

Nonfarm Activities and Household Production Choices in Smallholder Agriculture in Vietnam

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Abstract: This paper explores the effects of labour movement into nonfarm activities on household production choices in rural Vietnam. It finds that agricultural production declines and there are negative effects on farm revenue. However, these conclusions are limited in the North. Households in the North readjust their production structure by investing in livestock and other crops that require less labour. Rice farmers in the South have managed to keep their rice production unaffected by hiring more labour, and investing more capital to switch to less labour-intensive farming. Evidence of relaxing liquidity constraints is found, at least in the short run. While the decline in agricultural revenue in the north suggests some level of substitution between farming and nonfarm activities, the stability in rice production at the national level brings good news to policy makers and for food security despite rapid structural change over the past decades.

Keywords: Nonfarm, food security, rice self-sufficiency, agricultural transformation, household agricultural production.

1. Introduction

Agriculture has traditionally been perceived as the engine of rural growth in Asia. Nonfarm activities, however, have assumed an increasingly important role [1, 2]. The widely empirical evidence for developing countries shows that the rural nonfarm economy in Asia accounts for 30% of full-time rural employment and 50% of income [2]. In Vietnam, the percentage of households that were involved in at least one nonfarm activity increased from 25% to nearly 50% of rural households between 1993 and 1998 [3, 4].

Although the participation of household labour into nonfarm activities is a primary feature of the economic structural transformation process [1], the potential impacts of this process on agriculture can be quite complex. Economic theories show ambiguous predictions in terms of the magnitude or signs of the effects [5]. If farm households cannot substitute for nonfarm labour due to liquidity constraints, labour movement into nonfarm activities could result in the reduction of agricultural production. Alternatively, farm households can apply less labour-intensive farming or reorganize agricultural production by increasing family labour. Thus, the impact of nonfarm participation on agricultural production is theoretically indeterminate [1]. Taylor and Lybbert (2015) show that whether or not the

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movement of workers out of agriculture without losing crop production is an empirical question, a question that policy makers are trying to answer [5].

This paper aims to answer the following question: What choices of agricultural production do small farms make when household members participate in nonfarm activities? Moreover, it investigates whether or not nonfarm activities of farm households are complementary to agricultural production. Complementarity implies that nonfarm participation provides non-labour inputs, credit and capital to farm households, which can be used to improve agricultural productivity. Rivalry implies that nonfarm participation withdraws resources from farms, and thus reduces agricultural production.

There have been a few papers that examine the impact of nonfarm participation on agricultural production in rural Vietnam. Stampini and Davis (2009) find evidence for relaxing credit constraints to farming [6]. Their study, however,

only focuses on crop expenses and ignores rice production, farm revenue and regional differences. Using the same data source in the 1990s as Stampini and David (2009), De Brauw (2010) shows an increase in seasonal migrants resulted in a phasing out of rice production and reduced the demand for agricultural inputs in the early stage of agricultural reform in the 1990s [6], [7]. Nevertheless, seasonal migration only accounted for a small number of their households in the sample. As a result, no study has systematically addressed the impact of nonfarm participation on household production choices at a household level.

2. Methodology

2.1. Empirical model

A general two-way linear panel data model is expressed as follows:

$$\Delta \ln Y_{ict} = \sum_{x=1}^N \alpha_x \Delta \ln X_{ict} + \alpha_{L_n} \Delta L_n + \sum_{z=1}^K \alpha_z Z_{ict} + \sum_{a=1}^M \alpha_a A_{ict} + \alpha_r R_{ct} + \Delta \varepsilon_{ict} \quad (1)$$

Where i denotes households; c denotes communes; r indexes regions; Y measures agricultural outputs, revenue or non-rice revenue; X is a vector of inputs in farm production; L_n represents a measure of nonfarm participation including the number of household members participating in nonfarm activities, or share of household's working hours in nonfarm activities; Z is a variable related to household characteristics such as demographics, education and assets; A references other factors that affect agricultural production such as the share of land that is titled; and R controls communal and regional characteristics. Given the short panel with only two time periods, the model is

specified in differences to remove unobserved household and regional fixed effects.

The empirical results from Equation (1) evaluate the effects of nonfarm participation on rice production, agricultural and non-rice agricultural revenue. By using the approach of Oseni and Winter (2009), the additional model focuses on the effects of nonfarm participation on crop expenses for farm households in rural Vietnam [8]. Dependent variables include input costs, hired labour and capital, and other expenses. All independent variables are the same as the variables in Equation (1), but without a vector of inputs. The relationship is mathematically expressed as:

$$\Delta \ln X_{ict} = \mu_{L_n} \Delta L_n + \sum_{z=1}^K \mu_z Z_{ict} + \sum_{a=1}^M \mu_a A_{ict} + \mu_r R_{ct} + \Delta v_{ict} \quad (2)$$

The null hypothesis associated with the hypothesis that there is evidence of relaxing liquidity constraints facing farm households is that: $\mu_{L_{ni}} = 0$.

2.2. Identification

Although unobserved fixed effects are eliminated from the first difference method, unobservable heterogeneity effects that change over time may drive the omitted variable problem.

$$\Delta L_{nicr} = \rho_m M_{crt-1} + \sum_{z=1}^K \rho_z Z_{icr} + \sum_{\alpha=1}^N \rho_{\alpha} A_{icr} + \rho_r R_{cr} + \Delta \theta_{icr}^{Ln} \quad (3)$$

Where i denotes households; c denotes communes; r indexes region; L_{nicr} represents a measure of nonfarm participation; $M_{cr,t-1}$ is the lagged commune-level nonfarm network, which measures the share of people working in nonfarm activities over the past 12 months at the communal level (taken from the communal surveys in 2004); Z includes household characteristics, other variables are the same as Equations (1) and (2). It should be noted that nonfarm networks are widely used in previous studies¹. They are considered as the most important factor driving nonfarm participation [9]. Hoang et al. (2014) exploit this instrument to study the impact of nonfarm participation on poverty and expenditure in Vietnam [10]. Members who have already participated in nonfarm sectors will reduce some costs related to the search for work in nonfarm employment, due to the sharing of information on jobs in other regions with their relatives and neighbours.

In Vietnam, having nonfarm networks gives farm households more connections and access to nonfarm employment, particularly the connections between fellow villagers or fellow countrymen [10]. Furthermore, Oseni and Winter (2009) argue that the effect of nonfarm networks on crop expenses only occurs via its impact on nonfarm participation [8]. Therefore, nonfarm networks can be seen as a good choice.

¹ See also [11, 12]. These papers also use nonfarm networks as instrumental variables for nonfarm participation.

In addition, reverse causality may cause a simultaneous bias [13]. Therefore, in order to reduce the problems of omitted variables and reverse causality, an instrument variable is used to estimate interested coefficients consistently. Nonfarm networks are selected as an instrument variable for the equations.

The first-stage equation is expressed as follows:

In this study, nonfarm networks are constructed by exploiting the unique feature of nonfarm activities from the survey of 2,216 communes in Vietnam. The variable ($M_{cr,t-1}$) is collected from the commune level survey in 2004. Furthermore, the paper also accounts for the direct effect of economic shocks on nonfarm networks and agricultural production simultaneously by including some commune-level infrastructure variables such as transport, markets, irrigated land and regional dummies.

3. Data and trends of agricultural production in Vietnam

3.1. Data

The Vietnam Household Living Standard Surveys (VHLSS) of 2004 and 2006 are used for empirical analysis.² These surveys are nationally representative, and consist of questionnaires at both household and communal levels. The Vietnamese General Statistics Office has undertaken these surveys with technical support from the World Bank and UNDP since 1992/1993. The surveys use a multi-stage, randomized cluster design to survey 2,216 communes of all provinces in each round. They cover 9,188 and 9,189 households, respectively. In total, 3,224 rural households were included in both surveys after accounting for missing data. The panel of 2,801 rural households that reported farm income in

² These VHLSSs cover the details of land uses of households in rural Vietnam, particularly in VHLSS 2004.

both datasets is constructed. The total sample size is 5,602 observations.

The model uses various dependent variables such as the quantity of rice output, agricultural and non-agricultural revenue, to explore the impact of nonfarm participation on household production choices. VHLSS surveys provide revenues for each crop, which is useful when calculating total farm revenue and non-rice farm revenue. As rice represents a large share of total farm revenue, I now disaggregate farm production into rice and others. Although farm households tend to diversify their livelihoods, crop incomes represent more than 68% of agricultural incomes³. Nonfarm labour includes rural nonfarm labour and seasonal migrants as defined by Haggbalde et al. (2007) [1]. The proportion of seasonal migration households among all nonfarm households represents 5.15 and 10.25% in two surveys, respectively.

3.2. Agricultural production in rural Vietnam

Rice is the most common crop growing in all provinces in Vietnam, representing 65.4% of farm households. Table 1 summarises the measures of agricultural production from VHLSS 2004 and 2006. The average rice production increases from 3436.03 kg in 2004 to 3698.5 kg in 2006. Rice output of the households in the sample represents more than 75% of the total annual crops in terms of quantity, and over 78% in terms of value. In addition, the proportion of rice revenue reduced from an average of 42.3% in 2004 to 39.3% in 2006. This compared with an average of 70% of agricultural revenue in the period 1993-1998 [14]. Nguyen (2017) also found evidence of annual crop diversification of rural farm households in Vietnam [15].

Table 2 provides information on changes in rice production and inputs between 2004 and 2006. When the paper compares the change in paddy production, it can be noted that there were small but noticeable differences in

summary statistics. Agricultural output among nonfarm households grew somewhat more slowly than that of farm households. When potential negative effects of labour movement into nonfarm activities were offset by the increased use of capital financed from nonfarm incomes, differences in paddy production between the two groups of households were not apparent in the descriptive statistics. In addition, nonfarm households also appeared to reduce paddy land and the farm labour input more than those of farm households, and used more capital and hired labour, while on average farm households decreased the amount of hired capital.

3.3. Trends of nonfarm activities

Although agricultural production plays an important role, many farm households augment incomes with a wide array of other productive activities such as wage labour within, or near local communities, or by migrating. Table 3 shows the percentage of nonfarm employment of rural individuals by industry and sector. Manufacturing, construction and trading were the main industries, accounting for over 65% of employment in the nonfarm sector. Similarly, nonfarm wage employment was mainly of nonfarm work, representing more than 67% of nonfarm employment. In 2006, nonfarm self-employment constituted approximately 32.3% of total nonfarm employment.

The household-level data are compiled using the amount of labour allocated to each of the following activities: (a) only farm, (b) farm wages, (c) nonfarm wages, (d) nonfarm self-employment. Based on these activities, Figure 1 introduces the patterns of labour allocation of a rural household, on average. Households relying only on farm work accounted for 38% of the total, while households that combined own-farming with nonfarm wage work and nonfarm self-employment accounted for 22 and 23%, respectively. Yet nonfarm labour is important for agricultural households: 62% of households had one or more family members that were engaged in nonfarm activities (including (b), (c), or (d)).

³ When taking the log of dependent variables, I add an arbitrary constant of "1" to variables with zero value to avoid creating missing values.

Table 1. Characteristics of agricultural production measures, 2004 and 2006, Vietnam

Variables	2004		2006	
	Number of observations	Mean (Std.dev.)	Number of observations	Mean (Std.dev.)
<i>Agricultural output</i>				
Paddy (kg)	2190	3436.03 (6077.15)	1900	3698.55 (7491.96)
Agricultural revenue (1000 VND)	2801	11924.05 (33520.01)	2801	15174.1 (51255.48)
Agricultural revenue without rice (1000 VND)	2486	5633.66 (3030.96)	2479	6657.62 (40960.63)
<i>Agricultural inputs</i>				
Fertiliser (1000 VND)	2572	1517.72 (2573.35)	2544	1843.28 (3278.35)
Pesticide (1000 VND)	2333	449.95 (1109.64)	2311	489.89 (1346.82)
Seeds (1000 VND)	2368	368.38 (612.05)	2302	366.33 (626.81)
On farm family hours	2369	2465.78 (1798.27)	2317	2406.15 (1786.69)
Paddy land (m ²)	2190	7087.64 (11356.51)	2109	7266.80 (13494.87)
Total annual land (m ²)	2771	7989.23 (11356.51)	2683	8592.38 (18843.15)
Hired labour (1000 VND)	1253	976.51 (3856.67)	1244	1137.48 (3266.38)
Hired capital (1000 VND)	1786	692.84 (1642.4)	1757	748.36 (1299.22)

Notes: Standard deviations are in parentheses. All summary statistics are conditional on positive values and deflated to January 2004 prices; 1 USD = 15,965 VND (2006).

Source: Calculated from VHLSS 2004 and 2006.

Table 2. Changes in farm outputs and inputs between 2004 and 2006, rural Vietnam

Variables	Farm households (full-time farming)	Non-farm households* (part-time farming)	All households
Change in paddy production (kg)	392.60 (4392.57) 547	95.90 (3538.81) 1298	180.65 (3803.46) 1845
Change in agricultural revenue (1000 VND)	1512.02 (15494.46) 819	940.22 (13295.95) 1983	1099.34 (13941.90) 2802
Change in agricultural revenue without rice (1000 VND)	1688.00 (21055.45) 748	734.99 (10106.97) 1618	1020.17 (14293.43) 2366
Change in paddy land (m ²)	609.61 (7928.56) 626	-29.00 (6210.20) 1423	155.94 (6757.23) 2049
Change in farm hours	-44.02 (1998.73) 690	-167.50 (1709.71) 1416	-129.09 (1805.03) 2106

Change in fertiliser (1000 VND)	369.68 (2189.41) <i>760</i>	289.27 (1873.34) <i>1716</i>	312.68 (1970.51) <i>2476</i>
Change in seeds (1000 VND)	-19.21 (405.58) <i>695</i>	-8.83 (479.83) <i>1539</i>	-11.88 (459.17) <i>2234</i>
Changes in hired labour (1000 VND)	13.78 (1593.84) <i>790</i>	88.07 (1361.95) <i>1768</i>	66.31 (1433.85) <i>2558</i>
Change in hired capital (1000 VND)	-22.16 (1325.84) <i>790</i>	36.57 (1423.94) <i>1768</i>	19.37 (1395.93) <i>2558</i>

Notes: All means are conditional on the mean being larger than zero; standard deviations are in parentheses; number of observations is in italics. All values are deflated to January 2004 prices; 1 USD=15,965 VND (2006); *Nonfarm households are defined as having at least one family member who participates in nonfarm activities.

Source: calculated from VHLSS 2004 and 2006.

Table 3. Percentage of rural individuals in nonfarm activities

Sectors	2004	2006
<i>By industries</i>		
Mining	2.20	2.11
Manufacturing	30.26	31.80
Construction	16.53	15.74
Finance and real estate	0.34	0.31
Government administration	5.61	5.68
Education, culture and science	9.11	8.23
Hotel, administration and services	4.67	4.37
Trading	20.27	22.10
Utility (electricity and water)	0.39	0.46
Transport and communication	5.97	4.62
Others	4.63	4.57
<i>By sectors</i>		
Wage employment	68.46	67.67
Self-employment	31.54	32.33

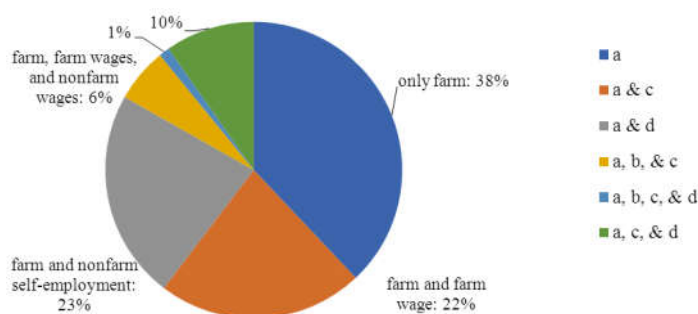


Figure 1. Trends of part-time farming in rural areas.

Notes: (a) farm; (b) farm wages; (c) nonfarm wages; (d) nonfarm self-employment.

Source: Calculated from VHLSS 2004 and 2006.

4. Empirical results

4.1. First-stage regression

The first-stage results for the instrumented measures of nonfarm participation, reported in Table 5, are estimated using the first difference method. Using the communal surveys in 2004, the share of people working in nonfarm activities measures the lagged nonfarm networks. The coefficients of the instrumental variable are positive and statistically significant, which implies that the increase in the share of nonfarm

networks at the communal level leads to an increase in the nonfarm participation of household members. This paper also considers a value of F -statistic above 10 from the test of joint significance of the instruments in the first-stage regression as essential to state that instruments are sufficiently strong. Columns (2) and (4) are estimated without agricultural variables such as production inputs and unit values of rice as a proxy of rice price. Results, however, are consistent.

Table 5. Results of first stage regression

Independent variables	Change in number of individuals in nonfarm activities		Change in the share of hours working in nonfarm activities	
	(1)	(2)	(3)	(4)
Lagged nonfarm network at commune level, 2004	0.291*** (0.006)	0.291*** (0.006)	0.062*** (0.002)	0.062*** (0.002)
Agricultural variables (differenced)	Included		Included	
Household characteristics (differenced)	Included	Included	Included	Included
Commune characteristics	Included	Included	Included	Included
Regional dummies?	Yes	Yes	Yes	Yes
R ²	0.454	0.452	0.292	0.288
Number of observations	2801		2801	

Notes: Columns (1) and (3) refer to annual crop production; Columns (2) and (4) refer to crop expenses; Standard errors are robust through cluster option and in parentheses; *, **, *** indicates that the corresponding coefficients are significant at the 10%, 5%, and 1% levels, respectively.

4.2. The effect of participation in nonfarm activities on rice production

Table 6 shows the results of OLS and 2SLS estimates of two separated equations on rice output. The estimated coefficients with 2SLS for rice output find that an additional family member participating in nonfarm activities shows a negative and significant effect on rice production. According to Panel A, an additional household member working in the nonfarm sector reduces the household rice output by around 3% between the period 2004 and 2006. As mean rice output in the sample is around 3561.9 kg per farm household per year, this result implies that a household may lose around 106.9 kg of rice. Although there is evidence of

structural change in rural areas, the magnitude of the impact on paddy production is small, illustrating weak evidence of the impact of labour movement into nonfarm activities on paddy output.

In Panel B, the measure of changes in the share of hours working in the nonfarm economy is selected. The 2SLS estimations find that a 10% increase in the share of hours that family members work in nonfarm sectors reduces rice output by 1.28% between 2004 and 2006. This finding is also consistent with [16] when authors used the Vietnam Agricultural Sector model to explore the impact of rural-urban migration on Vietnamese agriculture.

Table 6. The effects of nonfarm participation on rice output in rural Vietnam, 2004-2006

Explanatory variables	Dependent variable: Rice output					
	The whole country		North		South	
	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS
1. Panel A						
<i>Change in number of individuals in nonfarm activities</i>	-0.001 (0.006)	-0.027** (0.011)	-0.004 (0.007)	-0.031** (0.014)	-0.007 (0.014)	-0.020 (0.02)
Tests of instruments						
DWH F-test, p-value		0.0041		0.004		0.296
F-statistics, excluded instruments		500.8		251.04		267.34
R ²	0.317	0.313	0.330	0.323	0.321	0.320
2. Panel B						
<i>Changes in the share of hours working in nonfarm activities</i>	-0.003 (0.015)	-0.128** (0.053)	-0.021 (0.024)	-0.163** (0.072)	-0.004 (0.026)	-0.082 (0.081)
Tests of instruments						
DWH F test, p-value		0.0035		0.0042		0.221
F statistics, excluded instruments		361.77		205.76		186.11
R ²	0.317	0.307	0.330	0.313	0.321	0.317
Number of observations	2801	2801	1649	1649	1152	1152

Notes: FD means first difference; Standard errors are robust through cluster option and in parentheses; Dependent variables are expressed in the log; All regional, household and communal variables, and rice price are included in the models in each panel; All models differenced and estimated using instrument variables with IV-GMM procedure; *, **, *** indicates that the corresponding coefficients are significant at the 10%, 5%, and 1% levels, respectively.

The effects of nonfarm participation are further decomposed into regional differences (Table 6). In the North, an additional family member in the nonfarm sector reduces paddy output by 3.1%; and a 10% increase in the share of working hours in nonfarm activities results in a reduction of 1.63% in rice output. In contrast, in the South, there is no effect of labour movement into the nonfarm economy on rice production. One possible reason for this is that rice production is more labour-intensive in the North than in the South. Similarly, there are significant differences in total on-farm working hours per household per year in the panel

sample between regions. Thus, the reduction of on-farm family members may result in a decrease in rice production in the North.

More interestingly, the magnitude of the reduction in paddy output is smaller when compared with the previous study by De Brauw (2010) on seasonal migration [7]. The impact on paddy production is consistent with other studies that found a decline of paddy output. De Brauw (2010) also finds that in Vietnam, an additional seasonal migrant is associated with between 29-39% less rice production [7]. This is a huge decline. In this study, if the participation in rural nonfarm activities and

part-time farming are captured, the adverse impact on rice production is less severe. Moreover, the decline in rice output only occurs in the North, which has more land constraints to cope with than the South.

4.3. The effect of nonfarm activities on agricultural revenue

One question is whether or not aggregate production or agricultural revenue in Vietnam has changed as a result of rapid rural transformation. If agricultural revenue reduces due to the participation in nonfarm activities by household members, households may move away from agriculture. On the other hand, if there is no impact or an increase in agricultural revenue, this implies that farmers may diversify

their livelihoods to cope with the reduction of farm labour.

As can be seen in Table 7, OLS estimations find a statistically insignificant impact on agricultural revenue in both Panels A and B. However, 2SLS estimations show statistically significant effects in the whole country, and the north samples. In Panel A of 2SLS, an additional family member in the nonfarm sector results in a reduction of agricultural revenue in the whole country by 4.8% and in the north by 5.3%. Similarly, the 2SLS estimations find that a 10% increase in the share of hours of family members working in the nonfarm economy reduces total agricultural revenue in the whole country and north sample by 2.24% and 2.8% between 2004 and 2006, respectively.

Table 7. The effects of nonfarm participation on agricultural, and non-rice agricultural revenue in rural Vietnam, 2004 and 2006

Explanatory variables	Dependent variable: Total agricultural revenue						Dependent variable: Total non-rice agricultural revenue					
	The whole country		North		South		The whole country		North		South	
	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS	FD-OLS	FD-2SLS
1. Panel A												
Change in number of individuals in nonfarm activities	-0.013 (0.01)	0.048*** (0.017)	-0.009 (0.009)	0.053*** (0.016)	-0.014 (0.02)	-0.04 (0.036)	-0.014 (0.017)	-0.051 (0.032)	-0.019 (0.018)	-0.044 (0.035)	-0.01 (0.043)	-0.097 (0.065)
Tests of instruments												
DWH F test, p-value	0.012		0.0009		0.338		0.146		0.403		0.119	
F statistics, excluded instruments	502.21		252.77		267.09		413.06		229.4		202.17	
R ²	0.512	0.510	0.584	0.578	0.474	0.476	0.232	0.23	0.274	0.273	0.205	0.199
2. Panel B												
Changes in the share of hours working in nonfarm activities	-0.053 (0.034)	0.224*** (0.08)	-0.018 (0.034)	0.280*** (0.083)	-0.074 (0.058)	-0.166 (0.146)	-0.062 (0.059)	-0.236 (0.15)	-0.027 (0.063)	-0.230 (0.182)	-0.105 (0.113)	-0.389 (0.255)
Tests of instruments												
DWH F test, p-value	0.021		0.0017		0.473		0.176		0.246		0.236	
F statistics, excluded instruments	361.86		206.32		186.93		319.07		192.99		155.16	

R ²	0.512	0.507	0.584	0.566	0.475	0.476	0.232	0.229	0.274	0.270	0.206	0.199
Number of observations	2801	2801	1649	1649	1152	1152	2365	2365	1593	1530	835	835

Notes: Standard errors are robust through cluster option and in parentheses; Dependent variables are expressed in the log; All regional, household and communal variables are included in the models in each panel; All models differenced and estimated using instrument variables with IV-GMM procedure; *, **, *** indicates that the corresponding coefficients are significant at the 10%, 5%, and 1% levels, respectively.

5.4. The effect of nonfarm participation on agricultural inputs

Small farms are likely to adapt to the shortage of farm labour and hours by investing in agricultural assets, and inputs, changing to less labour-intensive farming, spending cash on other crops or labour-saving inputs [2]. Therefore, in the medium and long run, farm households can maintain or increase crop production. If there is no evidence of relaxing liquidity constraints, farm households move away from farming production.

Table 8 presents the empirical results of changes in the number of individuals participating in nonfarm activities on agricultural expenditure. It only examines statistically significant coefficients, and finds evidence of the reduction in crop expenses in the north as a result of nonfarm participation. Moreover, expenditure on fertilisers, accounting for nearly 40% of the total cost of production,

also decrease for the North sample as a result of labour movement into nonfarm activities. This finding is consistent with the reduction in the rice output and farm incomes of Northern households.

Regarding the effect of nonfarm participation on livestock expenditures, the point estimates are negative for the whole and South samples. An additional household member engaged in nonfarm activities results in the reduction of expenditures on livestock by 9.2% for the total sample, and 25.7% in the South. Although the point estimates for the impact of nonfarm participation on livestock expenses are negative and large in the South, they are only statistically significant in 2SLS, which implies that the impacts on livestock spending are large among households likely to respond to the availability of nonfarm networks. Northern households still keep or switch to livestock sectors, instead of crop production.

Table 8. The effects of changes in number of individuals participating in nonfarm activities on agricultural inputs in rural Vietnam, 2004 and 2006

Agricultural inputs as dependent variables	FD-OLS			FD-2SLS		
	The country	North	South	The country	North	South
Crop expenditures	-0.008 (0.016)	-0.000 (0.014)	-0.018 (0.029)	-0.023 (0.027)	-0.007 (0.028)	-0.064 (0.051)
Livestock expenditures	-0.017 (0.021)	0.026 (0.027)	-0.071 (0.044)	-0.092** (0.038)	0.024 (0.039)	-0.257*** (0.068)
Pesticides	0.008 (0.018)	0.033* (0.019)	-0.026 (0.03)	0.005 (0.027)	0.027 (0.035)	-0.032 (0.044)
Fertilizer	-0.021 (0.016)	0.005 (0.015)	-0.085 (0.114)	-0.03 (0.024)	-0.028* (0.015)	-0.017 (0.033)
Seeds	-0.03* (0.016)	0.004 (0.015)	-0.014 (0.065)	-0.047** (0.022)	0.03 (0.027)	-0.016 (0.024)
Hired labour	0.001 (0.01)	-0.002 (0.008)	0.095*** (0.034)	0.008 (0.017)	-0.001 (0.017)	0.103** (0.042)

Hired capital	-0.014 (0.012)	-0.012 (0.015)	0.016 (0.016)	-0.017 (0.018)	-0.022 (0.023)	0.01 (0.027)
Farm hours	-0.119*** (0.011)	-0.127*** (0.023)	-0.109*** (0.023)	-0.108*** (0.025)	-0.091*** (0.034)	-0.125*** (0.033)
Agricultural service	-0.005 (0.004)	-0.006 (0.004)	-0.004 (0.007)	-0.005 (0.003)	-0.006 (0.004)	-0.002 (0.005)

Notes: Standard errors are robust through cluster option and in parentheses; Dependent variables are expressed in the log; All regional, household and communal variables are included in the models in each panel; All models differenced and estimated using instrument variables with IV-GMM procedure; *, **, *** indicates that the corresponding coefficients are significant at the 10%, 5%, and 1% levels, respectively.

The paper also finds evidence of relaxing liquidity constraints on crop production by allowing farm households to increase spending on the value of hired labour. Table 8 shows that an additional family member working in the nonfarm economy results in an increase in the value of hired labour by 10.3% in the 2SLS estimation. Thus, the substitution of hired labour for family labour may explain the evidence of small impacts of nonfarm participation on rice production and farm revenue for Southern households. These findings are robust with the results related to rice production associated with labour movement into nonfarm sectors. The analysis also rejects the hypothesis investing in capital from farm households, as all estimated coefficients on hired capital are statistically insignificant. However, they do show positive signs and an increasing trend, which can affect long-term production toward less labour-intensive farming. In addition, the estimates in Table 8 show that one additional household member associated with nonfarm activities reduces the total number of farm households by over 10%, on average.

6. Conclusions

The government currently gives priority to boosting structural transformation, where labour and resources are reallocated from the agricultural sector to other sectors, and used more productively. In addition, the government has implemented policies to ensure national

food security, particularly rice self-sufficiency. However, these objectives appear to be in conflict. The movement of resources out of agriculture may reduce agricultural production and threaten sustained food security. In contrast, maintaining the current rice self-sufficiency policy may slow down the process of structural changes.

The paper finds evidence that labour movement to nonfarm sectors reduces rice production. Aggregate agricultural production declines, and there are negative effects of labour movement into nonfarm activities on farm revenue. Regardless of the level of agricultural market integration, nonfarm employment is more of a substitute than a complement to rice production. However, these conclusions are limited to Northern farmers. Households that participate in nonfarm sectors in the north readjust their production structure by investing in livestock sectors and alternate crops that require less labour. The government has designed policies to encourage farmers to maintain and increase rice production. However, rice farmers are struggling to survive.

Similarly, labour movement into nonfarm activities induces rice farmers in the South to maintain rice production by hiring more labour to substitute for family labour during the periods of peak labour demand, and by investing in more capital to facilitate less labour-intensive farming. This study finds that nonfarm incomes partially compensate for the labour reallocation effect by enabling more spending on hired labour and capital. This finding provides evidence that nonfarm

incomes relax the liquidity constraints on expanding crop production through purchased inputs, at least in the short run.

While the reduction in agricultural revenue in the North suggests some level of substitution between farm and nonfarm income generation strategies, the stability in rice production at the national level, despite rapid rural structural change, brings welcome news to policy makers and their concern for food production in rural Vietnam. However, agriculture in the North is losing its comparative advantage as farm households reduce their investments in agriculture. This study indicates that Vietnam should change its approach toward food security, particularly its rice self-sufficiency policy. Rice farmers with small and fragmented landholdings are struggling to survive and have to diversify. As a result, the opportunity cost of rice production has increased in recent years.

Thus, institutional reforms of land markets are important because they break the vicious circle that traps small farmers when they apply more capital and mechanisation [17].

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Appendix: Summary statistics from panel sample

Variables	Mean	Std. Dev.	Min	Max
Paddy (kg)	3561.94	6793	30	169128
Annual industrial products (kg)	181.43	344.82	1	6767
Starchy products (kg)	2051.16	6479.39	3	125000
Vegetables (kg)	507.94	1313.12	3	25200
Farm revenue (1000 VND)	10272.99	17405.56	16.59	532808.3
Seeds (1000 VND)	367.35	619.48	1.61	12168.2
Fertiliser (1000 VND)	1683.48	2957.61	4.03	58201.1
Pesticides (1000 VND)	469.72	1235.7	1.84	22322.1
Hired labour (1000 VND)	1058.1	3569.9	8.05	119792.6
Hired capital (1000 VND)	720.9	1479.03	9.66	42404.5
Annual land (m ²)	5129.83	7862.37	20	145800
Number of land plots titled	2.69	4.6	0	166
Farm hours	2437.1	1793.83	5	17420
Unit values of rice (1000 VND)	2.48	0.235	1.35	3.5
Household members, from 15 to 60	2.78	1.3	0	10
Dependency ratio	0.37	0.24	0	1
Mean education of working age men	3.88	2.32	0	16
Mean education of working age women	3.7	2.37	0	16
Remittances (1000 VND)	2546.21	8354.1	6.45	241984.3
Transfers (1000 VND)	4214.3	5271.03	2.42	74890.3
Disasters in commune	1.34	1.27	0	7
Farm assets (1000 VND)	18186.5	58456.95	8.05	1862755
Nonfarm assets (1000 VND)	8862.2	40099.08	18.44	921744.1
Access to asphalt road	0.62	0.48	0	1
Having markets in commune	0.58	0.49	0	1
Land area irrigated (%)	61.27	31.16	0.5	100
Number of household members who were born or had lived in urban areas	0.042	0.29	0	7
Number of people in commune participating in nonfarm activities	244.22	552.37	0	8414

Notes: All values and deflated to January 2004 prices.