MEASURING THE IMPACT OF CASH CROPS ON HOUSEHOLD EXPENDITURE AND POVERTY IN RURAL VIET NAM

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This paper measures the impacts of cash crops on household consumption expenditure and poverty in rural Viet Nam using data from the Viet Nam household living standards surveys (VHLSSs) of 2002 and 2004. It has been found that revenues from cash crops have positive and statistically significant impacts on per capita expenditure. More specifically, an increase of 1 Viet Nam dong (VND) in rice revenues leads to an increase of 0.019 VND in per capita expenditure, and the corresponding figures for revenues from annual crops, perennial crops and fruits are 0.038, 0.040 and 0.036, respectively. As a result, crop sales have positive and statistically significant impacts on poverty reduction for crop-growing households and the rural population. The poverty-reducing impacts are found to be positive for all three Foster-Greer-Thorbecke poverty measures.

I. INTRODUCTION

It is often argued that crop production has an important role in economic development and poverty reduction. Crop production can contribute to economic growth through different channels, such as the provision of food and employment generation (e.g., see Johnston and Mellor 1961; Ranis and others 1990; Irz and others 2001; Timmer 2002). Agricultural growth can result in a remarkable reduction in poverty (Thorbecke and Jung 1996). Together with the trade liberalization trend, it can bring important sources of income from exportation.[1]

However, when integrated into the global economy, the crop sector of a country can be adversely affected by global economic shocks. A channel for shock transmission is the price of output and inputs (Winters and others 2004; Easterly and Kraay 2000). A sudden decrease in the price of crop outputs can quickly push the poor households who produce crops into losses and poverty. Coffee growing in Viet Nam is an example. In the late 1990s, the price of coffee was very high in the world market, and many households in Tay Nguyen Province grew coffee. However, afterwards the price of coffee suddenly dropped, and this affected many households as 80 per cent of the poor households grew coffee in Tay Nguyen (World Bank 2004). The farmers often bought production inputs with delayed payments, and as the coffee price fell, they became indebted, and had to sell their land to pay the debts. Another example is the harmful impact of the reduction in the price of corn in Mexico. Poor farmers could not respond to decreases in the price of corn and they suffered from losses

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[1] The role of trade liberalization is discussed in numerous studies, e.g., Harrison (2005), Winters and others (2004), and McCulloch and others (2001).

in incomes from corn production (Levy and Wijnbergen 1992; Nadal 2000). As a result, the effect of a decrease in crop prices on poverty reduction is not assumed to be always positive.

In addition, the industry and service sectors tend to grow more quickly than the agricultural sector in the long run. The shrinking of agriculture relative to industry and services has been observed in both developed and developing countries. Non-farm employment and business have proved to be an effective way to increase household income and reduce poverty (e.g., Lanjouw and Lanjouw 1995; Lanjouw 1998; Van de Walle 1994; Ruerd and van den Berg 2001).

Viet Nam has been an agricultural country, with about 60 per cent of the population involved in crop production in 2006. It is also a leading country in exporting rice, coffee and tea. The export value of agricultural products increased from 24,500 billion VND to 100,200 billion VND during the period 1995-2006.[2] However, the share of crop products in total export revenues dropped from 32 to 14 per cent during this period. It is not clear whether cash crops still make an important contribution to household consumption and poverty reduction. The main objective of this paper is to measure the impacts of household sales of different crops on per capita expenditure and poverty reduction. Information from the study can be helpful for policymakers in designing programmes and policies related to crop production. Data used in this paper are from the Viet Nam household living standards surveys (VHLSSs) of 2002 and 2004.

There are six sections of this paper. The second section describes data sources used for this paper, and the third section gives a brief overview of cash crop production and household welfare in Viet Nam. Next, the fourth section presents a methodology of the impact evaluation of crop sales. The fifth section presents empirical findings on impact estimation. Finally, the sixth section provides a conclusion.

II. DATA SET

This study relies on data from the two recent VHLSSs, which were conducted in 2002 and 2004 by the General Statistics Office of Viet Nam with technical support from the World Bank. The VHLSSs covered 30,000 and 9,000 households, respectively.

The samples are representative of the national and regional, rural and urban, levels. It should be noted that the General Statistics Office increased the sample size of the 2002 VHLSS to 30,000 households so that the data could be representative of some large provinces. However, this large sample survey was very expensive, and the sample size of VHLSS 2004 was reduced to 9,000 households. The 2002 and 2004 VHLSSs set up a panel of 4,000 households, which were representative of the whole country, for both the urban and rural populations.

[2] $1 was approximately 16,000 VND in January 2006.

The surveys collected information through household and community level questionnaires. Information on households included basic demography, employment and labour force participation, education, health, income, expenditure, housing, fixed assets and durable goods, and the participation of households in poverty alleviation programmes.

In VHLSSs, expenditure and income per capita are collected using very detailed questionnaires. Expenditure includes food and non-food expenses. Food expenditure includes purchased food and foodstuffs, and self-produced products of households. Non-food expenditure comprises spending on education, health care, houses and commodities, and on power, water and garbage removal. Regarding income, household income can come from any source, and includes income from agricultural and non-agricultural production, salaries, wages, pensions, scholarships, income from loan interest and house rentals, remittances and social transfers. Income from agricultural production comprises crop income, livestock income, aquaculture income, and income from other agriculture-related activities.

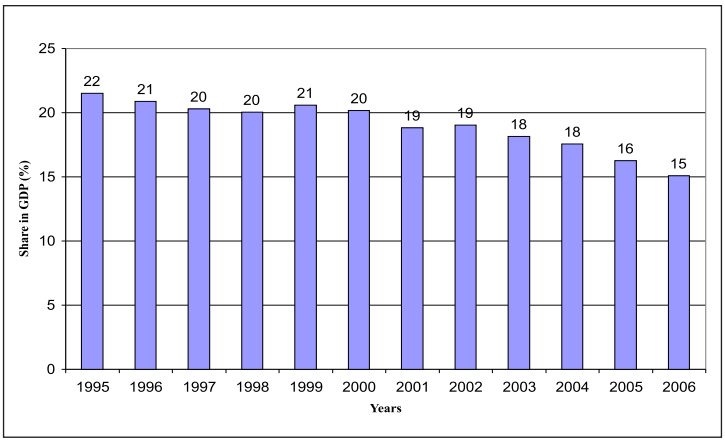
Information on commune characteristics was collected from 2,960 and 2,181 communes in the 2002 and 2004 surveys, respectively. Data on commune characteristics consist of demography and the general situation of communes, general economic conditions and aid programmes, non-farm employment, agriculture production, local infrastructure and transportation, education, health and social affairs. Commune data can be linked with household data. However, the commune data in the 2004 VHLSS are only available for rural areas.

This study focuses on the rural population. The main reason is that commune variables are used in regression analysis of the transfer impact, and there are only data on commune variables for rural areas in the 2004 VHLSS. In addition, poverty in Viet Nam is mostly a rural phenomenon, with 95 per cent of all poor living in rural areas in 2004. The number of households in the rural panel for 2002-2004 is 3,099.

III. CASH CROP PRODUCTION AND HOUSEHOLD WELFARE IN VIET NAM

In this paper, cash crops are defined as crops that households grow for sale. They consist of rice, industrial perennial crops (rubber, coffee, tea, peanuts, cashew nuts and peppers), fruits and annual crops. Annual crops include sugar cane, vegetables, potatoes, maize and others. The value of cash crops increased at an annual growth rate of 6 per cent during the period 1995-2006. However, there is evidence that the agricultural sector is shrinking. Figure 1 presents the share of the crop value in gross domestic product (GDP) over time. It shows that this share was decreased from 23 to 15 per cent during the period 1995-2006.

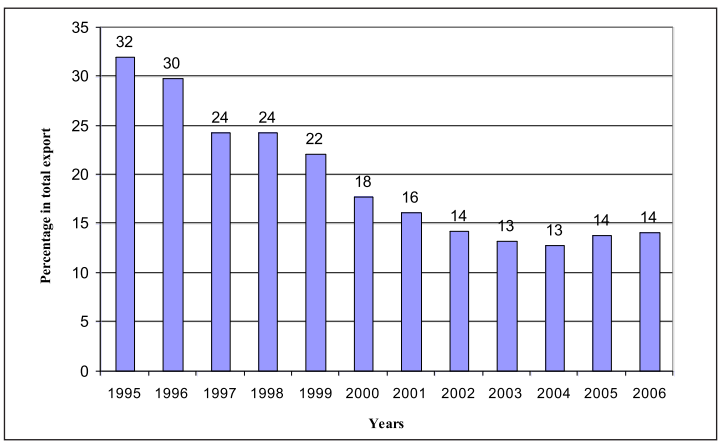
Figure 1. Share of the crop value in GDP



Source: Statistical yearbooks of the General Statistics Office of Viet Nam.

In addition, the share of agricultural products of total export revenues was reduced more quickly. Figure 2 shows that this share decreased from 32 per cent in 1995 to 14 per cent in 2006.

Figure 2. Crop exports share of total export revenues

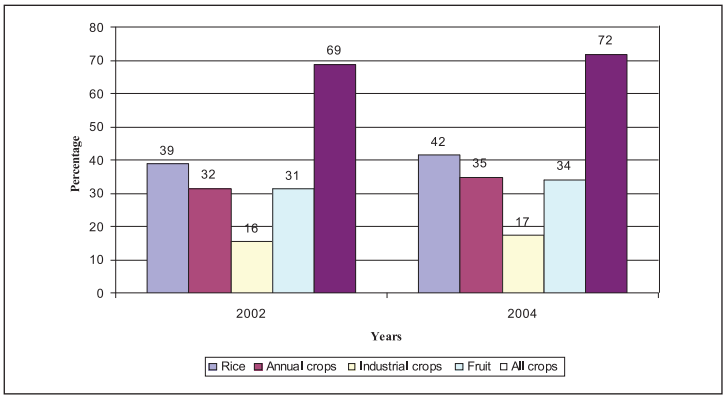


Source: Statistical yearbooks of the General Statistics Office of Viet Nam.

Although the share of agriculture of GDP tends to decrease over time, the proportion of households involved in agriculture remains rather high in rural Viet Nam. Figure 3 presents the percentage of rural households producing cash crops in the period 2002-2004. It shows that the ratio of households producing cash crops increased from 69 to 72 per

cent. The proportion of households producing each crop type also increased. It should be noted that the proportion of households producing all crops was larger than the proportion of households producing cash crops (crops for sale), since there were households growing crops for consumption. The proportion of households producing crops in rural areas decreased slightly from 82 to 81 per cent during the period 2002-2004.

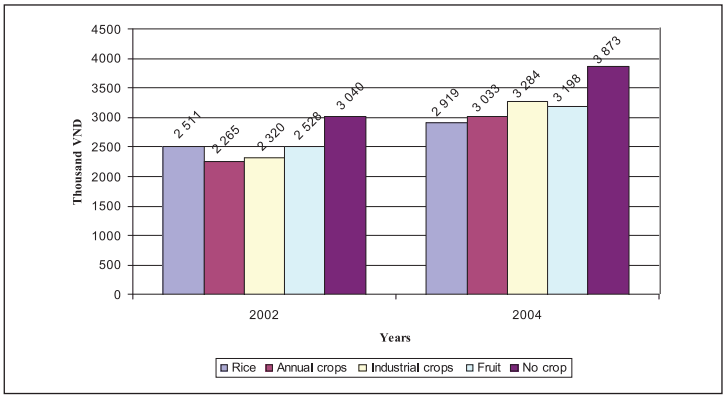
Figure 3. Percentage of households producing cash crops



Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.

Households without cash crops tended to have a higher consumption expenditure and lower poverty than those with cash crops (figures 4 and 5). Among the cash crop households, households with industrial crops experienced the highest expenditure growth rate during 2002-2004.

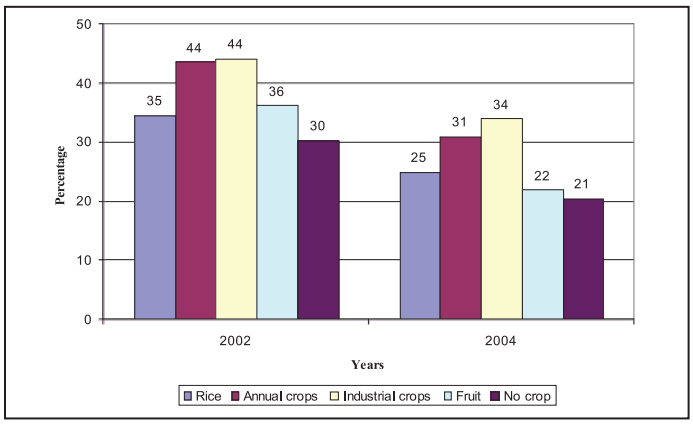
Figure 4. Per capita expenditure of households with and without cash crops



Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.

All the household groups had experienced poverty reduction during the period 2002-2004. Households with rice sales had the lowest poverty incidence compared with households with other crops (annual and industrial crops). Meanwhile, households with industrial crops had the highest poverty incidence.

Figure 5. Poverty incidence of households with and without cash crops (percentage)



Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.

IV. METHODS OF IMPACT MEASUREMENT

Impact on household consumption expenditure

This section presents the method for measuring the impacts of crop sales on household consumption expenditure and poverty. In this paper, expenditure is assumed to be a linear and a semi-log linear function of household characteristics:

$$Y_i = \alpha + X_i\beta + D_i\gamma + \varepsilon_i, \quad (1)$$

$$\ln(Y_i) = \alpha + X_i\beta + D_i\gamma + \varepsilon_i, \quad (2)$$

where Y_i is the per capita expenditure of household I, X_i are household characteristics, and D_i is a vector of revenues of crops, including rice, annual crops, industrial crops and fruit crops from crop-growing households. It should be noted that crop revenues are money that households obtain from crop sales.[3] The impact of D is estimated using both functions to examine the sensitivity of impact estimates to different functions of outcome.[4]

[3] Income is defined as revenues minus costs.

[4] We do not use the double-log function, i.e., $\ln (Y_i) = \alpha + X_i\beta + \ln (D_i)\gamma + \varepsilon_i$, since for households without crops, we get missing values of $\ln (D_i)$.

Since D is a continuous variable, one is often interested in the marginal effect (ME), which is the derivative of Y with respect to D. For equations (1) and (2), respectively, ME is equal to:

$$ME = \frac{\partial Y}{\partial D} = \gamma\,, \tag{3}$$

$$ME = \frac{\partial Y}{\partial D} = e^{(\alpha + X_i\beta + D_i\gamma + \varepsilon_i)}(\gamma) = Y_i\gamma\,. \tag{4}$$

Since ME in the semi-log function of outcome varies across the outcome value, one can use the average partial effect to measure the impact of D (Wooldridge 2001). In this paper, we define the average partial effect on the treated (APET), which measures how the average impact on crop-selling households changes due to a small change in crop revenues.

In the case of equation (1), APET is equal to ME, and it is estimated by $\hat{\gamma}$ In the case of equation (2), APET is expressed as follows:

$$APET = E\left(\frac{\partial Y}{\partial D}\middle| D > 0\right) = E(Y_i\gamma \mid D_i > 0)\,. \tag{5}$$

Thus the estimator is given by:

$$\hat{APET} = \frac{1}{n_p}\sum_{i=1}^{n_p}(Y_i\hat{\gamma})\,, \tag{6}$$

where n_p is the number of crop-selling households. The standard error of the estimates is calculated using a bootstrap technique.

The difficulty in estimating the effect of crop sales is the endogeneity of the crop sales. Unobserved variables, such as working conditions, production and business skills, and information, can be correlated with the crop sales. This paper uses instrumental-variables regressions and fixed-effect regressions to correct for the endogeneity of crop sales in the expenditure equation.

Impact on poverty

In this paper, poverty is measured by three Foster-Greer-Thorbecke poverty indexes, which can all be calculated using the following formula (Foster, Greer and Thorbecke 1984):

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - Y_i}{z}\right]^\alpha\,, \tag{7}$$

where Y_i is a welfare indicator (consumption expenditure per capita in this paper) for person i, z is the poverty line, n is the number of people in the sample population, q is the number of poor people, and α can be interpreted as a measure of inequality aversion.

When α = 0, we have the headcount index H, which measures the proportion of people below the poverty line. When α = 1 and α = 2, we have the poverty gap *PG,* which measures the depth of poverty, and the squared poverty gap $P_{2,}$ which measures the severity of poverty, respectively.

The impact of crop sales on the index of poverty of the recipients is expressed as follows:

$$\Delta P = P(D > 0, Y) - P(D > 0, Y_{(D=0)}), \tag{8}$$

where the first term on the left-hand side of (8) is the poverty measurement of the crop-selling households in the presence of crop revenues. This term is observed and can be estimated directly from the sample data. However, the second term on the right-hand side of (8) is the counterfactual measurement of poverty, i.e., the poverty indexes of crop-selling households if they had not sold the crops. This term is not observed directly, and it is estimated for household *i* using the following predicted expenditure:

$$\hat{Y}_{i(D_i=0)} \mid D_i > 0 = Y_i - \hat{\gamma} D_i, \tag{9}$$

Where $\hat{\gamma}$ is estimated from equation (1). In the case of equation (2), expenditure without crop revenues for crop-selling households is predicted as follows:

$$\begin{aligned} \hat{Y}_{i(D_i=0)} \mid D_i > 0 &= e^{\hat{\ln}(Y_{i(D=0)})} \\ &= e^{\hat{\alpha} + X_i\hat{\beta} + \hat{\varepsilon}_i} \\ &= e^{\hat{\alpha} + X_i\hat{\beta} + D_i\hat{\gamma} + \hat{\varepsilon}_i - D_i\hat{\gamma}} \\ &= e^{\ln(Y_i) - D_i\hat{\gamma}} \\ &= Y_i e^{-D_i\hat{\gamma}}. \end{aligned} \tag{10}$$

We can also measure the impact of crop sales on the total rural poverty as follows:

$$\Delta P = P(Y) - P(Y_{(D=0)}), \tag{11}$$

where $P(Y)$ is the observed poverty index of all the rural population (in which crop-selling households had crop sales), and $P(Y_{(D=0)})$ is the poverty index of all the rural population if crop-selling households had not received any money from crop sales.

V. EMPIRICAL RESULTS ON IMPACT MEASUREMENTS

In order to measure the impact of cash crops, the models of per capita expenditure are estimated using VHLSSs 2002 and 2004. The explanatory variables include household composition, the age of household head, the education of household head and household head's spouse, land and housing characteristics, regional dummy variables and commune characteristics. The list of explanatory variables is presented in table A.1 in the appendix.

In order to control for inflation, we have deflated all variables in terms of 2004 prices. To examine the sensitivity of impact estimates to different models, we use eight models (table A.2 in the appendix). Models 1 to 4 use the linear function of expenditure, while models 5 to 8 use the semi-log linear function of expenditure. For both outcome functions, there are four methods of estimation: fixed-effect and random-effect regressions using panel data from the 2002-2004 VHLSSs, ordinary least squares (OLS) regression using the 2004 VHLSS, and instrumental variable (IV) regression using the 2004 VHLSS. For the instrumental variable regression, the instrumental variables used for the crop revenues in 2004 are the revenues of cash crops in 2002. Although the validity of these instrumental variables can be questionable, empirical studies often use treatment variables in the past as instruments for the current treatment variables (e.g., see Van de Walle 2004).

The regression results reported in table A.2 in the appendix show that the estimates are stable across the models. The estimates of all the crop revenues are statistically significant in all the models. The R-squared is higher in the semi-log equations than in the linear function. The estimates of the coefficients of crop sales are also more statistically significant in the semi-log equations.

Using the instrumental variable regression, we can test the endogeneity of crop sales. Results from Durbin-Wu-Hausman tests show that the hypothesis on the exogeneity of crop sales is not rejected (table A.2 in the appendix). A problem in the instrumental variable regression is that the assumption on the exclusion of the instruments in the outcome equations might not be valid, since the sales in 2002 (the instruments) can affect household expenditure in 2004. Regarding the random-effect and fixed-effect models, the Hausman statistic that tests the null hypothesis of no systematic difference in coefficient estimates between two models is equal to 67.2 (result not reported in the paper). Thus, the null hypothesis is strongly rejected, and we incline to the fixed-effect model. In the following tables, only estimation results from models 1 and 5 (i.e., fixed-effect regressions) are reported. The estimation results from other models are quite similar and are not reported in this paper.[5]

Table 1 presents the estimates of APET for cash crop sales. All the estimates are positive and statistically significant. For example, model 5 shows that an increase of 1 VND in rice revenues leads to an increase of 0.019 VND in per capita expenditure. The corresponding figures for the sales of annual crops, perennial crops and fruits are 0.038, 0.040 and 0.036, respectively.

[5] These results can be provided on request.

Table 1. Impact of crop revenues on per capita expenditure

	Model 1	Model 5
Revenues of rice (thousand VND)	0.023*	0.019**
	[0.013]	[0.008]
Revenues of other annual crops (thousand VND)	0.030**	0.038***
	[0.013]	[0.013]
Revenues of perennial crops (thousand VND)	0.035***	0.040***
	[0.011]	[0.010]
Revenues of fruit (thousand VND)	0.039***	0.036***
	[0.015]	[0.013]

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: * significant at 10%, ** significant at 5%, *** significant at 1%.
Figures in parentheses are standard errors. Standard errors are corrected for sampling weights and estimated using bootstrap (non-parametric) with 200 replications.

Since cash crops have increased household expenditure, they can reduce the poverty of crop-selling households. In this paper, a household is classified as poor if their per capita expenditure is below the expenditure poverty line.[6] Tables 2 through 5 present the impact estimates on poverty of sales from rice, annual crops, perennial crops and fruits.

In table 2, estimates from model 1 are not statistically significant, while estimates from model 5 are statistically significant at the 5 per cent level. According to model 5, rice sales reduce the poverty incidence of the rice-growing households by about 1.4 percentage points. They also decrease the poverty gap and severity indexes by about 4.5 per cent. The effects on total poverty are smaller. Rice sales help to reduce the poverty incidence of all rural households by about 0.6 percentage points, and decrease the rural poverty gap and severity indexes by about 2 per cent.

[13] This poverty line was set up by the World Bank and the General Statistics Office. The poverty line is equivalent to the expenditure level that allows for nutritional needs and some essential non-food consumption, such as clothing and housing. This poverty line was first estimated in 1993. Poverty lines in the following years are estimated by deflating the 1993 poverty line using the consumer price index. Thus, the poverty lines are comparable over time. The poverty lines in the years 1993, 1998, 2002 and 2004 are equal to 1,160, 1,790, 1,917 and 2,077 thousand VND, respectively.

Table 2. Impact of rice sales on poverty

Index	With crop sales	Model 1		Model 5	
		Without crop sales	Impact	Without crop sales	Impact
Poverty of recipients					
Poverty incidence (P0)	0.2534***	0.2731***	-0.0197	0.2671***	-0.0137**
	[0.0144]	[0.0217]	[0.0176]	[0.0145]	[0.0070]
Poverty gap index (P1)	0.0630***	0.0713***	-0.0083	0.0661***	-0.0031**
	[0.0048]	[0.0080]	[0.0061]	[0.0050]	[0.0014]
Poverty severity index (P2)	0.0227***	0.0266***	-0.0039	0.0238***	-0.0011**
	[0.0023]	[0.0046]	[0.0037]	[0.0025]	[0.0005]
Poverty of the rural population					
Poverty incidence (P0)	0.2540***	0.2624***	-0.0084	0.2598***	-0.0059**
	[0.0085]	[0.0118]	[0.0076]	[0.0090]	[0.0030]
Poverty gap index (P1)	0.0611***	0.0646***	-0.0036	0.0624***	-0.0013**
	[0.0026]	[0.0039]	[0.0026]	[0.0030]	[0.0006]
Poverty severity index (P2)	0.0218***	0.0235***	-0.0017	0.0223***	-0.0005**
	[0.0012]	[0.0022]	[0.0016]	[0.0014]	[0.0002]

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: * significant at 10%, ** significant at 5%, *** significant at 1%.
Figures in parentheses are standard errors. Standard errors are corrected for sampling weights and estimated using bootstrap (non-parametric) with 200 replications.

Tables 3 and 4 present the impact estimates on poverty indexes of annual and perennial crop sales. All the estimates are statistically significant. Sales from annual and perennial crops reduce the poverty incidence of crop-growing households by 2.6 per cent (table 3) and 5.2 (table 4) percentage points (model 5). They also decrease the poverty gap and severity indexes of the crop-growing households and rural households. The effect of perennial crops is higher than that of annual crops. They reduce the poverty gap and severity indexes of the perennial-crop-growing households by approximately 12 per cent and 4 per cent (table 4), respectively.

Table 3. Impact of annual crop sales on poverty

Index	*With crop sales*	*Model 1*		*Model 5*	
		Without crop sales	*Impact*	*Without crop sales*	*Impact*
Poverty of recipients					
Poverty incidence (P0)	0.3102***	0.3394***	-0.0292***	0.3364***	-0.0262***
	[0.0157]	[0.0177]	[0.0094]	[0.0149]	[0.0077]
Poverty gap index (P1)	0.0823***	0.0941***	-0.0118**	0.0889***	-0.0065***
	[0.0053]	[0.0075]	[0.0048]	[0.0053]	[0.0022]
Poverty severity index (P2)	0.0315***	0.0381***	-0.0066**	0.0342***	-0.0027**
	[0.0028]	[0.0046]	[0.0034]	[0.0028]	[0.0010]
Poverty of the rural population					
Poverty incidence (P0)	0.2540***	0.2649***	-0.0109**	0.2638***	-0.0098***
	[0.0085]	[0.0102]	[0.0036]	[0.0087]	[0.0029]
Poverty gap index (P1)	0.0611***	0.0655***	-0.0044**	0.0635***	-0.0025***
	[0.0026]	[0.0038]	[0.0018]	[0.0027]	[0.0008]
Poverty severity index (P2)	0.0218***	0.0243***	-0.0025**	0.0228***	-0.0010**
	[0.0012]	[0.0021]	[0.0013]	[0.0013]	[0.0004]

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: * significant at 10%, ** significant at 5%, *** significant at 1%.
Figures in parentheses are standard errors. Standard errors are corrected for sampling weights and estimated using bootstrap (non-parametric) with 200 replications.

Table 4. Impact of perennial crop sales on poverty

Index	With crop sales	Model 1		Model 5	
		Without crop sales	Impact	Without crop sales	Impact
Poverty of recipients					
Poverty incidence (P0)	0.3370***	0.4087***	-0.0717***	0.3889***	-0.0520***
	[0.0222]	[0.0287]	[0.0202]	[0.0268]	[0.0153]
Poverty gap index (P1)	0.0795***	0.1103***	-0.0308**	0.0912***	-0.0117***
	[0.0069]	[0.0185]	[0.0160]	[0.0088]	[0.0043]
Poverty severity index (P2)	0.0271***	0.0431***	-0.0160	0.0314***	-0.0042**
	[0.0031]	[0.0178]	[0.0172]	[0.0039]	[0.0018]
Poverty of the rural population					
Poverty incidence (P0)	0.2540***	0.2676***	-0.0136***	0.2638***	-0.0099***
	[0.0085]	[0.0094]	[0.0039]	[0.0091]	[0.0029]
Poverty gap index (P1)	0.0611***	0.0669***	-0.0058**	0.0633***	-0.0022***
	[0.0026]	[0.0044]	[0.0032]	[0.0030]	[0.0008]
Poverty severity index (P2)	0.0218***	0.0249***	-0.0030	0.0226***	-0.0008***
	[0.0012]	[0.0037]	[0.0033]	[0.0015]	[0.0003]

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: * significant at 10%, ** significant at 5%, *** significant at 1%.
Figures in parentheses are standard errors. Standard errors are corrected for sampling weights and estimated using bootstrap (non-parametric) with 200 replications.

Finally, table 5 reports impact estimates of fruit sales. Fruit sales decrease the poverty rate of growing households by about 1.1 percentage points (model 5). The estimated effect on the poverty rate of rural households is quite small, at 0.4 percentage points. Regarding poverty gap and severity, most of the estimates are not statistically significant. This might be because the poverty gap and indexes of the fruit-growing households are smaller than those of households with other crops.

Table 5. Impact of fruit sales on poverty

Index	With crop sales	Model 1		Model 5	
		Without crop sales	Impact	Without crop sales	Impact
Poverty of recipients					
Poverty incidence (P0)	0.2162***	0.2373***	-0.0210**	0.2267***	-0.0105**
	[0.0120]	[0.0158]	[0.0095]	[0.0153]	[0.0051]
Poverty gap index (P1)	0.0475***	0.0525***	-0.0049	0.0499***	-0.0023**
	[0.0039]	[0.0057]	[0.0039]	[0.0047]	[0.0009]
Poverty severity index (P2)	0.0163***	0.0185***	-0.0021	0.0167***	-0.0003
	[0.0020]	[0.0044]	[0.0039]	[0.0023]	[0.0003]
Poverty of the rural population					
Poverty incidence (P0)	0.2540***	0.2615***	-0.0076**	0.2580***	-0.0041**
	[0.0076]	[0.0088]	[0.0034]	[0.0090]	[0.0018]
Poverty gap index (P1)	0.0611***	0.0628***	-0.0018	0.0615***	-0.0005
	[0.0027]	[0.0032]	[0.0014]	[0.0028]	[0.0003]
Poverty severity index (P2)	0.0218***	0.0226***	-0.0008	0.0219***	-0.0001
	[0.0013]	[0.0020]	[0.0014]	[0.0013]	[0.0001]

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: * significant at 10%, ** significant at 5%, *** significant at 1%.
Figures in parentheses are standard errors. Standard errors are corrected for sampling weights and estimated using bootstrap (non-parametric) with 200 replications.

It should be noted that the impact of cash crop revenues on expenditure and poverty is measured by comparing expenditure and poverty in the presence of crop revenues and counterfactual expenditure and poverty in the absence of crop revenues. Expenditure and poverty are not compared between crop households and non-crop households. Although households with crops tend to have lower expenditure and higher poverty than households without crops, crop revenues still play an important role in increasing expenditure and reducing poverty for the crop-growing households. This is because crop revenues are still a main revenue source for crop-growing households.

VI. CONCLUSION

Viet Nam is a developing country with a large proportion of the population involved in agricultural activities. Although crop production is often named as an important activity for economic growth and poverty reduction, there are only a few studies measuring the quantitative impacts of crop production on poverty reduction. This paper is the first study that uses nationally representative household surveys in order to measure the impacts of cash crop sales on household consumption expenditure and poverty in Viet Nam.

It has been found that revenues from cash crops have positive and statistically significant impacts on the per capita expenditure of crop-selling households. More specifically, an increase of 1 VND in rice revenues leads to an increase of 0.019 VND in per capita expenditure, and the corresponding figures for sales of annual crops, perennial crops, and fruits are 0.038, 0.040 and 0.036, respectively. As a result, the crop sales help reduce poverty of the crop-growing households and rural population. Among the crops, perennial crops have largest effect on poverty reduction in terms of point estimates. They decrease the poverty incidence of the crop-growing households by approximately 5.2 percentage points. They reduce the poverty gap and severity indexes of the perennial-crop-growing households by about 12 per cent. The fruit crop sales have small point estimates of impacts on poverty. They decrease the poverty rate of the growing households and all rural household by about 1.1 and 0.4 percentage points, respectively.

The findings might suggest several policy implications for crop production in Viet Nam. First, non-farm production can be an important activity for increasing income, expenditure and reducing poverty. Descriptive data analysis shows that households with crops tend to have lower expenditure and higher poverty than households without crops. Second, cash crops still have an important role in poverty reduction, and the Government should have measures and policies to increase the crop revenues of farm households. The findings also show that perennial crops have a greater effect on poverty reduction than other crops. Thus, the promotion of perennial crops can result in a remarkable reduction in rural poverty.

ANNEX

Table A.1. Variable description

Variables	Type	2002		2004	
		Mean	Standard deviation	Mean	Standard deviation
Per capita expenditure (thousand VND)*	Continuous	2 839.6	40.1	3 340.4	46.0
Variables of crop sales					
Revenues of rice (thousand VND)*	Continuous	2 330.3	214.1	2 687.7	207.1
Revenues of annual crops (thousand VND)*	Continuous	604.4	56.4	984.6	91.1
Revenues of perennial crops (thousand VND)*	Continuous	848.6	158.9	1 295.0	220.2
Revenues of fruit (thousand VND)*	Continuous	855.4	107.9	898.0	100.9
Household variables					
Ratio of members younger than 16 years	Continuous	0.305	0.005	0.280	0.004
Ratio of members older than 60 years	Continuous	0.089	0.003	0.095	0.003
Age of household head	Discrete	47.0	0.3	48.4	0.3
Household size	Discrete	5.061	0.044	5.133	0.049
Head with less than primary school	Binary	0.341	0.011	0.316	0.011
Head with primary school	Binary	0.260	0.009	0.264	0.009
Head with lower secondary school	Binary	0.282	0.011	0.278	0.010
Head with upper secondary school	Binary	0.070	0.005	0.055	0.005
Head with technical degree	Binary	0.036	0.004	0.070	0.005
Head with post secondary school	Binary	0.011	0.002	0.017	0.003
Head with no spouse	Binary	0.137	0.007	0.140	0.007
Head's spouse with less than primary school	Binary	0.334	0.012	0.323	0.011
Head's spouse with primary school	Binary	0.228	0.009	0.229	0.009
Head's spouse with lower secondary school	Binary	0.231	0.010	0.224	0.010
Head's spouse with upper secondary school	Binary	0.043	0.004	0.037	0.004
Head's spouse with technical degree	Binary	0.017	0.003	0.036	0.004
Head's spouse with post secondary school	Binary	0.010	0.002	0.010	0.002
Log of living areas (log of m^2)	Continuous	3.902	0.012	3.981	0.012

Table A.1. Variable description *(continued)*

Variables	*Type*	*2002*		*2004*	
		Mean	*Standard deviation*	*Mean*	*Standard deviation*
Living in permanent house	Binary	0.117	0.008	0.136	0.008
Living in semi-permanent house	Binary	0.603	0.012	0.624	0.011
Living in temporary house	Binary	0.279	0.011	0.239	0.011
Area of annual crop land (m^2)	Continuous	4 305.1	203.5	4 374.7	195.6
Area of perennial crop land (m^2)	Continuous	1 532.7	141.5	1 248.8	139.5
Area of forestry land (m^2)	Continuous	1 666.1	296.9	1 144.8	191.8
Area of aquaculture water surface (m^2)	Continuous	399.7	84.7	316.6	70.1
Commune variables					
Having non-farm enterprise in commune	Binary	0.979	0.005	0.841	0.012
Distance to nearest town (km)	Continuous	8.785	0.283	9.158	0.309
Distance to nearest road (km)	Continuous	0.684	0.099	0.594	0.099
Distance to nearest daily market (km)	Continuous	2.795	0.184	3.087	0.187
Distance to nearest periodic market (km)	Continuous	3.560	0.233	2.052	0.140
Distance to nearest post (km)	Continuous	3.091	0.192	2.361	0.152
Dummy regional variables					
Red River Delta	Binary	0.201	0.013	0.201	0.013
North East	Binary	0.129	0.010	0.129	0.010
North West	Binary	0.031	0.005	0.031	0.005
North Central Coast	Binary	0.152	0.013	0.152	0.013
South Central Coast	Binary	0.089	0.009	0.089	0.009
Central Highlands	Binary	0.063	0.008	0.063	0.008
North East South	Binary	0.094	0.009	0.094	0.009
Mekong River Delta	Binary	0.242	0.014	0.242	0.014
Number of observations		3 099		3 099	

Source: Estimations from Viet Nam household living standards surveys 2002 and 2004.
Note: * 2004 price.

Table A.2. Regression results

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
Revenues of rice	0.023*	0.031***	0.034***	0.030***	0.0000043**	0.0000088***	0.0000083***	0.0000093***
	[0.013]	[0.007]	[0.009]	[0.010]	[0.0000020]	[0.0000012]	[0.0000012]	[0.0000019]
Revenues of annual crops	0.030**	0.023***	0.018**	0.025*	0.0000102***	0.0000091***	0.0000074***	0.0000103**
	[0.013]	[0.008]	[0.008]	[0.015]	[0.0000031]	[0.0000022]	[0.0000021]	[0.0000046]
Revenues of perennial crops	0.035***	0.023***	0.020***	0.024***	0.0000086***	0.0000055***	0.0000044***	0.0000051***
	[0.011]	[0.003]	[0.005]	[0.007]	[0.0000021]	[0.0000008]	[0.0000010]	[0.0000015]
Revenues of fruit	0.039***	0.040***	0.036***	0.035***	0.0000093***	0.0000116***	0.0000097***	0.0000106***
	[0.015]	[0.010]	[0.011]	[0.013]	[0.0000024]	[0.0000018]	[0.0000019]	[0.0000030]
Ratio of members younger than 16 years	-1 261.4***	-1 720.9***	-2 001.0***	-1 995.7***	-0.35524***	-0.50076***	-0.55623***	-0.55494***
	[277.9]	[150.4]	[190.3]	[189.0]	[0.06152]	[0.03625]	[0.04579]	[0.04559]
Ratio of members who older than 60	-1 225.4***	-1 104.0***	-1 063.6***	-1 080.8***	-0.27818***	-0.28503***	-0.26653***	-0.26530***
	[340.9]	[176.8]	[231.8]	[232.0]	[0.07231]	[0.03923]	[0.04931]	[0.04929]
Head age	67.319**	-0.669	-2.76	-2.534	0.02319***	0.00523	-0.00001	-0.00015
	[31.319]	[14.067]	[15.835]	[15.663]	[0.00793]	[0.00381]	[0.00424]	[0.00422]
Head age squared	-0.505*	0.085	0.081	0.083	-0.00018**	-0.00002	0.00002	0.00002
	[0.303]	[0.136]	[0.149]	[0.147]	[0.00008]	[0.00004]	[0.00004]	[0.00004]
Household size	-813.307***	-562.218***	-592.555***	-594.747***	-0.18473***	-0.13634***	-0.12364***	-0.12426***
	[109.723]	[63.408]	[78.441]	[78.030]	[0.02271]	[0.01324]	[0.01602]	[0.01596]

Table A.2. ***(continued)***

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
Household size squared	45.758***	25.554***	24.996***	24.915***	0.00860***	0.00464***	0.00323**	0.00329**
	[8.430]	[5.146]	[6.043]	[5.973]	[0.00187]	[0.00111]	[0.00134]	[0.00133]
Head with less than primary school	Omitted							
Head with primary school	199.253*	254.947***	253.845***	252.004***	0.04643**	0.08811***	0.09348***	0.09457***
	[110.781]	[62.640]	[94.990]	[94.831]	[0.02357]	[0.01557]	[0.02178]	[0.02175]
Head with lower secondary school	299.179**	404.695***	547.563***	547.180***	0.08099**	0.12412***	0.15533***	0.15729***
	[149.047]	[76.227]	[113.818]	[113.283]	[0.03273]	[0.01858]	[0.02491]	[0.02493]
Head with upper secondary school	260.563	518.121***	475.746***	476.868***	0.12790***	0.18150***	0.16949***	0.17103***
	[253.859]	[114.893]	[148.381]	[147.202]	[0.04928]	[0.02898]	[0.03606]	[0.03570]
Head with technical degree	881.8***	1 073.54***	1 061.94***	1 062.55***	0.23388***	0.29430***	0.29453***	0.29786***
	[207.90]	[141.93]	[180.17]	[179.03]	[0.04200]	[0.02882]	[0.03740]	[0.03729]
Head with post secondary school	1 055.29**	1 735.88***	1 873.94***	1 874.67***	0.26970***	0.43397***	0.46631***	0.46988***
	[490.660]	[280.295]	[314.350]	[313.048]	[0.07819]	[0.04646]	[0.05257]	[0.05234]
Head with no spouse	Omitted							

Table A.2. ***(continued)***

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
Head's spouse with less than primary school	-386.828*	-312.130***	-313.697***	-310.602***	-0.05797	-0.08579***	-0.09113***	-0.09265***
	[221.162]	[88.222]	[115.865]	[114.872]	[0.04497]	[0.02102]	[0.02535]	[0.02533]
Head's spouse with primary school	-366.332	-152.198	-107.205	-104.212	-0.03685	-0.01672	-0.00898	-0.01201
	[234.085]	[101.092]	[132.681]	[131.098]	[0.04565]	[0.02317]	[0.02840]	[0.02850]
Head's spouse with lower secondary school	-325.632	-362.411***	-510.096***	-512.178***	-0.01596	-0.05061**	-0.09259***	-0.09412***
	[240.926]	[106.936]	[144.959]	[143.424]	[0.04947]	[0.02420]	[0.03048]	[0.03032]
Head's spouse with upper secondary school	-285.121	126.614	81.632	86.872	0.00537	0.06202	0.03807	0.03667
	[379.955]	[172.244]	[253.240]	[251.963]	[0.07318]	[0.03805]	[0.05078]	[0.05057]
Head's spouse with technical degree	572.955	884.202***	715.544**	713.291**	0.13973**	0.19583***	0.16427***	0.16285***
	[418.545]	[310.969]	[313.438]	[312.271]	[0.06998]	[0.04105]	[0.04549]	[0.04530]
Head's spouse with post secondary school	593.67	1 200.40***	1 327.12***	1 326.61***	0.20749**	0.28664***	0.27745***	0.27808***
	[595.691]	[348.851]	[424.874]	[422.373]	[0.09514]	[0.05953]	[0.06711]	[0.06690]

Table A.2. ***(continued)***

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
Log of living areas (log of m^2)	368.599***	751.248***	968.838***	975.854***	0.08287***	0.18655***	0.24961***	0.24795***
	[82.784]	[68.084]	[104.766]	[105.512]	[0.01780]	[0.01596]	[0.02289]	[0.02281]
Living in permanent house	705.865***	742.172***	780.790***	775.023***	0.16731***	0.20322***	0.20782***	0.20724***
	[156.135]	[100.190]	[143.871]	[143.318]	[0.03104]	[0.02181]	[0.03048]	[0.03036]
Living in semi-permanent house	192.595**	248.010***	237.497***	233.312***	0.06663***	0.09793***	0.09949***	0.09935***
	[78.723]	[48.789]	[79.680]	[79.565]	[0.01873]	[0.01396]	[0.02086]	[0.02082]
Living in temporary house	Omitted							
Area of annual crop land (m^2)	0.006	-0.004	0.004	0.006	0.0000022	-0.0000012	0.0000011	0.0000002
	[0.009]	[0.005]	[0.007]	[0.008]	[0.0000018]	[0.0000014]	[0.0000016]	[0.0000019]
Area of perennial crop land (m^2)	0.002	0.010**	0.021***	0.018***	0.0000006	0.0000027**	0.0000052***	0.0000047***
	[0.006]	[0.005]	[0.005]	[0.007]	[0.0000013]	[0.0000012]	[0.0000012]	[0.0000014]
Forestry land (m^2)	0.006**	-0.001	-0.003	-0.003	0.0000015*	-0.0000003	-0.0000011	-0.000001
	[0.003]	[0.002]	[0.003]	[0.003]	[0.0000009]	[0.0000005]	[0.0000007]	[0.0000007]
Area of aquaculture water surface (m^2)	0.02	0.030***	0.017	0.017	0.0000043	0.0000096***	0.0000070**	0.0000070**
	[0.013]	[0.011]	[0.014]	[0.014]	[0.0000038]	[0.0000022]	[0.0000031]	[0.0000031]

Table A.2. ***(continued)***

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
Commune having non-farm activities	-185.442**	-198.540**	-41.603	-46.602	-0.06431***	-0.06598***	-0.02965	-0.02995
	[85.032]	[78.267]	[100.667]	[100.282]	[0.02027]	[0.01606]	[0.02288]	[0.02275]
Distance to nearest town (km)	1.276	-3.593	-8.955**	-9.100**	0.00107	-0.0006	-0.00234**	-0.00237**
	[4.047]	[2.869]	[4.229]	[4.245]	[0.00111]	[0.00083]	[0.00110]	[0.00109]
Distance to nearest road (km)	35.894	30.125***	34.730***	35.322***	0.00295	0.00642**	0.00890***	0.00885***
	[29.651]	[11.541]	[12.451]	[12.573]	[0.00519]	[0.00287]	[0.00299]	[0.00297]
Distance to nearest daily market (km)	7.328	-7.800**	-16.643**	-17.083**	0.00166	-0.00346***	-0.00930***	-0.00915***
	[6.072]	[3.733]	[6.826]	[6.677]	[0.00130]	[0.00099]	[0.00200]	[0.00197]
Distance to nearest periodic market (km)	-2.141	-2.531	-29.344***	-29.772***	-0.00067	-0.00103	-0.00756***	-0.00736***
	[4.787]	[4.077]	[7.426]	[7.498]	[0.00121]	[0.00099]	[0.00199]	[0.00199]
Distance to nearest post (km)	-10.523**	-14.368***	-17.676**	-17.985***	-0.00372***	-0.00501***	-0.00351*	-0.00364*
	[5.019]	[3.610]	[6.960]	[6.925]	[0.00135]	[0.00120]	[0.00193]	[0.00190]
Year 2008	451.777***	366.697***			0.12966***	0.10351***		
	[37.449]	[35.081]			[0.00931]	[0.00878]		
Red River Delta	Omitted							
North East		-189.344**	-323.409***	-343.437***		-0.06517**	-0.09394***	-0.09615***
		[92.510]	[112.082]	[113.021]		[0.02648]	[0.02924]	[0.02926]

Table A.2. ***(continued)***

	Dependent variable: Per capita expenditure				*Dependent variable: Logarithm of per capita expenditure*			
Explanatory variables	*Model 1: Fixed-effect*	*Model 2: Random effect*	*Model 3: OLS*	*Model 4: IV*	*Model 5: Fixed-effect*	*Model 6: Random effect*	*Model 7: OLS*	*Model 8: IV*
North West		-299.428**	-136.261	-196.882		-0.18678***	-0.10716**	-0.11485**
		[123.528]	[172.881]	[177.290]		[0.04259]	[0.05222]	[0.05261]
North Central Coast		-200.129**	-302.910***	-316.375***		-0.08774***	-0.10776***	-0.10914***
		[83.708]	[105.745]	[105.541]		[0.02529]	[0.02913]	[0.02898]
South Central Coast		212.903**	174.441	153.874		0.06441**	0.0322	0.02996
		[100.582]	[130.848]	[129.647]		[0.02937]	[0.03383]	[0.03361]
Central Highlands		43.188	114.78	55.23		-0.06256*	-0.01886	-0.02795
		[118.826]	[167.408]	[176.044]		[0.03607]	[0.04667]	[0.04806]
North East South		1 321.041***	1 503.411***	1 507.550***		0.32822***	0.34042***	0.34022***
		[149.064]	[203.907]	[200.913]		[0.03248]	[0.03746]	[0.03719]
Mekong River Delta		775.163***	672.015***	749.269***		0.23169***	0.19538***	0.20387***
		[115.672]	[152.590]	[162.300]		[0.02742]	[0.03317]	[0.03551]
Constant	3 841.43***	1 977.73***	1 777.18***	1 677.43***	7.94997***	7.50379***	7.49063***	7.48028***
	[848.153]	[393.784]	[503.803]	[499.960]	[0.21306]	[0.10635]	[0.13217]	[0.13182]
Observations	6 198	6 198	3 099	3 099	6 198	6 198	3 099	3 099
Number of i	3 099	3 099			3 099	3 099		
R-squared	0.28	0.33	0.38		0.34	0.42	0.48	

Source: Estimations from the Viet Nam household living standards surveys of 2002 and 2004.
Note: Robust standard errors in brackets.
***, **, and * represent statistical significance at 1%, 5% and 10%, respectively.
The first stage regression in the IV regression is not reported. It can be provided on request.

Table A.3. Tests on weak instruments and underidentification of IV, and endogeneity of crop sales in IV regressions

	Per capita expenditure (model 4)	*Logarithm of per capita expenditure (model 8)*
Underidentification test of IV: Hansen J statistic	$\chi_{(1)}$ = 886.04 P-value = 0.000	$\chi_{(1)}$ = 886.04 P-value = 0.000
Test of endogeneity: Durbin-Wu-Hausman statistic	$\chi_{(1)}$ = 1.772 P-value = 0.777	$\chi_{(1)}$ = 1.799 P-value = 0.773
Weak IV identification test: Cragg-Donald F statistic	253.526	253.526

Source: Estimation from the 2004 Viet Nam household living standards survey.

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