)
Asset Index squared	-0.014** (0.006)	-0.004*** (0.001)	-0.021*** (0.007)	-0.005*** (0.002)
Ln(rice quantity produced)	-0.172* (0.098)	-0.044 (0.028)	0.153* (0.088)	0.037 (0.026)
Ln(rice quantity produced)*Asset Index	-0.013 (0.022)	-0.003 (0.006)	-0.004 (0.034)	-0.001 (0.008)
Hh owns phone (1 = yes)	-0.225* (0.130)	-0.057* (0.032)	-0.304** (0.146)	-0.074* (0.038)
Hh owns transport (1 = yes)	0.364 (0.277)	0.093 (0.068)	1.252*** (0.427)	0.304*** (0.088)
Distance from nearest road (km)	-0.001 (0.014)	-0.000 (0.004)	0.007 (0.012)	0.002 (0.003)
Distance commune – nearest road (km)	-0.064*** (0.018)	-0.016*** (0.004)	-0.066*** (0.025)	-0.016*** (0.004)
Proportion of villages in commune with all –weather road	-0.002 (0.002)	-0.001 (0.001)	-0.006* (0.003)	-0.001** (0.001)
Daily market in commune (1 = yes)	0.280** (0.124)	0.067** (0.031)	0.293* (0.162)	0.071** (0.036)
Distance commune centre – bus stop (km)	-0.006 (0.009)	-0.001 (0.002)	-0.007 (0.008)	-0.002 (0.002)
Household size	-0.055 (0.038)	-0.014 (0.009)	0.007 (0.044)	0.002 (0.011)
Age of hh head	0.005 (0.005)	0.001 (0.001)	0.010 (0.007)	0.002* (0.001)
Gender of hh head (1 = male)	-0.036 (0.150)	-0.014 (0.038)	-0.461** (0.196)	-0.112*** (0.043)
Hh head is literate (1 = yes)	0.135 (0.215)	0.040 (0.055)	0.074 (0.250)	0.018 (0.062)
Hh head is Kinh (1 = yes)	0.501** (0.233)	0.134*** (0.044)	0.443** (0.218)	0.108* (0.058)
Hh head is single (1 = yes)	-0.195 (0.414)	-0.037 (0.099)	-0.310 (0.425)	-0.075 (0.105)
Child younger than 5 in hh (1 = yes)	0.290 (0.224)	0.074 (0.058)	0.078 (0.267)	0.019 (0.066)
Primary school age child in hh (1 = yes)	0.126 (0.155)	0.032 (0.040)	0.035 (0.203)	0.008 (0.049)
Constant	0.734 (1.345)		-3.074*** (1.043)	
Observations	1,361		1,406	
rho	-0.340		0.875	

Explanatory variables are previous period characteristics. District dummies are included. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

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