Food Policy 94 (2020) 101811

Contents lists available at ScienceDirect

Food Policy

journal homepage: www.elsevier.com/locate/foodpol

The impact of agricultural commercialisation on household welfare in rural Vietnam

Chiara Cazzuffi[a], Andy McKay[b,*], Emilie Perge[c]

[a] Economics Department, Universidad Iberoamericana, Mexico
[b] University of Sussex, Brighton, UK
[c] World Bank, United States

ARTICLE INFO

Jel Classification:
O12
O13
Q12
Q13

Keywords:
Commercialisation
Smallholders
Rice
Vietnam
Panel data

ABSTRACT

Commercialisation by smallholder farmers has played a major role in agricultural development in many Asian countries, and while there are assumptions that this has led to welfare improvement, in fact there is relatively little evidence on this question. In this paper we use high quality panel data to examine the welfare impact of agricultural commercialisation in a leading Asian producer, Vietnam. We use the five-wave Vietnam Access to Resources Household Survey (VARHS) panel data set from 2008 to 16, three measures of household welfare and create commercialisation indexes in relation to all crops and to rice specifically. We find a significant positive relationship of commercialisation with household asset accumulation, but a negative association with consumption expenditure.

1. Introduction

Agricultural commercialisation is an important driver of structural transformation and can play a critical role in rural development and poverty reduction. Commercialisation, defined as the degree to which a farm household is connected to markets, can take many forms. At one extreme, fully commercialised households make production decisions based on market signals and comparative advantage; at the other, subsistence farm households make production decisions based on their semi-fixed factor endowments and subsistence requirements, selling only the surplus left after household consumption (Pingali and Rosegrant, 1995).

From a theoretical point of view, commercialisation is expected to generate welfare gains at both household and aggregate levels. The gains derive, on the one hand, from static welfare effects of specialization and trade according to comparative advantage. These translate in income and employment effects directly reflected in household welfare, and in improvements in health and nutrition which are contingent on the level of income. On the other hand, dynamic gains derive from the growth in productivity arising from technological changes fostered by increased interactions and exchange of ideas (Barrett, 2008). However, when markets are imperfect, switching from subsistence to commercial agriculture may have negative impacts on household welfare by exposing households to volatile prices and food insecurity (Jaleta et al., 2009). Households with better endowments in terms of productive assets or human capital, for example, might be better placed to take advantage of commercialisation opportunities.

In Asia, agricultural development and commercialisation of both traditional and higher-value crops have been predominantly driven by small farms. Commercialisation of agriculture has expanded substantially as a result of many factors, including investment to provide greater access to markets, roads and technology (Wiggins, 2018). This increase in commercialisation has also been accompanied by a rapid growth in nonfarm activities in rural areas and has been a critical driver of the process of industrialization and urban growth. Wiggins argues that increasing rural wages and shortages of labour in rural areas in many Asian countries suggests that many rural households may have benefited from the direct and indirect effects of commercialisation. The literature finds mixed results: in some cases, households benefit from commercialisation through greater productivity and income (Tipraqsa and Schreinemachers (2009) in Thailand; Bellemare (2012) in Madagascar); or contract farming leads to increased food security in Madagascar (Bellemare and Novak, 2017). But commercialisation does not lead to an increase in durable goods and land (Michelson, 2013, in

* Corresponding author.
E-mail addresses: a.mckay@sussex.ac.uk (A. McKay), eperge@worldbank.org (E. Perge).

https://doi.org/10.1016/j.foodpol.2019.101811
Received 15 November 2019; Accepted 11 December 2019
Available online 08 January 2020

Nicaragua) or nutritional status (Carletto et al., 2017 in Malawi, Tanzania and Uganda). Impacts from commercialisation are highly heterogeneous among groups (e.g. gender) and specific to location and policy environments (Poulton, 2017; von Braun and Kennedy, 1994; Fischer and Qaim, 2012).

In this paper, we present an in-depth study of the impact of agricultural commercialization on the welfare of rural households in one important agricultural country in Asia, Vietnam, where agriculture has historically been one of the largest sectors of the economy and which has been an impressive success story in terms of growth and poverty reduction. Since the *Doi Moi* reforms, initiated in 1986 and accelerated from the early 1990s, per capita GDP grew at an average rate of 5.0%, and of 5.5% from 1992 onwards, accompanied by one of the fastest rates of monetary poverty reduction in the world, from 49.2% of the population in 1992 to only 3.1% in 2014.[1] Rural areas also experienced a significant decline in monetary poverty, falling in the recent period from 27.0% in 2010 to 13.6% in 2016 (World Bank, 2018).

The *Doi Moi* reforms sparked a process of structural transformation, and of transformation of the agricultural sector. The share of agriculture in employment decreased as the importance of rural non-farm activities increased, but data from World Development Indicators 2018 shows that the value added of agriculture continued to increase by an average of 3.7% per year between 1992 and 2016. The productivity of agriculture also increased substantially, partly as the result of land reforms that transferred land use rights from collectives to individual households, and progressively increased tenure security and duration, with significant impacts on investment, especially in irrigation (Bellemare et al., 2018; Markussen, 2017; Newman et al., 2015).

Overall, agriculture has been an important part of Vietnam's development and structural transformation over the past thirty years (Glewwe et al., 2004; McCaig and Pavcnik, 2013), and it has been suggested that the shift from mainly subsistence to increasing commercialisation may have played a role in improving rural living conditions (World Bank, 2008). Increased connection to the world market, however, also means higher exposure to its volatility. Vu and Glewwe (2011) analyse the welfare impacts of price changes until 2006, and find that, overall, the increase in food prices raised average household welfare. However, they find that higher food prices made most households worse-off. The positive average effect arises because the average welfare loss of net food purchasers was smaller than the average welfare gains of food sellers.

Moreover, despite the overall positive role of agriculture in Vietnam's development, and some evidence that it has also contributed to reducing inequality over time (Benjamin et al., 2017), important distributional concerns exist. Benjamin and Brandt (2004) find that agricultural liberalization and other reforms have benefitted farm households living in the South more than those in the North. Benjamin et al. (2017) highlight the deteriorating position of ethnic minorities compared to the rest of the population. McKay and Tarp (2017) confirm both geographic and ethnic heterogeneities in welfare improvements.

In this paper we use the five waves of the Vietnam Access to Resources Household Survey (VARHS) panel data set to consider the extent to which the increase in commercialisation is associated with improvements in welfare levels of rural households, considering both more short-term welfare measures (food consumption, income) as well as longer term measures (asset holdings), and differences among socioeconomic and demographic groups. This high-quality panel survey data enables us to control for unobserved heterogeneity across households. The survey covers an 8-year period from 2008 to 2016, including the period of the major food price rise – which impacted Vietnam positively in aggregate (thanks to effective government policies) but not for all individual farmers (McKay and Tarp, 2015). This time span also allows short-term fluctuations and medium-term impacts to be distinguished.

While agricultural commercialisation in Vietnam took many forms, in this paper we focus both on sales of rice – Vietnam's dominant agricultural product – and overall crop sales. Since the 1990s, as restrictions on internal and external trade were relaxed, rice productivity increased substantially, and Vietnam moved from being a net importer of rice, to becoming the fourth biggest rice exporter worldwide (Goletti and Minot, 1997; Minot and Goletti, 1998). Today, rice is the crop produced by most smallholder households throughout the country and sold by many, while other crops (maize, peanuts) are grown by a smaller set of households for their home-consumption and to some extent for sales. The last twenty years have also seen the development of cash crops, which are however not as widespread as rice: coffee, for instance, is mainly grown in the Central Highlands region. We also include these crops in a more comprehensive measure of agricultural commercialisation. Thus, compared to most of the literature, which tends to focus on cash or export crops, or on particular forms of commercialisation, such as contract farming, we examine a more comprehensive concept of commercialisation.

We measure commercialisation as the share of output that is sold, to capture the extent to which producers engage with the market, and explore heterogeneity of impacts between farmers with different characteristics, based both on the characteristics of the households (gender of head, ethnicity, location) and the nature of their engagement with the market, that is, whether they consistently sell some of their crops, or whether they only occasionally participate in sales. We estimate the welfare impact of commercialisation using fixed effects models with lagged values of potentially endogenous variables and an instrumental variable approach.

We find that increasing agricultural commercialisation is associated with higher asset levels, while it has no significant impact on household income. This suggests that agricultural commercialisation is associated with welfare improvements in the medium to long term, but not in the short term. In fact, we also find indication of a negative effect of commercialisation on household consumption. These results hold both for the overall measure of commercialisation, and for rice commercialisation in particular, and we find very little heterogeneity in impacts across groups. Meanwhile, selling cash crops is associated with increases in household income per capita.

This paper is structured as follows. Following this introduction, Section 2 reviews the relevant literature on commercialisation. In Section 3 we introduce the data and present an in-depth descriptive analysis. Our modelling approach is set out in Section 4, after which Section 5 highlights our results. Section 6 concludes.

2. The international literature on the impacts of agricultural commercialisation

The literature has used various measures to qualify a farm household as commercialised, including whether it is producing a significant amount of cash commodities, or selling a considerable proportion of agricultural output. A definition of commercialisation focused only on resources allocated to cash crops may be misleading, as food crops are also often sold. Von Braun (1994) defined three indices for measuring different and complementary aspects of commercialisation: (a) the proportion of agricultural output sold to the market and input acquired from market to the total value of agricultural production; (b) the ratio of the value of goods and services acquired through market transactions to total household income, including in-kind transaction; and (c) the ratio of the value of goods and services acquired by cash transactions to total household income. These indices, especially variations of the first two, are widely used in the literature and we use the first as a basis for our measure of commercialisation.

Cross-section studies addressing endogeneity issues by controlling

[1] According to the $1.90 poverty line. More recent data finds the national poverty headcount, computed relative to a recently reset poverty line, fell from 20.7% in 2010 to 9.8% in 2016.

for self-selection into agricultural commercialisation tend to find positive impacts of commercialisation on various aspects of household welfare. Using an instrumental variable technique, Tipraqsa and Schreinemachers (2009) find that integration into output markets improves farm productivity and net per capita income among the Karen Hill tribes in Thailand; and Bellemare (2012) and Bellemare and Novak (2017) find that participating in contract farming is associated with an increase in household income, a decrease in its variability, and a shortening of the hungry season experienced by households in Madagascar. Rao and Qaim (2011), using an endogenous switching regression model, find positive effects of supplying to supermarkets on household income in Kenya, especially for households that are poor or own little land. Ogutu and Qaim (2019) use a control function method and find that commercialisation significantly reduces poverty in Kenya, in both income and multidimensional terms. They find that impacts are heterogeneous: while the magnitude of income gains increases with income, the magnitude of poverty reduction is strongest among the poorest households. Meanwhile, Romero Granja and Wollni (2018) combine cross-sectional household data with longitudinal data on export market transactions. They estimate a duration model of smallholders' entry and exit from the market for broccoli in Ecuador, and then use the predicted length of participation derived from the duration model as the treatment of interest in a least squares equation. They find no evidence that participation translates into tangible benefits for farmers.

Studies using panel data tend to find more nuanced results. Carletto et al. (2011) use panel data and a difference-in-difference estimation to evaluate the long term impact (1985–2005) of non-traditional agricultural exports on changes in household consumption status and asset position in Guatemala, taking into account the timing and duration of participation. On average, they find that welfare levels have improved for all households regardless of adoption status and duration, but the extent of the improvement varies widely across groups: households with longer term participation experienced the smallest increase in welfare, while early participants who switched out after the 1980s boom in export commodities achieved the best outcomes in terms of assets and housing conditions. Using similar methods, Michelson (2013) estimates that participation in the supermarket supply chain of vegetables in Nicaragua is associated with higher holdings of productive assets, but not of consumer durables or land. Muricho et al. (2017) use an endogenous switching regression model and correlated random effects estimation strategy, and find that agricultural commercialisation significantly increases annual per capita household expenditure in Kenya. Meanwhile, Carletto et al (2017) find little evidence of a positive relationship between commercialisation and nutritional status in Malawi, Tanzania and Uganda. Andersson et al (2015) find that participation in supermarket chains increase income levels of smallholders in Kenya. Finally, Muriithi and Matz (2015) find positive impacts of vegetable commercialisation on welfare in Kenya, with sales for exports positively associated with increases in income, and sales for the domestic market associated with increases in both incomes and assets.

3. Description of households participating in rice commercialisation

3.1. Data and measures

As already noted, the present analysis relies on a panel dataset, the Vietnam Access to Resources Household Survey (VARHS), formed of five waves collected at two-year intervals (2008, 2010, 2012, 2014 and 2016). Administered in the rural areas of 12 provinces[2] by the Institute for Labour Science and Social Affairs (ILSSA) of the Ministry of Labour, Invalids and Social Affairs (MOLISA) in partnership with the Central Institute for Economic Management (CIEM) and the University of Copenhagen with financial support from DANIDA, the survey has detailed modules on agricultural activities, land uses, aquaculture and income sources along with household composition and characteristics.[3] In these five waves, 2131 households were repeatedly surveyed. The attrition rates was low in this data set (McKay and Tarp, 2017).

This dataset allows us to focus on three complementary household welfare measures: income, food consumption, and assets (McKay and Tarp, 2017). The asset measure serves as a longer-term welfare measure which is less likely to fluctuate over time and which can make a direct contribution to household productivity. The survey collects information on a wide range of household assets, including ownership of productive assets (land, livestock), durable goods, human capital (the average level of education of household members 15 years and above) and social/political connections (e.g. membership of local organisations).[4] As values for many of these assets are not available, we follow Sahn and Stifel (2000) and combine these into a single measure estimated by factor analysis. Details of the index used are presented in Appendix Table A.1.

While income is invariably difficult to measure accurately, the survey collects detailed information on incomes from all productive activities of the household. We compute household income as the sum of salaries, rents, government and private transfers, net revenues generated by sales of crops, livestock, aquaculture, and forestry (minus input costs), and net revenues from other own-account activities. Food consumption data encompasses 22 groups covering most categories of food commodities consumed over the preceding four weeks (from purchases, own production, or other sources). Both income and consumption expenditures are adjusted for price differences over time. The price adjustment over time for the income measure is made using the rural value of the consumer price index (CPI) at province level; and the adjustment for consumption expenditure is made using the province-level value of the food price index from the CPI.

3.2. Agriculture in Vietnam

Agriculture is central to the livelihood strategies of rural households in Vietnam: across all waves, more than 80% of households in the sample report at least some income from crop cultivation and 58% of households report having some income from livestock. Meanwhile, 60% of households report earning wage income. In 2016, participation in cultivation and in livestock raising decreased compared to earlier years to 77% and 49% of households respectively, while the share of households reporting wage income increased to 65%. Few households have income from forestry (2%) and aquaculture (8%) activities. Many households are also dependent on income from public and private transfers for their livelihoods (45.3% and 51.4% respectively). In terms of the composition of the average household income, the most important source is wages, representing more than 35% of household incomes, while agriculture provides about 25% of household incomes, across all waves.

Table 1 reports the cultivation and sale characteristics of the main crops that are cultivated. While households have diversified portfolios, rice is by a large margin the most important crop, with more than 60% of households cultivating this crop over time. Maize and potatoes are the next most important crops but are cultivated by many fewer households. The number of households that grow each of these crops declines over time. The most important cash crop is coffee, which is cultivated by 8 to 9% of households and does not decline over time.

[2] Dak Lak, Dak Nong, Dien Bien, Ha Tay, Khanh Hoa, Lai Chau, Lam Dong, Lao Cai, Long An, Nghe An, Phu Tho, and Quang Nam.

[3] Further details on the survey can be found in Tarp (2017).

[4] 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 include as control variables in the analysis.

Table 1
Cultivation, Sales, and Percentage sold of all crops (%).

	2008			2010			2012			2014			2016		
	Cult.	Sell	Sold	Cult.	Sell	Sold	Cult.	Sell	Sold	Cult.	Sell	Sold	Cult.	Sell	Sold
Rice	74	54	48	71	56	54	69	57	54	66	58	59	60	51	62
Maize	30	38	72	27	42	67	23	42	73	20	48	72	19	35	69
Potatoes	18	46	83	16	49	79	13	53	79	9	58	86	7	63	88
Peanut	8	66	82	7	67	76	7	52	78	6	57	79	3	70	81
Coffee	8	99	98	8	97	99	9	99	99	9	99	99	9	98	98

Note: *Cult.* reports the proportion of households growing a crop in that year; *Sell* is the percentage of cultivators that sell some of their output; and *Sold* reports the proportion of the output which is sold.

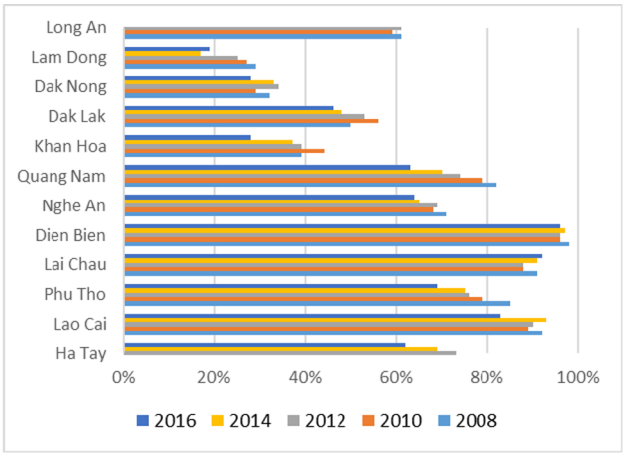

Fig. 1. Percentage of households growing rice, by province, 2008–2016. Source: Authors' elaboration using the VARHS 2008–2016 panel.

Other cash crops grown by smaller numbers of households include tea, cashew, sugar cane and pepper. Coffee is grown predominantly in the Central Highlands region, whereas rice is produced in all Vietnamese provinces, although to varying extents, with more than 90% of households in the poor northern province of Lao Cai doing so over the survey periods (Fig. 1).

While rice is a food crop, it is also sold substantially. Table 1 shows that in all years more than half of rice producers sell and they usually sell more than half of their production. In fact, the share of households selling some of their rice production follows an upward trend until 2014, though declining in 2016. In addition, over time, households are selling more of their rice production, from less than half in 2008, to more than 60% in 2016. For many households this is the main form of agricultural commercialisation they engage in. Rice cultivation and sale is also a stable activity over time: on average across all waves, 85% of households have grown rice three times or more and many have grown rice in all five periods. More than half of these households have sold rice constantly in the 5 waves. Households do not have a very diversified portfolio of crop sales, with overall 55% of households exclusively selling rice (this proportion rising from 36.7% in 2008 to about 65% in 2016). Among those who do not sell rice exclusively, 74% sell only two crops: mostly rice and something else (maize or potatoes). Overall, rice sales represent between 9% and 10% of households' gross income while maize, the second most cultivated crop, accounts for 2% to 4% of households' gross income. When households do sell rice, rice sales represent between 17% and 22% of households' gross income.

Almost all households combine rice sales with other income sources. Across all waves, two thirds of households have income from livestock production and 80% of households raising livestock also grow rice, and half of them generate income through rice sales. About 30% of households grow coffee and rice, and half of them sell rice as well as coffee.

Participation in rice cultivation and sales has increased over time for both poorer and richer households. While the share of households growing rice was highest in the bottom three quintiles of per capita food expenditure in 2008, by 2016 it had become quite homogeneous across quintiles (McKay and Tarp, 2017). The increase in the proportion of rice sold is also observed across quintiles, although with some differences in pattern: in the bottom two quintiles we observe the highest fluctuation in the proportion of output sold from one wave to the next, while in the top quintile the increase is steady throughout the survey period.[5]

3.3. Commercialisation measures

We compute two separate measures of commercialisation: one for all crops produced, and one specifically for rice, given the dominance of rice in production and sales in Vietnam. We define commercialisation as the proportion of output which has been sold, similar to Von Braun (1994) and Muriithi and Matz (2015), defined as follows:

$$CI1_{it} = \frac{Gross\ \ value\ \ of\ \ ricesales_{it}}{Total\ \ gross\ \ value\ \ of\ \ rice\ \ production_{it}} \times 100 \quad (1)$$

$$CI2_{it} = \frac{Gross\ \ value\ \ of\ \ crop\ \ sales_{it}}{Total\ \ gross\ \ value\ \ of\ \ crop\ \ production_{it}} \times 100 \quad (2)$$

The first index, *CI1*, measures households' rice commercialisation, while CI2 measures overall crop commercialisation. A lower index means the household is less engaged with the market. We use the median value of the CI1 commercialisation index (25 percent) to define a household's degree of engagement with rice commercialisation. According to this definition, 37 percent of households are highly engaged in rice sales across all years. In Table 2, based on the sample of households that produced rice in all five waves, we compare the characteristics of rice-producing households more and less engaged in rice commercialisation.

Households highly engaged in rice commercialisation have higher per capita income and consumption and are less likely to be identified as officially poor by MOLISA, compared to the rest of the households, but they do not hold significantly more assets. On average, households highly engaged in rice commercialisation have greater income from crop cultivation but also greater wage income in 2012 and 2016. Even if actively participating in the rice market, as already noted, these sellers depend greatly on wage activities for their welfare. Meanwhile, over the panel period, these households are less likely to have received public transfers.

As expected, households more engaged in rice commercialisation produce and sell substantially more rice on average and are more likely to be regular sellers (having sold more than 3 times over the period).

[5] In contrast, close to 60% of households growing coffee are in the top two quintiles of per capita food consumption in the first 4 waves; in 2016, only 30% of households growing coffee are in the top two quintiles of per capita food consumption. All households growing coffee sell on average more than 90% of their production in all five waves.

Table 2
Selected household characteristics, by participation in rice commercialisation 2008–2016.

	2008		2010		2012		2014		2016	
	No/low	High	No/low	High	No/low	High	No/low	High	No/low	High
Welfare										
HH income	64096.17 (72554.7)	62326.9 (114051.6)	63688.6 (57581.2)	66628.51 (131667.9)	72141.98 (72735.2)	77,087 (57925.1)	83804.65 (83519.9)	91660.35 (83857.9)	96148.84 (95530.9)	96635.77 (100148.1)
Per capita HH income	14619.79 (17773.8)	14437.26 (21064.9)	15483.7 (15567.1)	16046.48 (32594.4)	16938.26 (17525.7)	19559.31*** (15840.4)	19955.66 (19689.8)	22804.73*** (19456)	22,577 (23243.1)	24434.49 (28182.8)
Asset index	−0.6 (3)	−0.5 (2.6)	−0.1 (3)	0.1 (2.8)	0.5 (2.8)	0.6 (2.9)	0.7 (2.8)	1 (2.7)	0.7 (2.6)	0.8 (2.8)
Per capita food expenditures	299.7 (315.2)	296.6 (2 1 4)	283.5 (184.2)	322*** (2 1 3)	386 (261.2)	430.5*** (292.1)	374.7 (268.9)	409** (2 5 5)	419.5 (335.5)	444.4 (378.1)
Poor MOLISA	0.22 (0.4)	0.15*** (0.4)	0.14 (0.4)	0.13 (0.3)	0.22 (0.4)	0.14*** (0.4)	0.14 (0.4)	0.10** (0.3)	0.04 (0.2)	0.02** (0.2)
Activities										
Income from crop cultivation	21152.65 (41581.8)	18200.1 (38563.7)	12398.61 (16654.8)	15258.19** (23900.1)	14284.38 (24065.4)	19927.37** (27306.1)	15089.94 (27422.5)	20883.46*** (34622.3)	15610.25 (29152)	20779.54** (43026.1)
Share income crops (%)	37.74 (104.6)	40.41 (86.3)	26.68 (108.4)	29.41 (78.2)	24.73 (39.2)	30.53** (48.4)	29.21 (206.1)	27.74 (51.1)	24.69 (85.8)	22.86 (44.5)
Income from wage	25591.32 (42602.4)	26886.57 (36928.7)	29824.01 (49817.6)	29340.49 (38976.2)	26609.06 (35977.6)	33327.67*** (39982.5)	34772.78 (49684)	39416.79 (59034.5)	41416.8 (56951.6)	48476.64** (56020.6)
Share income wage (%)	[2]6.39 (50.1)	31.48 (48.3)	31.28 (40.6)	35.35 (73.3)	31.61 (36.8)	39.08*** (49.2)	58.74 (635.3)	40.35 (47.3)	37.99 (137.7)	44.89 (63.8)
Rice sales over income (%)	1.3 (3.4)	33.1*** (93.4)	1.6 (3.4)	24.1*** (27.2)	1.3 (3)	22.3*** (24)	1.2 (3.1)	23.5*** (32.4)	1.1 (2.8)	22.6*** (24.2)
Rice production and land										
RICE: Prod value	14225.4 (16297.6)	70284.5*** (143694)	14292.5 (12048.2)	52799.3*** (112259.9)	12033.7 (20325.8)	43334.4*** (79392.2)	10521.5 (14601.2)	41114.6*** (75788)	9998.9 (9431.8)	48426.7*** (105655.5)
RICE: Sale value	1377.9 (3569.6)	53,840*** (129979.6)	1557.6 (3662.6)	43606.5*** (111577.5)	1394 (4231.2)	36029.8*** (80296.2)	1342.4 (4145.1)	37267.6*** (84219.5)	11335.2 (12827.8)	91530.3*** (212047.7)
Share rice sold	0.1 (0.2)	0.6*** (0.2)	0.1 (0.2)	0.6*** (0.2)	0.1 (0.2)	0.6*** (0.2)	0.1 (0.2)	0.6*** (0.2)	0.1 (0.2)	0.7*** (0.2)
Total area own (sq. meters)	8217.7 (14371.2)	8964 (14548.8)	7263.2 (13507.1)	8849** (13721.8)	7307 (12705.7)	8598.6* (13067)	3942.6 (5143.8)	5221.9*** (8885.4)	3948.1 (5183.2)	5362.2*** (9449)
Irrigated area (sq. meters)	3934.8 (10422.7)	6382*** (12406.2)	3435.3 (9092.7)	6636.9*** (11837.5)	3525.7 (7176.1)	6467.1*** (11645.9)	2148.2 (4056.4)	3600.3*** (6624.9)	2409.4 (4124)	4077.8*** (7073.7)
Number plots owned	5.2 (3.1)	5.2 (2.8)	5.5 (2.7)	5.5 (3.2)	5.5 (2.6)	5.4 (2.8)	3.2 (1.3)	3.1 (1.3)	3.2 (1.3)	3*** (1.3)
Rice yields (kg/m2)	0.75 (0.03)	1.21*** (0.04)	0.82 (0.03)	1.09*** (0.05)	0.83 (0.04)	1.21*** (0.05)	1.50 (0.12)	2.08*** (0.06)	1.31 (0.05)	1.99*** (0.08)
HH has a red book	0.86 (0.3)	0.86 (0.3)	0.79 (0.4)	0.83* (0.4)	0.87 (0.3)	0.93*** (0.2)	0.88 (0.3)	0.94*** (0.2)	0.86 (0.3)	0.93*** (0.2)
Market access										
Regular sellers	0.06 (0.01)	0.40*** (0.02)	0.05 (0.00)	0.39*** (0.02)	0.06 (0.01)	0.37*** (0.02)	0.05 (0.01)	0.38*** (0.02)	0.07 (0.01)	0.46*** (0.02)
Nearest all weather road (km)	3.3 (9.3)	4.5* (15.5)	2.6 (6)	3.2* (5.7)	2.5 (8.9)	3.5** (9.3)	1.6 (2.9)	2.7*** (8.9)	1.3 (2.6)	2** (6.6)
Household characteristics										
HH size	4.7 (1.8)	4.5** (1.7)	4.6 (1.8)	4.4** (1.6)	4.6 (1.8)	4.3*** (1.6)	4.6 (1.8)	4.3*** (1.7)	4.5 (1.7)	4.1*** (1.7)
Dependency ratio	0.6 (0.6)	0.5* (0.6)	0.6 (0.7)	0.5*** (0.6)	0.6 (0.7)	0.5*** (0.6)	0.6 (0.7)	0.5** (0.6)	0.6 (0.7)	0.5*** (0.7)
Age HH head (years)	50.9 (13.2)	51.9 (13.1)	51.6 (12.4)	53.1** (12.3)	53 (12.3)	53.8 (11.6)	54.2 (11.8)	54.9 (11.9)	54.9 (11.8)	56.9*** (11.7)
HH receives private transfers	0.3 (0.5)	0.4 (0.5)	0.5 (0.5)	0.6 (0.5)	0.6 (0.5)	0.5** (0.5)	0.6 (0.5)	0.5* (0.5)	0.6 (0.5)	0.7*** (0.5)
HH receives public transfers	0.4 (0.5)	0.3*** (0.5)	0.5 (0.5)	0.4*** (0.5)	0.5 (0.5)	0.4*** (0.5)	0.53 (0.5)	0.45*** (0.5)	0.6 (0.5)	0.4*** (0.5)

Note: we define 'high' participation in rice commercialization when the income from rice sales represent 25 percent or more of the total gross value of rice production. All values (income, sales, and inputs) are in real terms in thousand dongs.
Regular sellers: households selling rice more than 3 times in the 5 waves.
Standard deviation in parenthesis. For each row, the reported measure is the mean value for the variable and the *t*-test of the null hypothesis that this mean is equal to the mean for one-off seller.
CI 2 = rice sales over total gross household income.
Source: authors' elaboration using the VARHS 2008–2016 panel.
* Difference in means that is significant at the 10% levels.
** Difference in means that is significant at the 5% levels.
*** Difference in means that is significant at the 1% levels.

Table 3
Results of fixed effects models of welfare as a function of commercialisation.

	All crops			Rice		
	(1) Assets	(2) Consumption	(3) Income	(4) Assets	(5) Consumption	(6) Income
Lagged CI	0.002*	−0.001**	0.000	0.001	−0.001	0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Age of head	0.014**	0.003	−0.001	0.012*	0.004	0.001
	(0.006)	(0.002)	(0.002)	(0.007)	(0.002)	(0.002)
Married head	0.474**	−0.018	−0.089	0.450**	−0.016	−0.046
	(0.196)	(0.067)	(0.076)	(0.204)	(0.069)	(0.075)
Highest education of head	0.159***	0.011	−0.007	0.148***	0.013	−0.015
	(0.049)	(0.018)	(0.015)	(0.051)	(0.019)	(0.016)
Female head	0.062	−0.084	0.008	0.070	−0.079	0.001
	−0.205	−0.086	−0.084	(0.222)	(0.092)	(0.088)
Head of Kinh ethnicity	−0.049	0.16	0.148	−0.186	0.182	0.166
	(0.417)	(0.134)	(0.142)	(0.417)	(0.140)	(0.152)
number of girls < 5	0.117	−0.035	−0.092***	0.118	−0.039	−0.091**
	(0.098)	(0.034)	(0.033)	(0.101)	(0.036)	(0.035)
number of girls 5 to 15	0.164*	−0.109***	−0.148***	0.169*	−0.114***	−0.148***
	(0.092)	(0.030)	(0.029)	(0.097)	(0.032)	(0.031)
number of females aged 15 to 60	0.966***	−0.075***	−0.065***	0.973***	−0.081***	−0.066***
	(0.062)	(0.019)	(0.020)	(0.064)	(0.019)	(0.021)
number of females aged above 60	0.293**	−0.156***	−0.198***	0.355***	−0.159***	−0.196***
	(0.130)	(0.046)	(0.045)	(0.134)	(0.048)	(0.047)
number of boys < 5	0.067	−0.075**	−0.162***	0.098	−0.072**	−0.149***
	(0.097)	(0.032)	(0.035)	(0.103)	(0.034)	(0.036)
number of boys 5 to 15	0.291***	−0.131***	−0.133***	0.324***	−0.119***	−0.135***
	(0.096)	(0.029)	(0.033)	(0.104)	(0.032)	(0.036)
number of males aged 15 to 60	0.944***	−0.099***	−0.014	0.954***	−0.100***	−0.026
	(0.076)	(0.023)	(0.024)	(0.081)	(0.024)	(0.025)
number of males aged above 60	0.373**	−0.226***	−0.155**	0.369*	−0.248***	−0.197***
	(0.188)	(0.054)	(0.066)	(0.197)	(0.056)	(0.067)
Total area of irrigated plots	−0.000***	0.000	0.000	−0.000***	0.000	0.000
household has use rights (lagged)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance from all-weather road	0.004*	0.003***	0.000	0.005*	0.003***	0.001*
	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Lagged income from selling cash crops				0.116	0.106*	0.147**
				(0.182)	(0.054)	(0.064)
Lagged income from other agricultural activities	−0.041	0.063**	−0.014	−0.052	0.062**	−0.016
	(0.073)	(0.028)	(0.029)	(0.074)	(0.029)	(0.030)
Lagged income from other non-agricultural activities	0.145**	0.002	−0.013	0.141*	−0.007	−0.023
	(0.071)	(0.026)	(0.028)	(0.075)	(0.027)	(0.030)
Lagged income from transfers	−0.059	−0.034	−0.058**	−0.047	−0.034	−0.058**
	(0.059)	(0.022)	(0.024)	(0.062)	(0.023)	(0.025)
Lagged income from common property resources	−0.01	−0.027	−0.001	0.029	−0.014	0.021
	(0.068)	(0.025)	(0.027)	(0.070)	(0.026)	(0.028)
Household hit by economic shock over previous 3 years	0.146**	−0.009	−0.059***	0.128**	0.000	−0.071***
	(0.058)	(0.021)	(0.022)	(0.060)	(0.022)	(0.023)
Constant	−5.058***	5.612***	9.735***	−4.810***	5.577***	9.647***
	(0.561)	(0.198)	(0.206)	(0.593)	(0.214)	(0.212)
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4,438	4,436	4,383	4,146	4,144	4,095
N of households	1110	1110	1110	1037	1037	1037

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

They also have on average larger landholdings and more irrigated land, while they are as likely as the others to have a land title (red book) for their land. Using irrigated land as the measure of land used for rice cultivation, households highly engaged in rice commercialisation have significantly greater yields per square meter of irrigated land; after decreasing in 2010, yields increase until 2014 and then decrease again. Interestingly, households highly engaged in rice commercialisation live on average further away from a market. This could explain their specialisation in rice cultivation in their agricultural strategy and livelihood strategy.

With respect to household characteristics, households highly engaged in rice commercialisation are on average smaller and have fewer dependents than other households, and tend to have older household heads, while no significant differences appear by ethnicity or gender of the household head (results not presented here).

The same comparison (not presented here but available upon request) between households who are more and less commercialised in terms of their overall crop production shows quite similar results. This is not surprising given the dominance of rice in crop production Vietnam.

4. Empirical strategy

At each point in time, a household decides whether or not to sell crops based on the utility it expects to derive from each option. We assume that farmers engaging in commercialisation are expecting their

Table 4
Coefficients of commercialisation variable for disaggregated models. Fixed effects model with lagged CI and income sources.

	All crops			Rice		
	Assets	Consumption	Income	Assets	Consumption	Income
Women	0.001	0.001	0.001	0.001	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Men	0.003**	−0.001**	0.000	0.002	−0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
F	0.79	0.59	0.00	0.07	0.01	0.02
p-value	0.375	0.442	0.998	0.787	0.933	0.877
Kinh	0.001	−0.001	0.000	0.002	−0.001**	0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Not Kinh	0.004	−0.001	−0.001	0.000	0.001	−0.001
	(0.003)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)
F	0.61	0.01	1.52	0.10	2.95*	1.01
p-value	0.435	0.914	0.217	0.751	0.086	0.314
North	0.003**	−0.001	0.000	0.001	−0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.002)	(0.001)	(0.001)
South	0.001	−0.001	0.000	0.003*	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
F	0.44	0.08	0.20	0.51	0.12	0.31
p-value	0.509	0.781	0.653	0.476	0.733	0.576
Occasional seller	0.002	−0.001**	0.000	0.001	−0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Consistent seller	0.002	−0.001	0.000	0.002	0.000	0.000
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
F	0.00	0.17	0.09	0.29	0.40	0.01
p-value	0.970	0.681	0.759	0.592	0.525	0.919

Standard errors in parentheses;
*** p < 0.01.
* p < 0.1.
** p < 0.05.

welfare to improve as a result of market participation, although we do not know which aspects of welfare households believe will be improved. Moreover, the coexistence of regular and occasional sellers in the panel suggests that the benefits from commercialisation are household-specific and time-varying.

We estimate separate models to look at the impact of selling any crop and of selling rice on household welfare. The models are estimated based only on households who were growing the crop being modelled (rice or all crops) consistently over the five waves.

If the decision to sell rice could be considered to be exogenous, that is, if there were no factors that simultaneously influence the decision to produce the crop, commercialisation, and household welfare, then for each welfare outcome we could use pooled ordinary least squares (OLS) to estimate the following equation:

$$Y_{idt} = \theta_t + \gamma CI_{Kidt} + X_{idt}\beta + Dist_d + \varepsilon_{idt} \quad (3)$$

where Y_{idt} is the measure of household welfare for household i in district d at time t; CI_{Kidt} is the index of commercialisation K (*CI1* and *CI2*) for household i in district d at time t; $Dist_d$ are district fixed effects and the vector X a set of controls.

Commercialisation decisions, however, are very likely endogenous. Unobserved individual or household characteristics that affect welfare outcomes, such as skills and motivation, may also affect the decision to sell a crop. If households with better unobserved skills decide to participate in commercialisation, Equation (3) would be overestimating the impact of commercialisation on household welfare. Other sources of potential endogeneity are production decisions and household location, both of which may simultaneously affect commercialisation decisions and welfare outcomes, and both of which may be correlated with unobserved characteristics that also affect household welfare.

As a first approach to address these potential endogeneity issues, we exploit the panel nature of the data by using a fixed effects estimator, which controls for time invariant unobserved heterogeneity across households and helps address self-selection into commercialisation, production and location decisions. To reduce potential problems of reverse causality, we use the lag of the commercialisation index. The fixed effects estimator allows us to measure the effect of commercialisation on welfare changes *within* households. Equation (3) thus becomes

$$Y_{it} = \theta_t + \gamma CI_{it} + X_{it}\beta + \alpha_i + \mu_{it} \quad (4)$$

where α_i is the household fixed effect that controls for unobserved heterogeneity across households, and the district variable disappears, since it is time invariant. The coefficient of interest is γ, expected to be positive for each commercialisation index if there is a positive association between commercialisation and household welfare. Parameter θ is a time varying intercept, and ε is the error term that, in this specification, we assume to be uncorrelated with the commercialisation measure.

The vector X includes a set of controls that we expect to affect household welfare outcomes. These include demographic characteristics of the household (size and age groups) and of the household head (sex, age, ethnicity, and education); a dummy variable to control for different types of past shocks to the household; and household distance from the nearest paved road as a measure of household relative isolation. We control for volume and quality of production by using the lagged value of the area of own land that is irrigated. We also include a set of dummy variables to control for the availability of other income sources, lagged by one period to reduce potential endogeneity problems: other agricultural income, non-agricultural earnings, transfers, and common property resources in both models; as well as income from cash crops in the rice model.

To explore possible heterogeneous impacts of commercialisation on welfare, we estimate variations of equation (4) and use a Chow test of significant differences for the following sub-samples: female-headed versus male-headed households; households of Kinh ethnicity versus ethnic minority households; households living in the North versus those living in the South of Vietnam; and households who are regular sellers (defined, as above, as those who sell in three or more of the years we

Table 5
Results of IV fixed effects model of welfare as a function of commercialisation.

	All crops			Rice		
	(1)	(2)	(3)	(4)	(5)	(6)
	Assets	Consumption	Income	Assets	Consumption	Income
Lagged CI	0.013*	−0.010***	−0.000	0.016*	−0.012***	−0.000
	(0.008)	(0.003)	(0.003)	(0.010)	(0.004)	(0.004)
Age of head	0.012*	0.003	0.001	0.013*	0.003	0.001
	(0.007)	(0.003)	(0.002)	(0.007)	(0.003)	(0.002)
Married head	0.496**	−0.053	−0.046	0.508**	−0.058	−0.042
	(0.211)	(0.071)	(0.076)	(0.210)	(0.074)	(0.075)
Highest education of head	0.135***	0.022	−0.015	0.143***	0.017	−0.014
	(0.052)	(0.021)	(0.016)	(0.052)	(0.021)	(0.016)
Female head	0.074	−0.078	0.006	0.076	−0.078	0.007
	(0.230)	(0.088)	(0.087)	(0.229)	(0.091)	(0.087)
Head of Kinh ethnicity	−0.156	0.154	0.160	−0.207	0.189	0.160
	(0.443)	(0.169)	(0.150)	(0.428)	(0.173)	(0.149)
number of girls less than 5	0.167	−0.076*	−0.091**	0.153	−0.065*	−0.091**
	(0.109)	(0.040)	(0.037)	(0.106)	(0.038)	(0.036)
number of girls 5–15	0.198**	−0.135***	−0.147***	0.197**	−0.130***	−0.145***
	(0.097)	(0.034)	(0.031)	(0.097)	(0.035)	(0.031)
number of females aged 15–60	0.967***	−0.076***	−0.066***	0.966***	−0.078***	−0.067***
	(0.065)	(0.021)	(0.021)	(0.065)	(0.021)	(0.021)
number of females aged above 60	0.376***	−0.177***	−0.199***	0.361***	−0.165***	−0.198***
	(0.133)	(0.051)	(0.048)	(0.134)	(0.051)	(0.047)
number of boys less than 5	0.107	−0.078**	−0.149***	0.091	−0.065*	−0.147***
	(0.103)	(0.036)	(0.037)	(0.104)	(0.037)	(0.036)
number of boys 5–15	0.339***	−0.131***	−0.136***	0.359***	−0.141***	−0.133***
	(0.105)	(0.034)	(0.036)	(0.107)	(0.035)	(0.036)
number of males aged 15–60	0.959***	−0.102***	−0.025	0.968***	−0.108***	−0.025
	(0.081)	(0.025)	(0.025)	(0.082)	(0.026)	(0.025)
number of males aged above 60	0.350*	−0.230***	−0.193***	0.371*	−0.243***	−0.192***
	(0.198)	(0.060)	(0.068)	(0.199)	(0.060)	(0.068)
Total area of irrigated plots	−0.000**	0.000	−0.000	−0.000**	0.000	−0.000
household has use rights (lagged)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance from all-weather road	0.004	0.004***	0.001*	0.004	0.003***	0.001*
	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Lagged income from selling cash crops				0.226	0.017	0.106**
				(0.145)	(0.047)	(0.051)
Lagged income from other agricultural activities	−0.016	0.033	−0.017	0.005	0.014	−0.020
	(0.081)	(0.032)	(0.031)	(0.088)	(0.035)	(0.033)
Lagged income from other non-agricultural activities	0.158**	−0.023	−0.024	0.165**	−0.030	−0.025
	(0.075)	(0.031)	(0.030)	(0.077)	(0.031)	(0.030)
Lagged income from transfers	−0.021	−0.054**	−0.059**	−0.007	−0.063**	−0.059**
	(0.064)	(0.025)	(0.027)	(0.068)	(0.027)	(0.028)
Lagged income from common property resources	0.028	−0.015	0.019	0.030	−0.015	0.021
	(0.072)	(0.028)	(0.028)	(0.072)	(0.028)	(0.028)
Household hit by economic shock over previous 3 years	0.119**	0.006	−0.070***	0.127**	−0.000	−0.070***
	(0.061)	(0.024)	(0.023)	(0.061)	(0.024)	(0.023)
Constant	−5.364***	6.021***	9.670***	−5.383***	6.009***	9.655***
	(0.687)	(0.270)	(0.256)	(0.683)	(0.278)	(0.254)
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4,010	4,009	3,958	3,710	3,709	3,662
N of households	4142	4140	4091	4142	4140	4091

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

observe).

The fixed effects estimator with lagged CI and other income sources addresses several endogeneity concerns but does not address time-variant unobserved heterogeneity, which might bias the estimated γ coefficient. To address this potential problem, we need an instrumental variable for the commercialisation index, that is, a variable that is correlated with the commercialisation index but does not directly affect household welfare. The instrument we use is the district average commercialisation index for all crops, lagged by one period. The instrument is constructed by averaging the overall commercialisation index of panel households in each district (excluding the household in question), and then dividing by the number of panel households in the district. A district is an administrative unit that is larger than a commune, but smaller than a province. The panel covers 28 districts, and on average 200 households were interviewed in each district.

We expect the average level of commercialisation in the district to influence household commercialisation through peer learning and lowering transactions costs. First, observing neighbours who engage in and benefit from commercialisation may encourage a household to also increase its engagement with the market. This is consistent with the literature on the importance of peer learning for innovation adoption (Conley and Udry, 2010; Krishnan and Patnam, 2014; Verkaart et al., 2017). Second, higher local levels of commercialisation can lower transactions costs by improving the information flow on prices and buyers, and by lowering transport costs through shared transport, thereby facilitating household participation in agricultural markets

(Negi et al., 2018; Roba et al., 2018).

In order to be valid, an instrument must be relevant and exogenous. The lagged district average commercialisation index for all crops is highly correlated with lagged household commercialisation index, both for rice and for all crops (rho = 0.22, p = 0.000 for rice CI; and rho = 0.26, p = 0.000 for overall CI). Hence, the first condition of instrument validity is satisfied.

However, the district average level of commercialisation might also affect household welfare directly, particularly if the gains from commercialisation generate new employment opportunities in other sectors, through local backward and forward linkages. We find no significant correlation between the instrument and household income from non-agricultural activities of the household (rho = 0.009, p = 0.539). On the other hand, binary correlations between the instrument and welfare measures are statistically significant, although small in magnitude (rho = 0.04, p = 0.017 for assets; rho = 0.05, p = 0.000 for food expenditure per capita; and rho = 0.11, p = 0.000 for income per capita). However, once we control for other characteristics and for the commercialisation index of the household in a regression model, the instrument turns insignificant, for both rice and overall commercialisation (Table A2 in the appendix). This suggest that district level commercialisation affects households through their own commercialisation behaviour and satisfies the second condition for instrument validity.

It is important to note that the effect of commercialisation estimated with the IV approach is an estimate of a *local* average treatment effect (LATE) (Imbens and Angrist, 1994), that is, the average effect of commercialisation (conditional on other explanatory variables) among those households who are induced to increase their commercialisation because of an increase in district-level commercialisation, a sub-group of the population known in the literature as 'compliers'.

5. Results

We estimate the impact of commercialisation on the different welfare measures, looking both at commercialisation of all crops cultivated by the household, and at rice commercialisation specifically. We focus on the sample of households who cultivated the crop in question in all five waves of the VARHS survey; this amounts to more than half the panel sample, about 1100 households observed at all five points in time. We base our analysis on fixed effects models, which focus on welfare changes over time *within* households. Random effects models were also estimated but results from the Hausman test (available upon request) indicate that a fixed effects model is to be preferred in all cases.

The results of the fixed effects models for overall and rice commercialisation are presented in Table 3. We use lagged values (by one period) of the commercialisation index and income sources, and control for contemporaneous socioeconomic characteristics and year fixed effects. We also estimated these models with additional controls for time-varying place effects, by interacting year and province fixed effects. The results are not significantly different and available upon request.

The results suggest that households who in the previous period were selling a bigger share of their agricultural output, currently have higher assets levels but also lower levels of consumption expenditure (columns 1 and 2). No significant association is found with current levels of income (column 3). Meanwhile, when we look at the rice commercialisation index (columns 4–6), we find no significant association with current welfare measures. These results are confirmed when estimating the model with contemporaneous levels of CI and income sources (available upon request). In contrast, selling cash crops and having income from other agricultural activities (primarily livestock, but also aquaculture and forestry) in the previous period is associated with higher current levels of income and of consumption expenditure. Having income from other agricultural activities is also associated with currently higher levels of food consumption expenditure. Although rice is a large part of the overall commercialisation index, these results suggest that it is the non-rice component of commercialisation which enables households to increase their asset levels: the extent to which a household does or does not sell rice does not have a significant association with its asset accumulation behaviour, on average and *ceteris paribus*, but the extent to which it sells overall does.

Having an income from non-agricultural activities in the previous period is also positively associated with current asset levels, although no significant association appears with current levels of food consumption and incomes. With respect to socio-demographic variables, results indicate that larger households have higher asset levels (which is expected, since assets are measured at household level, not per capita), but significantly lower levels of income and consumption per capita, especially as the number of household members aged 60 and above increases. Households where the head is older, married and more educated tend to have higher asset levels, but no significant differences appear with respect to consumption and income per capita. *Ceteris paribus*, no significant welfare differences appear between households by ethnicity or gender of the household head. Households who were hit by a shock over the previous three years have currently higher levels of assets, but still have lower levels of income per capita. This may depend on households having to spend resources to recover the assets lost in the shock. Meanwhile, households living further away from the nearest all-weather road tend to have higher levels of welfare, which is consistent with the descriptive evidence indicating that less well-connected households are more likely to sell larger quantities of crops.

Table 4 reports the coefficients of disaggregated models to test for heterogeneous effects of commercialisation among different groups of the population. Results show a significant positive association between overall commercialisation and asset accumulation among male-headed households and households living in the northern regions. Meanwhile, results show a significant negative association between commercialisation and consumption expenditure among male-headed households and occasional sellers. However, the F statistics computed with a Chow test indicates no significant differences between groups in the welfare impacts of commercialisation. For the case of rice commercialisation, results suggest a positive association with asset accumulation among households living in the south, and a negative association with per capita food expenditure among households with a head of Kinh ethnicity. The Chow test indicates that the only significant difference among groups in the welfare impacts of commercialisation is observed by ethnicity of the household head, with Kinh-headed households being worse off in terms of consumption per capita compared to the rest of the population. Overall, results suggest little evidence of heterogeneity in the dimensions we consider.

To address potential sources of endogeneity due to unobserved time-variant heterogeneity, we estimate a two-stage least squares panel model with household fixed effects, instrumenting both overall and rice lagged CIs with the lagged district average of the CI for all crops, controlling for the same vector of socioeconomic and demographic characteristics as before, and for lagged values of other income sources of the household. The results of the first stage models (presented in Appendix Table A3) confirm that the IV is relevant. Table 5 shows the results of the second stage equation. The results indicate a negative impact of overall commercialisation on current food consumption per capita and a positive impact on current asset levels (respectively columns 2 and 1), consistent with the results of the fixed effects model presented in Table 3. The IV estimate of the impact of rice commercialisation becomes now negative and significant for consumption, and positive and significant for asset levels. Consistent with the results presented in Table 3, we find no significant relationship between lagged commercialisation and current income per capita. Meanwhile, selling cash crops continues to have a positive and significant association with per capita income, but engaging in other agricultural activities now loses significance. The results for the other variables are similar to those presented in Table 3.

Overall, the results suggest that increasing crop commercialisation

has a positive influence on longer-term asset accumulation of the household, but a negative influence on food consumption. The relationship between household welfare and rice sales appears to follow the same trend but is less robust. Meanwhile, selling cash crops appears to be more consistently related to increases in income per capita. We also find some evidence of a positive relationship between engaging in other agricultural activities and higher incomes and consumption per capita. The results also show the importance of non-agricultural activities for household welfare, especially for asset accumulation.

6. Conclusions

Welfare levels of households in rural Vietnam have improved substantially over the past 30 years and more following the *Doi Moi* reforms. There has been substantial progress in agriculture, including a very large expansion of rice production and sale; and many new cash crops have been introduced. Even more striking has been the development of non-agricultural activities in rural areas, with households being increasingly engaged in wage work and in establishing their own business activities. The improvements in welfare this has been associated with are strongly confirmed by the data set used here as well as by the different rounds of the Vietnam Household Livings Standards Surveys.

This paper has sought to assess the importance of agricultural commercialisation in contribution to this welfare improvement. Using three different measures of welfare, our results suggest that agricultural commercialisation continues to be important for households' asset accumulation, but at the same time increasing commercialisation has a negative relationship with food consumption per capita. This holds for both overall commercialisation, and rice commercialisation. Even though the period under study saw an increase in the proportion of output sold among people engaging in rice commercialisation, it is important to note that the rice price was declining over most of this period, and sharply from the 2008 peak. This is likely to discourage increasing number of households from growing and selling rice and means lower incomes for those who did grow it. Meanwhile, selling cash crops has a positive relationship with income per capita, and earning incomes from other agricultural activities, such as livestock and aquaculture, helps increasing consumption expenditure. Overall, agricultural commercialisation and crop diversification appear to be an important factor for improving household welfare over time in rural Vietnam.

Our results also show that the increasing importance of non-farm activities has also contributed greatly to welfare improvements, especially in terms of asset accumulation. This is consistent with a broader trend of increase in the importance of rural non-farm employment for rural development and poverty reduction, observed across developing countries, and does not imply that agriculture is losing importance (Barrett et al., 2001; Reardon et al., 2001). Rural development policies that focus on improving the welfare of rural households need to recognize the diversity of roles that farm and non-farm activities play for households with different characteristics. A mixed approach may be required, combining actions that increase productivity and access to agricultural markets, including through investment in infrastructure and technology, with policies that support diversification of livelihood strategies and access to non-farm employment opportunities.

Acknowledgements

We are grateful for the financial support of UNU-WIDER to enable us to undertake this work. We are also very grateful for very helpful comments of two anonymous reviewers of the journal; and for helpful comments from other researchers who have been involved in the project of which this was a part; and in particular to the guidance and advice received from Carol Newman, Saurabh Singhal and Finn Tarp.

Appendix A

See Tables A1–A3.

Table A1
Factor index weights for asset index.

Variable	Weight
years of education per capita	0.171
number of active household members	0.105
number of plots owned	0.051
total area owned	0.035
irrigated area owned	0.049
Number of cows	0.039
Number of buffalos	0.000
number of pigs	0.024
number of chickens	0.027
if household has a business	0.032
number of color TVs	0.074
number of videos/DVDs	0.074
number of telephones	0.061
number of motorcycles	0.094
number of bicycles	0.079
number of pesticide sprayers	0.041
number of cars	0.034
number of groups attended	0.391
number of political groups	0.407
area of dwelling	0.054
if has a good lighting source	0.050
if has a toilet	0.067
if has a good drinking water source	0.042

Table A2
Test for instrument exogeneity.

	All crops			Rice		
	Assets	Consumption	Income	Assets	Consumption	Income
Lagged CI	0.002*	−0.001	−0.000	0.002	−0.000	0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Lagged district average CI	0.030	−0.000	−0.004	0.024	0.008	0.002
	(0.019)	(0.009)	(0.008)	(0.020)	(0.007)	(0.008)
Age of head	0.015**	0.004	−0.000	0.015**	0.003	−0.000
	(0.007)	(0.002)	(0.002)	(0.007)	(0.002)	(0.002)
Married head	0.457**	−0.069	−0.067	0.466**	−0.066	−0.063
	(0.206)	(0.068)	(0.071)	(0.205)	(0.068)	(0.070)
Highest education of head	0.131***	0.009	−0.025	0.135***	0.009	−0.024
	(0.050)	(0.019)	(0.016)	(0.050)	(0.019)	(0.016)
Female head	0.042	−0.079	0.001	0.045	−0.078	0.003
	(0.226)	(0.091)	(0.086)	(0.226)	(0.091)	(0.085)
Head of Kinh ethnicity	−0.201	0.106	0.192	−0.212	0.109	0.192
	(0.429)	(0.148)	(0.152)	(0.424)	(0.147)	(0.152)
number of girls < 5	0.131	−0.046	−0.099***	0.129	−0.044	−0.098***
	(0.101)	(0.034)	(0.035)	(0.101)	(0.034)	(0.035)
number of girls 5 to 15	0.163*	−0.114***	−0.145***	0.164*	−0.112***	−0.143***
	(0.098)	(0.031)	(0.031)	(0.098)	(0.031)	(0.031)
number of females aged 15 to 60	0.940***	−0.079***	−0.058***	0.936***	−0.080***	−0.060***
	(0.062)	(0.019)	(0.021)	(0.063)	(0.019)	(0.021)
number of females aged above 60	0.354***	−0.161***	−0.182***	0.351***	−0.160***	−0.182***
	(0.134)	(0.045)	(0.046)	(0.135)	(0.045)	(0.046)
number of boys < 5	0.120	−0.080**	−0.156***	0.120	−0.079**	−0.155***
	(0.100)	(0.034)	(0.037)	(0.100)	(0.033)	(0.037)
number of boys 5 to 15	0.292***	−0.116***	−0.135***	0.300***	−0.114***	−0.131***
	(0.106)	(0.030)	(0.036)	(0.107)	(0.031)	(0.036)
number of males aged 15 to 60	0.896***	−0.086***	−0.028	0.897***	−0.086***	−0.027
	(0.082)	(0.024)	(0.025)	(0.083)	(0.024)	(0.025)
number of males aged above 60	0.291	−0.237***	−0.178***	0.294	−0.238***	−0.178***
	(0.194)	(0.055)	(0.068)	(0.195)	(0.054)	(0.068)
Total area of irrigated plots	−0.000***	−0.000	−0.000	−0.000***	−0.000	−0.000
household has use rights (lagged)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance from all-weather road	0.004	0.003***	0.002**	0.004	0.003***	0.002**
	(0.003)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
Lagged income from selling cash crops				0.256*	0.079*	0.119**
				(0.137)	(0.040)	(0.048)
Lagged income from other agricultural activities	−0.055	0.061**	−0.010	−0.059	0.061**	−0.011
	(0.073)	(0.028)	(0.029)	(0.073)	(0.028)	(0.029)
Lagged income from other non-agricultural activities	0.136*	0.015	−0.011	0.135*	0.015	−0.011
	(0.075)	(0.028)	(0.030)	(0.075)	(0.028)	(0.030)
Lagged income from transfers	0.011	−0.030	−0.039	0.012	−0.029	−0.038
	(0.061)	(0.023)	(0.026)	(0.061)	(0.023)	(0.026)
Lagged income from common property resources	0.028	−0.021	0.014	0.031	−0.019	0.017
	(0.070)	(0.026)	(0.028)	(0.070)	(0.026)	(0.028)
Household hit by economic shock over previous 3 years	0.099	−0.007	−0.070***	0.099	−0.007	−0.070***
	(0.061)	(0.022)	(0.023)	(0.061)	(0.022)	(0.023)
Constant	−6.096***	5.596***	9.938***	−5.796***	5.169***	9.614***
	(1.137)	(0.488)	(0.453)	(1.164)	(0.412)	(0.452)
Year fixed effects	YES	YES	YES	YES	YES	YES
Observations	4,438	4,436	4,383	4,146	4,144	4,095
N of households	1110	1110	1110	1037	1037	1037

Standard errors in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

Table A3
First stage of the IV model with fixed effects.

	(1) All crops	(2)	(3)	(4) Rice	(5)	(6)
	Assets	Consumption	Income	Assets	Consumption	Income
District average overall CI	0.525***	0.525***	0.526***	0.421***	0.420***	0.418***
	(0.064)	(0.064)	(0.065)	(0.058)	(0.058)	(0.058)
Age of head	0.016	0.015	0.024	−0.010	−0.013	−0.008
	(0.117)	(0.117)	(0.120)	(0.102)	(0.102)	(0.103)
Married head	−2.993	−3.149	−2.810	−2.783	−3.188	−2.588
	(3.077)	(3.053)	(3.127)	(2.756)	(2.770)	(2.779)
Highest education of head	1.188*	1.162*	1.235*	0.479	0.489	0.492
	(0.682)	(0.683)	(0.684)	(0.630)	(0.630)	(0.634)
Female head	0.037	−0.080	0.040	0.099	−0.174	0.204
	(3.913)	(3.904)	(3.944)	(3.600)	(3.606)	(3.620)
Head of Kinh ethnicity	−1.305	−1.311	−1.518	1.974	1.948	2.188
	(7.401)	(7.403)	(7.608)	(7.011)	(7.012)	(7.235)
number of girls less than 5	−4.129***	−4.124***	−4.201***	−2.350*	−2.356*	−2.249*
	(1.398)	(1.398)	(1.407)	(1.205)	(1.205)	(1.218)
number of girls 5–15	−2.441**	−2.452**	−2.207*	−1.697	−1.702	−1.499
	(1.187)	(1.187)	(1.191)	(1.086)	(1.086)	(1.087)
number of females aged 15–60	0.436	0.403	0.366	0.236	0.226	0.201
	(0.798)	(0.799)	(0.802)	(0.693)	(0.693)	(0.696)
number of females aged above 60	−2.080	−2.102	−2.142	−0.683	−0.675	−0.610
	(1.770)	(1.770)	(1.774)	(1.596)	(1.596)	(1.603)
number of boys less than 5	−0.420	−0.402	−0.649	0.723	0.724	0.543
	(1.381)	(1.381)	(1.353)	(1.245)	(1.246)	(1.224)
number of boys 5–15	−1.390	−1.360	−1.027	−2.083*	−2.092*	−1.932*
	(1.310)	(1.311)	(1.314)	(1.087)	(1.087)	(1.092)
number of males aged 15–60	−0.671	−0.672	−0.685	−1.104	−1.095	−1.124
	(0.898)	(0.898)	(0.900)	(0.789)	(0.789)	(0.791)
number of males aged above 60	1.151	1.141	0.902	−0.289	−0.266	−0.221
	(2.106)	(2.106)	(2.113)	(1.859)	(1.859)	(1.881)
Total area of irrigated plots	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
household has use rights (lagged)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance from all-weather road	0.064*	0.063*	0.063*	0.050	0.050	0.049
	(0.036)	(0.036)	(0.036)	(0.032)	(0.032)	(0.032)
Lagged income from selling cash crops				−4.327***	−4.321***	−4.415***
				(1.504)	(1.504)	(1.531)
Lagged income from other agricultural activities	−3.135**	−3.089**	−3.217**	−3.965***	−4.008***	−4.096***
	(1.365)	(1.364)	(1.367)	(1.279)	(1.278)	(1.280)
Lagged income from other non-agricultural activities	−1.218	−1.219	−1.181	−1.515	−1.513	−1.491
	(1.232)	(1.232)	(1.233)	(1.078)	(1.078)	(1.072)
Lagged income from transfers	−1.940*	−1.962*	−2.037*	−2.380**	−2.352**	−2.431**
	(1.031)	(1.032)	(1.043)	(0.939)	(0.941)	(0.951)
Lagged income from common property resources	−0.021	−0.020	−0.095	−0.078	−0.076	−0.072
	(1.175)	(1.175)	(1.180)	(1.033)	(1.033)	(1.038)
Household hit by economic shock over previous 3 years	0.382	0.379	0.347	−0.220	−0.226	−0.288
	(0.930)	(0.931)	(0.939)	(0.815)	(0.815)	(0.823)
Observations	4142	4140	4090	4090	4090	4090

Standard errors in parentheses.
* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

References

Andersson, C.I.M., Chege, C.G.K., Rao, E.J.O., Qaim, M., 2015. Following up on smallholder farmers and supermarkets in Kenya. Am. J. Agric. Econ. 97 (4), 1247–1266. https://doi.org/10.1093/ajae/aav006.

Barrett, C.B., 2008. Smallholder market participation: Concepts and evidence from eastern and southern Africa. Food Policy 33 (4), 299–317. https://doi.org/10.1016/j.foodpol.2007.10.005.

Barrett, C.B., Reardon, T., Webb, P., 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. Food Policy 26 (4), 315–331. https://doi.org/10.1016/S0306-9192(01)00014-8.

Bellemare, M.F., 2012. As you sow, so shall you reap: the welfare impacts of contract farming. World Dev. 40 (7), 1418–1434. https://doi.org/10.1016/j.worlddev.2011.12.008.

Bellemare, M.F., Chua, K., Santamaria, J., Vu, K., 2018. Tenurial security and agricultural investment.

Bellemare, M.F., Novak, L., 2017. Contract farming and food security. Am. J. Agric. Econ. 99 (2), 357–378.

Benjamin, D., Brandt, L., 2004. Agriculture and income distribution in rural Vietnam under economic reforms: a tale of two regions. In: Glewwe, P., Agrawal, N., Dollar, D. (Eds.), Economic Growth, Poverty, and Household Welfare in Vietnam. World Bank, Washington, DC, pp. 133–185.

Benjamin, D., Brandt, L., McCaig, B., 2017. Growth with equity: income inequality in Vietnam, 2002–14. J. Econ. Inequality 15 (1), 25–46. https://doi.org/10.1007/s10888-016-9341-7.

Carletto, C., Corral, P., Guelfi, A., 2017. Agricultural commercialization and nutrition revisited: empirical evidence from three African countries. Food Policy 67, 106–118. https://doi.org/10.1016/j.foodpol.2016.09.020.

Carletto, C., Kilic, T., Kirk, A., 2011. Nontraditional crops, traditional constraints: the long-term welfare impacts of export crop adoption among Guatemalan smallholders. Agric. Econ. 42, 61–76.

Conley, T.G., Udry, C.R., 2010. Learning about a new technology: pineapple in Ghana. Am. Econ. Rev. 100 (1), 35–69. https://doi.org/10.1257/aer.100.1.35.

Fischer, E., Qaim, M., 2012. Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. World Dev. 40 (6), 1255–1268.

Glewwe, P., Agrawal, N., Dollar, D. (Eds.), 2004. Economic Growth, Poverty, and Household Welfare in Vietnam. World Bank, Washington, DC.

Goletti, F., Minot, N., 1997. Rice markets, agricultural growth, and policy options in Viet Nam, IFPRI. Retrieved September 15, 2018, from https://www.ifpri.org/publication/

rice-markets-agricultural-growth-and-policy-options-viet-nam.
Imbens, G.W., Angrist, J.D., 1994. Identification and Estimation of Local Average Treatment Effects. Econometrica 62 (2), 467. https://doi.org/10.2307/2951620.
Jaleta, M., Gebremedhin, B., Hoekstra, D., 2009. Smallholder commercialization: Processes, determinants and impact [Working Paper]. Retrieved from ILRI website: https://cgspace.cgiar.org/handle/10568/27.
Krishnan, P., Patnam, M., 2014. Neighbors and extension agents in Ethiopia: who matters more for technology adoption? Am. J. Agric. Econ. 96 (1), 308–327. https://doi.org/10.1093/ajae/aat017.
Markussen, T., 2017. Land issues: Markets, property righs, and investment. In: Tarp, F. (Ed.), Growth, Structural Transformation, and Rural Change in Viet Nam. A Rising Dragon on the Move. Oxford University Press, Oxford, pp. 117–138.
McCaig, B., Pavcnik, N., 2013. Moving out of Agriculture: Structural Change in Vietnam (Working Paper No. 19616). https://doi.org/10.3386/w19616.
McKay, A., Tarp, F., 2015. Distributional impacts of the 2008 Global Food Price Spike in Vietnam. In: Sahn, D.E. (Ed.), The Fight Against Hunger and Malnutrition. Oxford University Press.
McKay, A., Tarp, F., 2017. Welfare dynamics: 2006-14. In: Tarp, F. (Ed.), Growth, Structural Transformation, and Rural Change in Viet Nam. A Rising Dragon on the Move. Oxford University Press, Oxford.
Michelson, H.C., 2013. Small farmers, NGOs, and a Walmart world: welfare effects of supermarkets operating in Nicaragua. Am. J. Agric. Econ. 95 (3), 628–649. https://doi.org/10.1093/ajae/aas139.
Minot, N., Goletti, F., 1998. Export liberalization and household welfare: the case of rice in Vietnam. Am. J. Agric. Econ. 80 (4), 738–749. https://doi.org/10.2307/1244060.
Muricho, G., Manda, D., Sule, F., Kassie, M., 2017. Smallholder agricultural commercialization and poverty: Empirical evidence of panel data from Kenya. Presented at the 91st Annual Conference, April 24-26, 2017, Royal Dublin Society, Dublin, Ireland.
Muriithi, B.W., Matz, J.A., 2015. Welfare effects of vegetable commercialization: evidence from smallholder producers in Kenya. Food Policy 50, 80–91. https://doi.org/10.1016/j.foodpol.2014.11.001.
Negi, D.S., Birthal, P.S., Roy, D., Khan, Md.T., 2018. Farmers' choice of market channels and producer prices in India: Role of transportation and communication networks. Food Policy 81, 106–121. https://doi.org/10.1016/j.foodpol.2018.10.008.
Newman, C., Tarp, F., van den Broeck, K., 2015. Property rights and productivity: the case of joint land titling in Vietnam. Land Econ. 91 (1), 91–105. https://doi.org/10.3368/le.91.1.91.
Ogutu, S.O., Qaim, M., 2019. Commercialization of the small farm sector and multidimensional poverty. World Dev. 114, 281–293. https://doi.org/10.1016/j.worlddev.2018.10.012.
Pingali, P., Rosegrant, M., 1995. Agricultural commercialization and diversification: processes and policies. Food Policy 20 (3), 171–185.
Poulton, C., 2017. What is agricultural commercialisation, why is it important, and how do we measure it? APRA Working Paper 6.
Rao, E.J.O., Qaim, M., 2011. Supermarkets, Farm Household Income, and Poverty: Insights from Kenya. World Dev. 39 (5), 784–796. https://doi.org/10.1016/j.worlddev.2010.09.005.
Reardon, T., Berdegué, J., Escobar, G., 2001. Rural nonfarm employment and incomes in Latin America: overview and policy implications. World Dev. 29 (3), 395–409. https://doi.org/10.1016/S0305-750X(00)00112-1.
Roba, G.M., Lelea, M.A., Hensel, O., Kaufmann, B., 2018. Making decisions without reliable information: the struggle of local traders in the pastoral meat supply chain. Food Policy 76, 33–43. https://doi.org/10.1016/j.foodpol.2018.01.013.
Romero Granja, C., Wollni, M., 2018. Dynamics of smallholder participation in horticultural export chains: evidence from Ecuador. Agric. Econ. 49 (2), 225–235. https://doi.org/10.1111/agec.12411.
Sahn, D.E., Stifel, D.C., 2000. Poverty comparisons over time and across countries in Africa. World Dev. 28 (12), 2123–2155. https://doi.org/10.1016/S0305-750X(00)00075-9.
Tipraqsa, P., Schreinemachers, P., 2009. Agricultural commercialization of Karen Hill tribes in northern Thailand. Agric. Econ. 40 (1), 43–53. https://doi.org/10.1111/j.1574-0862.2008.00343.x.
Verkaart, S., Munyua, B.G., Mausch, K., Michler, J.D., 2017. Welfare impacts of improved chickpea adoption: a pathway for rural development in Ethiopia? Food Policy 66, 50–61. https://doi.org/10.1016/j.foodpol.2016.11.007.
von Braun, J., 1994. Introduction. In: von Braun, Joachim, Kennedy, Eileen (Eds.), Agricultural Commercialization, Economic Development, and Nutrition. Johns Hopkins University, Baltimore, Maryland, pp. 3–8.
von Braun, J., Kennedy, E., 1994. Agricultural Commercialization, Economic Development and Nutrition. Johns Hopkins University Press, Baltimore MA.
Vu, L., Glewwe, P., 2011. Impacts of rising food prices on poverty and welfare in Vietnam. J. Agric. Resour. Econ. 36 (1), 14–27.
Wiggins, S., 2018. 'Agricultural Commercialisation: Lessons from Asia and Latin America' APRA Working Paper 7, Future Agricultures Consortium.
World Bank, 2008, World Development Report: Agriculture.
World Bank, 2018. Climbing the Ladder: Poverty reduction and Shared Prosperity In Vietnam. Update report 2018.