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Is small beautiful? An empirical analysis of land characteristics and rural household income in Vietnam

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Small and fragmented farmland parcels are widely believed to be major impediments to agricultural activities. In this study, instrumental variables models are constructed to estimate the influence of the farm size and the number of farmland plots on household welfare proxied by income and the asset index in Vietnam. The study exploits the panel data of households collected from the Vietnam Access to Resources Household Survey (VARHS) every second year in the period 2008–2014, capturing cultural, political and socioeconomic dimensions of rural Vietnam. A positive relationship was found between farm size and household economic welfare proxied by household per capita income and a household asset index; however, this relationship was negative for the number of land plots. The main conclusion from our analysis is that household welfare would be aided by land policies towards increasing the size of farmland and decreasing land fragmentation. However, our findings also indicate that to be effective, these land policies should be complemented by rural education, effective community development and encouragement of non-farm employment activities.

Key words: *Doi moi* (Vietnam economic reform), instrumental variables, land fragmentation, rural household income, rural household assets, Vietnam Access to Resources Household Survey.

JEL classifications: J01, J31, J38, J43, Q15

1. Introduction

Vietnam is 'land-poor' and 'labour-abundant', where 85% of households have a farm size of <1 ha (Nguyen and Warr 2020). The Vietnamese agricultural sector is thus dominated by smallholders.[1] In addition, Vietnamese farmland is shrinking, with arable land per capita of 0.07 ha in 1998–2000, having decreased 0.04 ha compared to the period 1979–81 (Akram-Lodhi 2004). The growth of population, pattern of inheritance and

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The data that support the findings of this study are openly available in UNU-WIDER at https://www.wider.unu.edu/database/viet-nam-data, reference VARHS.

[1] Hazell and Rahman (2014) define smallholders as households operating land with an area of less than 2 hectares.

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conversion of farmland into non-agricultural land are the major factors behind this trend. It has been claimed that this situation has resulted in a deterioration of production capacity, negative externalities and greater disputes between neighbouring farmers (Hung *et al.* 2007).

While the total quantity of land or land area available to a farmer is obviously important, also relevance is the degree of land fragmentation. *Land fragmentation* refers to households cultivating several often relatively small and dispersed parcels of land (Hung *et al.* 2007; Tan *et al.* 2008; Rao 2019). Land fragmentation is especially commonplace in Vietnam due to the historical egalitarian strategy of land distribution of the government, especially in the north of the country. For example, Vietnam possessed approximately 75 million individual parcels of farmland in 2000, or 6.8 parcels on average, per agricultural household (Hung *et al.* 2007).

Land fragmentation can result in low levels of innovation and productivity (Hung *et al.* 2007; Tarp 2017). Tran and Vu (2019) also found that land fragmentation increases production costs and decreases yields, revenue, profitability and efficiency. In addition, fragmented and dispersed plots deter the deployment of large-scale machinery and increase the time for travelling between separate plots (MacAulay *et al.* 2006; Markussen 2017a). Therefore, land fragmentation may be an important factor constraining farmers' income growth in Vietnam.

In general, there is little consensus regarding the nature of the estimated link between land and income in empirical research within Vietnam. With respect to the direct relationship between land and income, Yamazaki and Thanh (1998) postulated a positive relationship between poverty and landlessness in the Mekong River Delta. However, Ravallion and van de Walle (2008) asserted that the probability of landlessness is lower for poor groups. Looking more broadly at the factors affecting land and income, Marsh and MacAulay (2002) highlighted the slow progress in farm mechanisation in Vietnam, with low income, small and scattered land plots, and various government policies impeding the mechanisation required for commercial scale farming. Such stagnation then provides incentives for rural households to leave the agricultural sector (World Bank 1999).

Indeed, available data show that agriculture's share of household income decreased by 13 percentage points (from 41.3% to 28.4%) over 2008–2014 (McKay and Tarp 2017), with Tuyen *et al.* (2014) establishing that land loss positively correlates with both income and expenditure due to restructuring household income sources away from agriculture. Similarly, Hoang *et al.* (2014) estimated that an additional household member with off-farm income decreases poverty incidence by at least 7% and increases household expenditure by 14%.

These issues of small farm size and land fragmentation remain important to Vietnam given the key role agriculture plays in terms of its contribution to employment and gross domestic product (GDP). Agriculture still accounts for over 15% of GDP and 40% of employment (General Statistics

Office 2018), which remains relatively high, even in the context of other Asian developing economies[2] (Tarp 2017). However, a divergence in the growth trajectory between agricultural and non-agricultural areas has contributed to increased well-being inequality between urban and rural areas (Van Phan and O'Brien 2019).

Therefore, the purpose of this research is to shed light on the specific role of land in the Vietnam agrarian economy, namely to quantify the role of land size and land fragmentation on household income. In this paper, we use the number of land plots and the Simpson index as key indicators of land fragmentation. Land plot consolidation or amalgamation implies the reduction of land plots, although the net result in terms of land size is ambiguous. Changes to fragmentation can occur from a number of sources. Empirically, the consolidation processes may embrace both plot transfers and plot exchanges. Land transfers occur in the land market, while the land exchanges do not necessarily involve a market transaction and exchange of money.

We do not claim to offer the first evidence of the negative effect of land fragmentation on household income. However, we assert that our methods are more comprehensive, and our findings are therefore more robust than previous research and thus represent a significant extension of research knowledge that addresses gaps left by the pioneering work of Tran and Vu (2019). The main contributions of this paper are threefold. First, we carefully analyse two separate measures of household welfare (income and household asset index) for our dependent variable. Income can be volatile between years, whereas the household asset index offers a relatively stable measure of household welfare. Second, we incorporate two potential avenues for land size to affect income, via land operated and land owned. Third, the use of four waves of panel data allows us to overcome the deficiencies of using an individual year of cross-sectional data, allowing us to use fixed and random effects of comparisons to our instrumental variable estimates, and providing an additional layer of robustness to our estimates.

2. Background of land fragmentation in Vietnam

Land fragmentation is partly the result of land reforms starting in the 1980s as part of the larger Doi Moi economic reforms. Resolution 10 of the Politburo in April 1988 initiated a land decollectivisation process, allowing households to independently cultivate on their distributed lands and legally own their means of production permanently. As a result of this transition from a planned to a market-oriented economy, rural households were reallocated farmland based on two primary criteria encompassing: (i) the number of household members and (ii) land quality determined by the

[2] See Tarp (2017) Table 1.1

irrigation system inter-plots distance, and other farming conditions (Tran and Vu 2019).

The second wave of agrarian reforms were covered by both the Land Law and Decree 64 in 1993, identifying households as autonomous economic units and providing longer terms for land use (Hung *et al.* 2007). Although land ownership was technically still the property of the people, households were provided legally endowed land use certificates including five rights (transfer, exchange, lease, inheritance and mortgage). Households could thus buy and sell 'the land use rights' (MacAulay *et al.* 2006). Markussen (2017a) noticed that despite a legal land sales market, it played a relatively small role for land allocation. Data from VARHS show that on average 8% of land plots had been acquired through purchase, although this was only 2.5% in the north.

Land fragmentation is an issue across all Vietnam; however, it is more acute in the north. On average, a northern household possesses between 7 and 8 plots. MacAulay *et al.* (2006) claim that for a limited set of provinces nearly 10% of these plots were 100 m^2 or less. By comparison, the majority of southern rural households have between 1 and 2 plots. The fundamental reason for this outcome is that the equitable allocation of land policy was not implemented, and instead, land distribution was primarily allocated based on land held before the 1975 reunification[3] (Dang 2010; Bui and Preechametta 2016; Tr n 2018).

Land fragmentation declined in the period 2008–2014 (Liu *et al.* 2020; Nguyen *et al.* 2020). Data extracted from VARHS show that the number of plots per household fell from 5.4 to 3.8 over the period 2008–2014. However, rather than representing land consolidation and increase in average plot size, somewhat surprisingly farmland area per household decreased from 4,121 to 3,334 m^2 from 1993 to 2014 (Nguyen *et al.* 2020). The exception to this rule is the Central Highlands where median farm size increased, implying a divergence in the farm size between this region and other areas of the country.

3. Literature review

Irrespective of the geographical context, land fragmentation has been established to be a deterrent to agricultural and rural development worldwide. In Europe, Hartvigsen (2014) found that an association between the high level of land use and land ownership fragmentation significantly hampers the development of agricultural and rural sector. In France, Latruffe and Piet (2014) confirmed that land fragmentation diminishes yields, revenue, profitability and efficiency. In Japan, scattered farming land can reduce the risk associated with rice production, but also increases production costs and inefficiency (Kawasaki 2010).

[3] See Dang (2010) for detailed information on the resistance of the southern farmers to the central government's land policy.

In South Asia, where the agricultural activities are dominated by small landholdings and tiny land parcels, fragmentation prevents farmers from adoption of many agricultural innovations (Niroula and Thapa 2005; Deininger *et al*. 2017). Fragmentation is associated with inefficient use of natural and human resources, especially when there is significant travelling time between plots (Markussen 2017a). Another negative influence of fragmentation is that it is detrimental to mechanisation and thus requires more labour (Marsh and MacAulay 2002; Jia and Petrick 2014; Ali *et al*. 2019). As such, land fragmentation hinders labour productivity and on-farm profit and income (Manjunatha *et al*. 2013; Ha *et al*. 2015).

Land policy research generally recommends land consolidation programs to ensure financial sustainability of the agricultural sector (Deininger *et al*. 2017). Accessing and accumulating agricultural land has a direct positive impact on rural household income (Chamberlin and Jayne 2020; Winters *et al*. 2009). In the context of Vietnam, Nguyen and Warr (2020), Nguyen *et al*. (2020) and Tran *et al*. (2022) found that land mergers raised farm productivity and income and also increased the pace of farm mechanisation. Similarly, Jia and Petrick (2014) claimed that land consolidation programs increase the efficiency of on-farm activities in China. In turn, they suggest that on-farm work will become more attractive and thus reduce off-farm labour supply (ignoring the effects of farmers leaving the sector). By contrast, land consolidation may become more of a necessity in Vietnam as it allows household members to seek off-farm jobs, thereby diversifying and increasing the income sources (Nguyen and Warr 2020; Tran *et al*. 2022).[4]

However, a policy dilemma exists when the costs associated with land consolidation outweigh its benefits (Ali *et al*. 2019). Tan *et al*. (2008) stressed that the benefits of land consolidation are conditional and in tandem with the measures of livelihood alternatives including increased market opportunities and non-farm income. Furthermore, land consolidation may negate the benefits that land fragmentation can play in mitigating the risks of food insecurity (Knippenberg *et al*. 2020) and yield volatility (Ali *et al*. 2019).

4. Data and methodology

4.1. Data and variable descriptive statistics

The research exploits the Vietnam Access to Resources Household Survey (VARHS) longitudinal household-level data from 2008 to 2014, which were collected by the United Nations University World Institute for Development Economics Research (UNU-WIDER. 2021). In comparison with the more

[4] Nguyen and Warr (2020) added that labour is released for off-farm work with plot consolidation, meaning that land consolidation and labour participation in the non-farm sectors remain two-way linked. However, this perspective is not in our research focus in the paper.

widely used Vietnam Household Living Standard Survey, VARHS data are focused exclusively on rural households. The VARHS land module is ideal for the present study, allowing the analysis of a number of facets or characteristics of land (farm size and the number of land plots), household income and household demographic information using a balanced sample of 2007 households. It is noteworthy that the number of observations used in our models is less than 8028 (4 X 2007), and varies between specifications, due to missing data on certain variables (particularly land owned vs land operated) and the logarithmic transformation of variables consisting of zero values (e.g. asset index).

Two dependent variables are used in this study to capture household welfare. The first is the logarithmic form of household income per capita (in millions of Vietnamese dong—mil. VND). McKay and Tarp (2017) described income as a main indicator of rural household economic well-being. The income sources in VARHS are diverse, encompassing agricultural and non-agricultural, wage and non-wage, including transfers. To allow meaningful income comparisons over time, income was deflated by provincial and regional consumer price indices. Nevertheless, our income measure contains a number of weaknesses. We are unable to capture the seasonality and volatility of income throughout the year, which is common for rural households. We are conscious of the need for adult equivalence scales when calculating income per capita as well; however, we lack the required data to apply this in practice.

In addition to household income per capita, we also use a household asset index (AI) as a dependent variable in an alternative model specification. Factor analysis weights published by McKay and Tarp (2017)[5] are used to construct this index, comprising 23 individual indicators and four dimensions of household welfare (land and productive assets owned by the household; consumer durable goods; human capital; and measures of social capital).

An independent variable of major interest is land fragmentation. We use alternative specifications to capture this variable. Firstly, we use the log of the number of land plots or parcels *frag(nplot)*. Secondly, we construct the Simpson index of land fragmentation *frag(SI)*:

$$\text{Simpson index}_i\ (\text{SI}_i) = 1 - \sum_i a_j^2 / A^2$$

where SI_i is the level of land fragmentation of household i; a_j is the area of the jth plot; and A is the sum of a_j, or the farm size (Simpson 1949).
The index ranges from 0 (single plot or land consolidation) to 1 (infinite number of land plots). Our measures of land fragmentation, disaggregated by region, are presented in Table 1. We see that land fragmentation is particularly concentrated in the northern regions of the Red River Delta

[5] Details of these weights are reported in table 10.A1 in McKay and Tarp (2017, p.220).

and Northern Mountains, with the mean number of plots approximately 5 and above, and Simpson indices of over 0.8. However, there is a potential endogeneity problem with the inclusion of our land fragmentation variable(s) if we use the standard ordinary least squares. Addressing this issue is further discussed in the next section.

In addition to land fragmentation, we include two land size independent variables in alternative model specifications. Land size is captured in both the area of land owned (*landow*) and land operated (*landop*) dimensions in VARHS. Only land that is owned is issued the land use certificate or any form of usufruct rights by the local government. It is hypothesised that land owned may be operated more sustainably than rented land, and as such, there may be a different relationship between these two variables and our income dependent variable.

Finally, we control for household size, household head gender, education, ethnicity, number of dependents and number of social and political groups. Variable descriptions are summarised in Table 2 with descriptive statistics for our variables presented in Table 3.

4.2. Model specification

4.2.1. Endogeneity of land fragmentation

Is land fragmentation exogenous or endogenous? The literature is divided on the answer. Taking a supply-side perspective, fragmentation should be considered as exogenous, being out of the farmer's control (Blarel *et al.* 1992). Using this reasoning, the main causes of land fragmentation are from geographical, policy and historical reasons (Bentley 1987). Land fragmentation in Vietnam may be considered to be predominantly a consequence of the resource allocation process and public policy (Research Institute of Agricultural Planning 2004). Additionally, in the case of land scarcity, the pressure of population may impede the consolidation process. It is noteworthy that the Vietnamese agricultural land market is both thin and sticky irrespective of the legality of land use right transaction (i.e. the 2003 Land Law). Markussen (2017a) highlighted the key role of the Vietnamese government in land allocation over the period 2006–2014. Namely, that government-related allocation accounted for approximately two-thirds of the total agricultural land plots.

However, there are a number or arguments for why land fragmentation may be endogenous. First, the role of government is steadily decreasing while that of the market is increasing in relation to land allocation. Second, studies focusing on the demand side infer that landholders may choose a certain level of fragmentation if they perceive that scattered plots are beneficial to them. Using this reasoning, households may choose the level of fragmentation or consolidation based upon the costs and benefits of these actions (MacAulay *et al.* 2006). For example, households can use individual land fragments as collateral for bank loans, or use fragmentation to diversify their crops to cope

Table 1 Land fragmentation of rural Vietnam in 2008–14

Region	Number of plots operated per household		Size of plot operated ('000 sqm^2)		Simpson index		Total owned land ('000 sqm^2)		Total operated land ('000 sqm^2)		Observations
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Red River Delta	4.99	3.52	0.62	1.27	0.84	0.29	2.43	4.43	2.52	4.62	470
Northern Mountains	5.51	3.16	1.47	2.30	0.84	0.29	6.80	11.57	6.87	11.65	778
Central Coast	4.13	2.79	1.94	3.96	0.78	0.32	5.90	12.02	5.94	12.48	350
Highlands	3.24	1.96	6.54	7.42	0.73	0.34	17.36	20.98	16.87	20.16	287
Mekong River Delta	2.53	1.86	2.76	2.51	0.63	0.39	6.43	8.76	6.45	8.98	122
Total Rural Vietnam	4.53	3.10	2.18	4.20	0.80	0.31	7.02	13.07	7.00	12.98	2007

Note: The number of observations in every year is 2007.
Source: VARHS 2008–2014.

Table 2 Description of variables

Variable	Description	Expected Sign
ln(incompc)	The first dependent variable indicating the log of annual household income per capita (mil. VND);	NA
ln(AI)	The second dependent variable, the logarithmic form of the household asset index;	NA
ln(frag(nplot))	The independent variable of interest, the logarithmic form of the number of land plots for agricultural activities possessed by a household;	Negative
ln(frag(SI))	The alternative independent variable of interest; the logarithmic form of Simpson index of land fragmentation;	Negative
ln(landop)	The second independent variable of interest, the log of arable land operated by the household *i* ('000 m^2);	Positive
ln(landow)	The alternative second independent variable of interest, the log of arable land owned by the household *i* ('000 m^2);	Positive
ln(edu)	The log of schooling year per capita; indicating the average schooling years of a household;	Positive
ln(hhsize)	The log of the total household members;	Ambiguous
depmem	The variable controlling the total dependent members of the household who are excluded from the labour force;	Ambiguous
nrgrp	The number of social groups a household is involved in;	Positive
nrpolgrp	The number of political groups a household participates in;	Positive
hhbus	Binary variable; = 1 if a household has non-agricultural business; = 0 otherwise;	Positive
femalehead	Binary variable; =1 if the household head is female, = 0 otherwise;	Negative
ethnic minority	Binary variable; =1 if a household is classified as non-Kinh ethnicity; = 0 otherwise;	Negative

Table 3 Descriptive statistics for model variables

Year	2008		2010		2012		2014	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
ln(incompc)	2.40	0.83	2.61	0.85	2.79	0.79	2.90	0.79
ln(AI)	−0.59	1.16	−0.42	1.07	−0.41	1.10	−0.39	1.12
ln(frag(nplot))	1.49	0.68	1.32	0.72	1.30	0.70	1.16	0.71
ln(frag(SI))	−0.07	0.08	−0.08	0.09	−0.08	0.09	−0.09	0.09
ln(landop)	1.37	1.20	1.30	1.27	1.27	1.30	1.24	1.28
ln(landown)	1.29	1.20	1.25	1.23	1.22	1.26	1.20	1.25
ln(edu)	1.90	0.53	1.96	0.50	1.98	0.49	2.04	0.48
ln(hsize)	1.43	0.44	1.38	0.45	1.34	0.49	1.30	0.51
depmem	1.1	1.1	1.2	1.1	1.1	1.1	1.1	1.0
nrgrp	1.9	1.4	2.0	1.4	2.1	1.3	2.1	1.4
nrpolgrp	1.5	1.3	1.6	1.3	1.7	1.3	1.6	1.2
hhbus	0.28	0.44	0.29	0.45	0.27	0.44	0.25	0.43
femalehead	0.21	0.41	0.21	0.41	0.21	0.41	0.21	0.41
ethnic minority	0.22	0.41	0.21	0.41	0.21	0.41	0.21	0.41

Note: Each year offers a maximum of 2007 observations. However, the number of usable observations differs for each variable in each year from a low of 1042 to 2007, due to loss of observations from the logarithmic transformation process.

with price volatility. Furthermore, Hung *et al.* (2007) explained that despite disadvantages of scattered land, some farmers may be reluctant to exchange their small plots in order to avoid the risks from natural disasters and use seasonal labour more efficiently. Finally, the possibility exists for a feedback loop between income and land fragmentation, whereby an increase in income may induce greater plot amalgamations, and as such, there are more amalgamations income rises. This possibility is indirectly supported by Khai *et al.* (2013) who established that the richest households were most active in both the supply and demand side of the Vietnamese market for land. In Vietnam, the main alternative for efficient farmers to grow is to undertake land consolidation by either buying land use rights in the land market to enlarge their farm size or implement new technologies in their farms (Markussen 2017a). Nguyen *et al.* (2021) further added that the development of a rental market stimulates the transfer of land from less to more efficient farmers and avoids administrative barriers to the operation of the market. These activities in turn possibly increase agricultural productivity and perhaps on-farm income.

The conservative approach is then to treat land fragmentation as endogenous as in Tran and Vu (2019) Nguyen and Warr (2020) and search for appropriate instrumental variables. Two potential instruments have been identified in the literature. First, a feasible instrument for land fragmentation is the initially inherited land plots because it is exogenously driven through demographic changes and the institutional reallocation process (Nguyen and Warr 2020). Second, regional dummies have also been applied as instruments for land fragmentation (Tran and Vu 2019) because land fragmentation is

especially concentrated in particular geographic regions as shown previously in Table 1. Due to data availability, we choose the latter approach. Applying this strategy, we initially selected the Mekong River Delta and the Central Highlands as two candidates for instruments. However, using the Sargan–Hansen statistic test of overidentifying restrictions developed in Schaffer and Stillman (2006), we ultimately decided to use one instrument variable only—the Mekong Delta dummy variable. This decision is based on the fact that the level of fragmentation on the Mekong Delta is the lowest and is consistent with Tran and Vu (2019). Furthermore, and as documented below, we also employ both fixed effects and random effects model specifications, which do not rely on the endogeneity assumption. Finally, we use the Hausman test to help assess the optimal specification.

4.2.2. Model specification

We compute the effects of land fragmentation on household welfare by adapting a Cobb–Douglas production function, as applied in related studies (Ravallion and Van de Walle 2008; Nguyen and Tran 2013; Tran and Vu 2019). The general specification is as follows:

$$y_{it} = \alpha_1 \text{frag}_{it} + \alpha_2 \text{landsize}_{it} + X\beta_X + \beta_0 + u_i + v_t + \varepsilon_{it} \quad (1)$$

where

y_{it}: the log of income per capita, incompc_{it}, or of asset index AI_{it}, of household i at year t;

$frag_{it}$: measured by the log of the number of plots cultivated, nplot_{it}; or of the Simpson Index of land fragmentation, SI_{it}, by the household i at year t;

landsize_{it}: measured by landop_{it}: the log of arable land *operated*, or landow_{it}: the log of arable land *owned*, by the household i at year t;

X: a vector of control variables;

α_1: land fragmentation slope coefficient of interest;

α_2: land size slope coefficient of interest;

β_0: the intercept of regression;

β_X: regression slopes;

u_i: household fixed effects;

v_t: time fixed effects;

ε_{it}: white-noise error term.

A number of specifications and methods are used to obtain robust results. First, we use household income and also the asset index as alternative dependent variables. Second, land fragmentation is proxied by both the number of land plots and the Simpson index of land fragmentation. Land size is measured by land owned and land operated. Finally, we present results using instrumental variables, fixed effects and random effects estimation techniques. Given a consensus on the land characteristics and household welfare nexus, we expect a negative effect of land fragmentation, but positive impacts of farm size on household economic outcomes. For the control

variables, positive slope signs are expected for education, non-farm business and social and political group participation, whereas negative coefficients are expected for female household head and ethnic minority.

5. Result and discussion

5.1. Internal validity and robustness checks

There is a concern that the number of land plots may positively associate with land size and lead to multicollinearity. Using the *collin* command in Stata, we analyse different estimates of collinearity among chosen variables including the variance inflation factor, tolerance and condition index (n.d.). This command outperforms other instruments (e.g. *vif* command) since it is able to run independently and prior to the regression. The results from those two matrices in response to the variance inflation factor are 1.21 and 1.11, respectively, far below the critical value (10.0), meaning that there is the high probability of orthogonality between the two pairs of explanatory variables. We report details in Appendix S1.

Further, the current research applies the Hausman specification test. For all cases, the instrumental variable models are likely to be more precise than the fixed and random effects, thereby underpinning the discussion on the relationship between income and land use. In addition, Wald tests of simple and composite linear hypotheses and of nonlinear hypotheses reaffirm the validity of the fixed effect models used in this analysis.

5.2. Land characteristics, income and asset ownership

The instrumental variables, fixed effects and random effects models demonstrate consistent negative consequences of fragmentation on household welfare outcomes irrespective of model specification. Furthermore, this inverse relationship is greater in magnitude for the instrumental variable models.

Starting with the income instrumental variables model in Table 4, each percentage increase in the number of land plots reduces household income per capita by 0.62 per cent. For example, if we increase the number of land plots from 4 to 5 (25%), household income per capita would decrease by 18.5%. Similar results are confirmed with the Simpson index in Table 5, although estimates suggest a more muted effect. Numerous land parcels are likely to be conducive to traditional old-fashioned, labour-intensive cultivation methods and discourage investments in new technology more suited to large-scale production. This behaviour is a widespread phenomenon in the Asian peasant economies (see Osei 2009).

By contrast, we generally estimate a positive effect of the size of farmland on household welfare. The instrumental variable income models reveal that an increase of 1% of farmland is associated with a rise of about 0.2% in

Table 4 Income model with frag(nplot)

Variable	Instrumental variables		Fixed effects		Random effects	
	(a)	(b)	(a)	(b)	(a)	(b)
Fragmentation	−0.623***	−0.631***	−0.235***	−0.204***	−0.139***	−0.119***
	(0.100)	(0.105)	(0.028)	(0.024)	(0.016)	(0.015)
Land operated	0.191***		0.045**		0.050***	
	(0.031)		(0.022)		(0.009)	
Land owned		0.156***		0.016		0.048***
		(0.026)		(0.022)		(0.009)
Education	0.435***	0.418***	0.316***	0.319***	0.483***	0.482***
	(0.026)	(0.027)	(0.036)	(0.036)	(0.023)	(0.023)
Household size	−0.415***	−0.403***	−0.549***	−0.538***	−0.420***	−0.417***
	(0.044)	(0.033)	(0.041)	(0.041)	(0.028)	(0.028)
Dependents	−0.08***	−0.08***	−0.051***	−0.053***	−0.077***	−0.077***
	(0.013)	(0.013)	(0.016)	(0.016)	(0.011)	(0.011)
Social group	0.043***	0.039***	0.018	0.018	0.041***	0.042***
	(0.012)	(0.012)	(0.014)	(0.014)	(0.012)	(0.011)
Political group	−0.026*	−0.021	−0.003	−0.004	0.027**	−0.027***
	(0.014)	(0.014)	(0.016)	(0.016)	(0.013)	(0.013)
Non-farm business	0.306***	0.303***	0.234***	0.234***	0.292***	0.291***
	(0.023)	(0.023)	(0.026)	(0.026)	(0.021	(0.020)
Female head	0.026	0.031	0.133**	0.133**	0.004	0.005
	(0.033)	(0.034)	(0.056)	(0.056)	(0.028)	(0.028)
Ethnic minority	−0.269***	−0.26***	−0.286	−0.287	−0.226***	−0.227***
	(0.039)	(0.040)	(0.103)	(0.103)	(0.032)	(0.032)
Constant	2.99***	3.05***	3.08***	3.05***	2.45***	2.41***
	(0.114)	(0.128)	(0.09)	(0.09)	(0.059)	(0.059)
R^2	0.180	0.166	0.228	0.228	0.276	0.276
Observations	6,653	6,707	6,653	6,707	6,653	6,707

Note: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$; SE in the bracket; column (a): using land operated variable, column (b): using land owned variable. R^2 in Fixed and Random effect models are overall R^2.

income (Table 4 and Table 5). Analogous impacts are found in the asset index models (Table 6 and Table 7). These results are also consistent with limited empirical analyses using different datasets and methods as found in Nguyen and Warr (2020), Tran and Vu (2019), Hanh *et al.* (2017) and Hung *et al.* (2007).

Yet, there is no evidence of efficiency differences between owned land and operated land on household income. In particular, households with rent-in land are unlikely to improve their income more than those without the additional land as such. This finding is contrary to conventional assertions that land ownership positively impacts household income (e.g. Manjunatha *et al.* 2013). A possible reason for this may arise from the characteristics of land rental markets. Slow development of this market is attributable to an insignificant difference in the areas of the operated and owned land (Table 1), which leads to identical effects on household income.

With the extension in our research to cover the variety of proxies for both land fragmentation and economic achievements over four survey waves, the

Table 5 Income Model with frag(SI)

Variable	Instrumental variables		Fixed effects		Random effects	
	(a)	(b)	(a)	(b)	(a)	(b)
Fragmentation	−4.49***	−5.49***	−1.072***	−0.666*	−0.663***	−0.435***
	(0.789)	(1.05)	(0.187)	(0.159)	(0.117)	(0.110)
Land operated	0.145***		−0.013		0.048***	
	(0.024)		(0.028)		(0.011)	
Land owned		0.095***		−0.014		0.036***
		(0.019)		(0.026)		(0.010)
Education	0.472***	0.446***	0.365***	0.368***	0.512***	0.504***
	(0.028)	(0.030)	(0.039)	(0.037)	(0.025)	(0.024)
Household size	−0.453***	−0.460***	−0.596***	−0.601***	−0.443***	−0.423***
	(0.035)	(0.036)	(0.046)	(0.044)	(0.031)	(0.030)
Dependents	−0.82***	−0.072***	−0.049***	−0.047***	−0.074***	−0.072***
	(0.014)	(0.015)	(0.018)	(0.018)	(0.012)	(0.012)
Social group	0.045***	0.038**	0.023	0.025*	0.045***	0.043***
	(0.013)	(0.014)	(0.016)	(0.015)	(0.013)	(0.012)
Political group	−0.026*	−0.017	−0.006	−0.008	−0.0433**	−0.032**
	(0.015)	(0.016)	(0.017)	(0.017)	(0.014)	(0.014)
Non-farm business	0.300***	0.285***	0.240***	0.235***	0.294***	0.290***
	(0.024)	(0.025)	(0.028)	(0.027)	(0.022)	(0.022)
Female head	0.019	0.004	0.156**	0.138**	0.013	0.003
	(0.036)	(0.039)	(0.061)	(0.059)	(0.030)	(0.030)
Ethnic minority	−0.208***	−0.207***	−0.313	−0.332	−0.198***	−0.212***
	(0.041)	(0.046)	(0.113)	(0.110)	(0.034)	(0.034)
Constant	1.74***	1.82***	2.66***	2.75***	2.15***	2.19***
	(0.123)	(0.128)	(0.107)	(0.100)	(0.064)	(0.061)
R^2	0.171	0.125	0.236	0.229	0.279	0.273
Observations	5,802	6,089	5,802	6,089	5,802	6,089

Note: ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$; SE in the bracket; column (a): using land operated variable, column (b): using land owned variable. R^2 in Fixed and Random effect models are overall R^2.

statistically significant results may help achieve a robust and unambiguous consensus that has been missing from previous empirical research.

5.3. Other determinants of rural household welfare

Most other findings were as expected. Education is crucial to improving economic performance. Ceteris paribus, a 1 % increase in schooling years increases household income per capita by between 0.4% and 0.5%. In contrast, the household size negatively associates with income growth, which is compatible with the structural characteristic of Vietnam having a young rural population. Another considerable determinant is the ethnic identity. Household welfare of non-Kinh groups significantly lagged the Kinh majority.

The positive impact of non-farm business, representing the diversification in earnings, is noteworthy as well. Specifically, a household with businesses other than farming increases monthly income per capita approximately 0.3%.

Table 6 Asset Index Model with frag(nplot)

Random effects	Instrumental variables		Fixed effects		Random effects	
	(a)	(b)	(a)	(b)	(a)	(b)
Fragmentation	−0.308**	−0.322**	−0.103**	−0.049	−0.049**	−0.036*
	(0.146)	(0.156)	(0.042)	(0.036)	(0.022)	(0.020)
Land operated	0.084**		−0.076**		0.016	
	(0.040)		(0.035)		(0.013)	
Land owned		0.065**		0.020		0.008
		(0.033)		(0.034)		(0.012)
Education	0.974***	0.968***	1.053***	1.061***	0.967***	0.965***
	(0.048)	(0.048)	(0.088)	(0.088)	(0.047)	(0.047)
Household size	0.663***	0.671***	0.492***	0.4499***	0.659***	0.664***
	(0.045)	(0.045)	(0.066)	(0.066)	(0.045)	(0.044)
Dependents	−0.088***	−0.091***	−0.007	−0.007	−0.082***	−0.084***
	(0.016)	(0.017)	(0.025)	(0.025)	(0.016)	(0.016)
Social group	0.315***	0.313***	0.311***	0.309***	0.309***	0.307***
	(0.016)	(0.016)	(0.020)	(0.020)	(0.015)	(0.015)
Political group	0.335**	0.336***	0.320***	0.318	0.337***	0.337***
	(0.018)	(0.018)	(0.023)	(0.023)	(0.017)	(0.017)
Non-farm business	0.172***	0.176***	0.139***	0.146***	0.151***	0.154***
	(0.030)	(0.031)	(0.039)	(0.038)	(0.028)	(0.028)
Female head	−0.198	−0.196	−0.361***	−0.366***	−0.211	−0.212
	(0.042)	(0.043)	(0.096)	(0.096)	(0.042)	(0.042)
Ethnic minority	−0.131***	−0.127***	0.106	0.103	−0.132***	−0.134***
	(0.044)	(0.045)	(0.217)	(0.142)	(0.044)	(0.044)
Constant	−4.82***	−4.78***	−5.00***	−5.02***	−5.04***	−5.054***
	(0.173)	(0.191)	(0.217)	(0.218)	(0.124)	(0.124)
R^2	0.517	0.511	0.525	0.5289	0.539	0.539
Observations	4,086	4,116	4,086	4,116	4,086	4,116

Note: ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$; SE in the bracket; column (a): using land operated variable, column (b): using land owned variable. R^2 in fixed and random effect models are overall R^2.

This result confirms that widening the portfolio of livelihoods benefits household income. This result is consistent with the finding in Kinghan and Newman (2017), who emphasised that diversification has been welfare improving. Besides this, being a member of social groups seems to be beneficial to household welfare, but having a membership of a political group (i.e. the Vietnam Communist Party) is generally detrimental to income but beneficial towards assets.

6. Conclusion and policy implications

Land is a dominant factor in determining agricultural household income. We have analysed its contribution to household welfare from two different angles, namely land size, and the level of land scattering, or fragmentation. Applying the instrumental variable models to the longitudinal data from the VARHS over 2008–2014, we established statistically significant positive effect (s) of farm size, but negative impact(s) for fragmentation, on rural household

Table 7 Asset index model with frag(SI)

Variable	Instrumental variables		Fixed effects		Random effects	
	(a)	(b)	(a)	(b)	(a)	(b)
Fragmentation	−1.654	−2.397*	−0.848***	−0.553**	−0.188	−0.120
	(1.191)	(1.394)	(0.291)	(0.251)	(0.161)	(0.152)
Land operated	0.046*		−0.085**		−0.018	
	(0.027)		(0.042)		(0.014)	
Land owned		0.032*		−0.041		0.011
		(0.018)		(0.038)		(0.013)
Education	1.015***	1.028***	1.100***	1.114***	1.016***	1.018***
	(0.050)	(0.051)	(0.096)	(0.094)	(0.050)	(0.049)
Household size	0.654***	0.635***	0.454***	0.451***	0.650***	0.641***
	(0.048)	(0.048)	(0.073)	(0.71)	(0.048)	(0.046)
Dependents	−0.091***	−0.084***	−0.117	−0.023	−0.083***	−0.082***
	(0.017)	(0.017)	(0.028)	(0.027)	(0.017)	(0.016)
Social group	0.318***	0.312***	0.310***	0.304***	0.315***	0.309***
	(0.016)	(0.016)	(0.023)	(0.022)	(0.016)	(0.015)
Political group	0.334***	0.341***	0.326***	0.328***	0.332***	0.335***
	(0.019)	(0.019)	(0.025)	(0.024)	(0.019)	(0.018)
Non-farm business	0.175***	0.179***	0.148***	0.152***	0.165***	0.167***
	(0.031)	(0.030)	(0.042)	(0.041)	(0.030)	(0.029)
Female head	−0.200	−0.204	−0.373***	−0.377***	−0.206	−0.202
	(0.043)	(0.044)	(0.105)	(0.105)	(0.044)	(0.043)
Ethnic minority	−0.100***	−0.087*	−0.183	−0.170	−0.117**	−0.115**
	(0.048)	(0.050)	(0.158)	(0.155)	(0.047)	(0.045)
Constant	−5.42***	−5.47***	−5.307***	−5.22***	−5.24***	−5.21***
	(0.204)	(0.204)	(0.235)	(0.227)	(0.133)	(0.129)
R^2	0.525	0.510	0.5194	0.526	0.538	0.542
Observations	3,574	3,740	3,574	3,740	3,574	3,740

Note: ***$P < 0.01$, ** $P < 0.05$, * $P < 0.1$; SE in the bracket; column (a): using land operated variable, column (b): using land owned variable. R^2 in fixed and random effect models are overall R^2.

incomes. Land fragmentation is an important impediment to agricultural household welfare and contributes to the relatively low rural household living standards. The robustness of the instrumental variable model estimates becomes evident by comparing to the fixed and random effect models. By incorporating characteristics of land, apart from size into our empirical analysis, our research reveals a further layer of insights into the relationship between land and household welfare.

The first policy recommendation is for land consolidation. Enlarging the size of land plots allows a higher probability of adoption of more advanced technologies and equipment. As a result, these advancements in production lead to increased labour productivity and on-farm labour income. The phenomenon of landlessness does not necessarily signal a livelihood failure of rural households (Ravallion and van de Walle 2008), but it reduces the inefficiency of land use in Vietnam. Nevertheless, landlessness may cause potential social exclusion if landless households are unable to move away from agricultural activities. This concern for landlessness may be relevant to the restriction on land acquisition in the 2013 Land Law, insofar as it allows

the maximum land size of 3 ha per household (Chapter X, Article 129). Difficulties with land consolidation could be the main challenge to the rural economy irrespective of the initial equalitarian reallocation of land in the 1990s (Ravallion and van de Walle 2004; Nguyen and Kim 2020). In terms of economics, land allocation could be mainly guided by the market. Thus, the Vietnamese land policy for agricultural development could relax the restrictions as such, and stimulate the development of land markets for the transformation to a more productive agricultural businesses based on the economies of scale.

Second, it is worthy of mention that land amalgamation is unlikely to be enough in its own right, as it ignores a number of other practical complexities and impediments to increasing household incomes. Using our other model findings, a set of additional measures to raise household welfare include, but are not limited to, better education for the rural workforce, social network engagement and income diversification. Rural households with better educated and trained labourers could improve their livelihood and income in both on-farm and off-farm sectors. Skills training is required for household members to engage with advanced technologies for agricultural production to increase farm income but may be limited by existing education and household access to finance for capital purchases. Similarly, limited local industries and services often mean that off-farm employment opportunities are limited to both manual and 'informal' jobs (without formal labour contracts and social and healthcare insurance). Finally, the positive relationship between social group membership and household welfare highlights the importance of social capital[6] that may aid households' in areas such as maintenance of public irrigation systems, obtaining information on job opportunities, developing diversified income generating activities beyond agriculture and gaining access to less costly credit (Markussen 2017b).

Unfortunately, our analysis was limited by data availability, particularly on land characteristics. Future analysis would be enhanced by the inclusion of data capturing land or soil quality, crop type or diversity. Similarly, data capturing the ability to convert land into income such as technology use and innovation would enhance the analysis. Finally, information on crop price volatility and seasonal fluctuations would allow a deeper analysis of household income dynamics.

Data Availability Statement

The data that support the findings of this study are openly available in UNU-WIDER at https://www.wider.unu.edu/database/viet-nam-data, reference VARHS

[6] See Markussen (2017b) for the list of social and political groups available in rural Vietnam. Among different social groups, Women's Union, Farmers' Union, Youth Union and Veterans' Union are the most important.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1