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The impact of land fragmentation on household income: Evidence from rural Vietnam[1]

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Abstract

Our study provides evidence that land fragmentation has negative consequences for household income, possibly because of its negative effects on crop income in ruralVietnam. Notably, using the Instrumental Variables (IV) method, we find that the negative effect is much greater after addressing the endogeneity of land fragmentation. IV analysis, therefore, suggests that a conventional approach which often uses the Ordinary Least Squares (OLS) method is likely to underestimate the impact of land fragmentation on rural households. Also, the finding implies that reducing land fragmentation would minimize its negative consequences for household income by reducing its negative effect on crop income.

Keywords: Cropland; Endonegeity; Land law 1993; Land reform; Fragmentation; Household income, rural Vietnam.

JEL codes: D31; D63; Q12; Q15; Q18

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1. Introduction

Land plays a strategic role in rural areas because of its multidimensional function. It constitutes a main factor in production (Finan, Sadoulet, & De Janvry, 2005), offers collateral in credit markets (Lipton, 1985), provides security against natural disasters or shocks, and gives social, economic and political status (Tran, 2013). A large number of studies have confirmed the importance of land and land reform in poverty reduction in developing countries (Nguyen & Tran, 2013; Tran, 2013). In Vietnam, the availability of cropland has contributed to the reduction of both the incidence and intensity of poverty in the Northwest region (Tran, Nguyen, Vu, & Nguyen, 2015), while forestland was found to be a major factor contributing to household income and poverty alleviation in the North Central region (Nguyen & Tran, 2018).

Although arable land is the key asset of rural households in Vietnam, it is highly fragmented and the plots are small (Nguyen, 2014; Van Hung, MacAulay, & Marsh, 2007). In the northern plains, for instance, the median farm size is less than a quarter of a hectare and on average, farmland is fragmented into 5.5 distinct plots (Markussen, Tarp, Thiep, & Tuan, 2016). Fragmentation is a barrier to using modern, mechanized equipment, such as tractors and harvesters. Also, it can hinder the adoption of crops which can only be cultivated profitably on a larger scale (Markussen et al., 2016). Fragmentation often requires more labour input, both because of the obstacles to using mechanized equipment and because significant amounts of time are spent travelling between plots (Ciaian, Guri, Rajcaniova, Drabik, & y Paloma, 2018). More is involved in maintaining boundary demarcations (Markussen et al., 2016) and there are higher costs for the

irrigation of many small units of land (Van Hung et al., 2007). Consequently, land fragmentation may have significant negative effects on agricultural productivity and growth (Niroula & Thapa, 2005), which in turn may have a substantial effect on household income in rural areas.

A number of studies have investigated the effect of land fragmentation on rural households in Vietnam. A study by Markussen et al. (2016) showed that fragmentation increases labour input per hectare in agriculture, while it has a positive effect on farming profits. The authors of the study explain this surprising result by saying that more fragmented farms may be more fertile and less likely to be exposed to the risk of crop disease or natural disasters. This result contrasts with other studies showing the negative effect of fragmentation on farming efficiency in the north of Vietnam (Van Hung et al., 2007), rural Vietnam (Xiaotuo et al., 2014) and in other countries (Niroula & Thapa, 2005). These studies found that land fragmentation resulted in a negative effect on agricultural production due to increased capital costs, labor demand and difficulties in agricultural mechanization.

While the consequences of land fragmentation for agriculture have been well established in the literature, no evidence exists, to the best of our knowledge, for its effect on household income in rural Vietnam. On the one hand, land fragmentation may have a negative influence on household income through its negative effect on farming efficiency, as already mentioned. On the other hand, land fragmentation may reflect a situation where farmers hold many plots of differing quality, enabling them to diversify their crops, spread labour requirements, and reduce production and price risks (Van Hung et al., 2007), which in turn may increase household income. In certain cases, the disadvantages or costs of

land fragmentation may persuade farmers to diversify their livelihoods towards non-farm activities, which may offer higher returns than farming (Tran, 2014). The discussion suggests that land fragmentation may have either a positive or negative effect on household income. This scenario motivates the authors to conduct the current study to answer the research question concerning the extent to which land fragmentation affects household income in rural Vietnam.

The study provides the first evidence that cropland fragmentation has a negative effect on both crop income and household income. Using different model specifications, we find notably that the negative impact is much greater when the instrumental variables (IV) method is employed. The IV analysis suggests that the conventional approach that often uses the OLS method, ignoring the endogeneity of land fragmentation, is likely to underestimate the impact of land fragmentation on rural households. Our research finding accords with previous work, which found that fragmentation results in negative effects on crop income, which in turn may reduce household income. Our findings suggest that by mitigating its negative effect on crop income, reducing land fragmentation would also reduce its negative effect on household income.

The paper is structured as follows. An overview of land fragmentation is discussed in Section 2, while data and methods are given in Section 3. The empirical results and discussion are given in Section 4, and finally the conclusion and policy implications are provided in Section 5.

2. An overview of land fragmentation in Vietnam

It has been recognized that agricultural reforms in the late 1980s contributed substantially to raising both food production and household welfare in rural Vietnam (Nguyen & Tran, 2013; WB, 2016). From being a net food consumer in the early 1980s, Vietnam has since emerged as a leading food exporter. In addition, the country's agricultural sector has made the shift from central planning to a dynamic market agricultural system (WB, 2016). The reforms commenced with the establishment of a household responsibility system whereby land was reallocated from collectives to households as production units. State purchase prices of agricultural products were increased, resulting in huge improvements in agricultural production (Nguyen, 2014). In particular, Resolution 10 in 1998 provided for the decollectivizing process in agriculture and allocated land to farm households, leading to a boost in agricultural output and improvements in the living standard of the rural population (Nguyen, 2014; WB, 2016).

The Land Law of 1993 and Decree 64 (1993) allocated agricultural land to long-term farmers with a history of stable land use and provided them with five land rights, including the right of transfer, exchange, lease, inheritance and mortgage. According to Resolution 10 in the late 1980s, the crucial principle in decollectivizing the agricultural system was to ensure equality in land allocation. Land was distributed according to two main criteria: (i) the number of household members and (ii) land quality in view of the irrigation system, distance among plots and other farming conditions (Nguyen, 2014). Consequently, every household tended to receive more than one plot of land with different qualities and locations. This policy of equality has become the major cause of land

fragmentation in Vietnam (Van Hung et al., 2007). Other causes are the absence of a complete regulatory framework and the high transaction costs that prevent participation in the land market (WB, 2003).

3. Data and methods

3.1. Data

To investigate the impact of land fragmentation on household income, the research utilized data from the 2014 VHLSS (Vietnam Household Living Standards Survey), which was carried out by the General Statistical Office of Vietnam (GSO) with technical assistance from the World Bank (WB). Each VHLSS covers 9,189 households sampled from 3,063 communes (2,280 rural and 783 urban communes). The households are randomly selected and representative on the national, rural and urban levels.

Data on both households and communes were collected by the VHLSS. Household data include detailed information about demography, employment and education, expenditures and income, assets and housing, and especially arable land and other types of land. Commune data were collected for rural areas only and cover demography, infrastructure and socio-economic characteristics. The information was merged with household data, providing a sub-sample of about 3,300 rural households owning annual croplands. The combined data allowed us to examine both household and commune-related factors affecting household income.

3.2. Methods

Measuring land fragmentation

While land fragmentation is commonly described as a large number of non-contiguous small plots or a large number of plot co-owners, it is actually a more complex issue including other dimensions, such as plot size, the shape of individual plots, the distance of plots from home and distances among plots (Latruffe & Piet, 2014). Since it is difficult to measure all dimensions of land fragmentation at the same time (Ciaian et al., 2018), most studies quantify farmland fragmentation using Simpson's diversification index, which takes into account the number of plots, plot size and farm size (Van Hung et al., 2007).

The Simpson's index of land fragmentation is described as $(1-(\sum a_j^2 / \mathrm{A}^2))$ where a_j is the size of the plot j, A is the farm size and $A = \sum a_j$. The value of the index varies between zero and one, with a greater value meaning more diversity or more land fragmentation (Ciaian et al., 2018). A zero value means that the farming household has only one parcel or plot of land, indicating complete land consolidation, while a value close to one shows that the household has numerous plots and the farm is "very fragmented" (Van Hung et al., 2007). In our study, because fragmentation is most common with annual cropland, only this type of land was measured, not other types of land. Also, households without annual cropland were excluded from our research sample.

Modelling the impact of land fragmentation on household income

Following Nguyen and Tran (2013), we used a Cobb–Douglas production function in the form of a double-log function commonly used to model the effect of land on household welfare (Ravallion & Van de Walle, 2008). Our study assumed that per capita household income is a function of land holdings and other explanatory variables as given in equation (1).

$$LnY_{ij} = b_0 + b_1X_{ij} + b_2LnZ_{ij} + b_3C_j + e_{ij} \quad (1)$$

where LnY_{ij} is the natural logarithm of per capita household income of household i in commune j. X_{ij} is a vector of household characteristics, such as ethnicity, education, gender and age of household heads, household size, dependency ratio and the main job of household heads (e.g., skilled vs unskilled)[2]. Z_{ij} is a vector of variables of various types of land and annual cropland fragmentation. C_j is a vector of commune variables controlling for natural and socio-economic characteristics. The variable of interest is the annual cropland fragmentation. e_{ij} is the error term.

$$Lncrop_{ij} = b_0 + b_1X_{ij} + b_2LnZ_{ij} + b_3C_j + e_{ij} \quad (2)$$

[2] Following the specific instructions of the International Standard Classification of Occupations (ISCO) (International Labour Organisation, 2012), we classified the main job of household heads into four groups, using ISO-88 and one-digit levels. Thus, four occupational groups are identified as: (i) unskilled workers; (ii) skilled manual workers; (iii) low-skilled non-manual workers; (iv) high-skilled non-manual workers.

Equation (2) was also used to examine the effect of land fragmentation on crop income, using the same controlling variables as those in equation (1), because land fragmentation is likely to be determined by other exogenous factors, such as geographic characteristics. A number of studies confirmed that land fragmentation more commonly occurs in the north than the south of Vietnam (Nguyen, 2014; Van Hung et al., 2007). This suggests that potential endogeneity may arise because land fragmentation is an explanatory variable but is jointly determined with household income by regional variables. Consequently, the OLS method would yield biased and inconsistent estimates and the method of instrumental variables (IV) should be used instead to generate consistent estimators (Wooldridge, 2013).

We used two dummy variables of geographical regions, namely the Southeast and Mekong Delta regions as the two potential instruments for annual cropland fragmentation.[3] The reason for this is that the level of fragmentation varies substantially across the eight geographical regions (Table 2). This suggests that the geographical dummy variables are closely linked with land fragmentation, which can meet the assumption of instrument relevance. However, using the regional variables as the instruments may fail to meet the assumption of instrument exogeneity because some regions with better socio-economic conditions may directly affect household income. The above discussions indicate that several necessary IV tests must be used to test whether both the assumptions of instrument relevance and exogeneity are satisfied or at least using a set of invalid and weak instruments that provides imprecise estimates and misleading conclusions can be avoided (Baum, Schaffer, & Stillman, 2003).

[3] The omitted category is other geographical regions as given in Table 2.

The current study utilized a formal weak instrument test proposed by Stock and Yogo (2005), using a test statistic value that is the F-statistic form of the Cragg-Donald Wald F statistic. Table 3 shows that the values of the Cragg-Donald Wald F statistic were 176.83, which is much larger than the reported critical value of 19.93, suggesting that the instruments are not weak and satisfying the relevance requirement. We also checked the validity of the instruments using an over-identifying restrictions test. The Hansen J-statistics were not statistically significant and thus confirmed the validity of the instrumental variables (Baum, Schaffer, & Stillman, 2003). The specification tests showed that the selected instrumental variables are in fact reliable instruments. Because land fragmentation is potentially an endogenous explanatory variable, an endogeneity test of this variable was performed. The results confirmed that the null hypothesis of exogenous regressors was rejected at the 1% level, indicating that land fragmentation is endogenous (Table 3). This result implies that it is more appropriate to use the IV than the OLS model.

4. Results and discussion

4.1. Descriptive statistics analysis

According to the descriptive statistics reported in Table 1, each household has an average of 4.0 members but household size may number as many as 11 members, given that households often have relatives in the extended family. The average age of the head of household is 50 years and ranges between 16 and 105 years, while their average years of education are approximately 7.20, varying between 0 and 16. The data show that household heads in unskilled jobs comprise about 62% of the sample, followed by those with skilled manual jobs (29%), while those with low-skilled and high-skilled non-

manual jobs account for about 7% and 3%, respectively. The commune data indicate that most households live in communes that are accessible by roads. The percentage of households living in communes prone to natural disasters is 60%. About one fifth of households resided in poor communes. The distribution of households by geographic region indicates that about half lived in inland deltas areas, while about 42 % resided in mountainous areas. Only 4% and 5% lived in coastal and hills/midland areas, respectively.

Table 1 is inserted here

Table 2 shows some of the main characteristics of land fragmentation. The average number of annual cropland plots per household is 2.88 for the whole sample. However, the figure varies significantly across regions, from only 1.41 in the Southeast region to 4.04 in the Northeast Mountains. On average, each plot has an area of 2,573 m^2 for the whole sample. The smallest plot size is found in the RRD region (947 m^2), while the largest is in the MK region (7,150 m^2). The average value of Simpson's diversification index is about 4.0 for all households, ranging from 0 to 0.93 (Figure 1 and Table 1). This index of land fragmentation shows its lowest values of 0.12 and 0.14 in the SE and MK regions, and the greatest values of 0.54 and 0.47 in the WNM and NCC regions, respectively. Overall, the data suggest that land fragmentation is much higher in the central (NCC and SCC) and northern regions (RRD, ENM, WNM) than in the southern regions (SE and MK).

Table 2 is inserted here

Figure 1 is inserted here

4.2. Econometric analysis

Table 3 reports the results for the impact of land fragmentation on household income, using both OLS and IV estimators. The Simpson index is used to measure land fragmentation, which is the variable of interest. Our regression models controlled for household characteristics such as age, gender, ethnicity, the education and main job of household heads, and the size of various types of land. In addition, commune factors related to infrastructure, and regional characteristics were also controlled for.

As mentioned earlier, one of the main purposes of our study is to examine the relationship between land fragmentation and household income. Using an OLS estimator, Model 2 analyzes the impact of land fragmentation, ignoring the endogenous issue[4]. To address the endogeneity problem, the study used the IV method and the results are given in Table 3. The coefficient of the land fragmentation variable in both estimators is negative and statistically highly significant. This confirms that land fragmentation has a depressing effect on household income, even after controlling for the endogeneity issue and other factors in the models. In particular, the estimates of the IV estimator show that increasing land fragmentation by one percentage point is associated with a decrease in household income by −0.34%, as compared to only −0.08% when using the OLS estimator. Therefore, the IV analysis suggests that the OLS estimation may underestimate the effect of land fragmentation. Our study provides the first evidence that land fragmentation does, in fact, result in a negative effect on household income in rural Vietnam. This can be explained by the consideration that land fragmentation may reduce crop income, which in turn may lower household income. Using the IV estimator, we also

[4] Endogeneity test in Table 3 confirms that land fragmentation is endogenous and thus the IV estimator should be preferred.

examine whether land fragmentation has a negative effect on crop income. The results (see Appendix 1) confirm that land fragmentation has the effect of reducing crop income.

The study finds that except for forestland, most types of land have a positive effect on household income. For instance, both models indicate that an increase of 1% in annual cropland would increase per capita income by about 0.09% on average, holding all other factors in the model constant. A positive effect is also observed for perennial cropland (0.04%-0.05%). Our research finding that forestland has no effect on income accords with results for the Northwest region (Tran, 2015) but contrasts with that from a study by Nguyen and Tran (2018), who found that forestland had a positive effect on household income in the North Central region. The reason for the discrepancy may be that our study used the VHLSS data covering the whole rural region, whereas other studies (Tran, 2015; Nguyen & Tran, 2018) focused on only one geographical region.

Unsurprisingly, the study confirms that the occupation of household heads plays a major role in household welfare. The results in both models in Table 3 show that on average, per capita income is about 17% higher for a household whose head has a skilled manual occupation than it is where the head works as an unskilled laborer. The effect is also much higher for a household whose head works in a low-skilled non-manual job (37%) or is in a high-skilled non-manual occupation (32%-35%) relative to one whose head works as an unskilled laborer.

Table 3 is inserted here

The education of household heads has a positive impact on household income, and an additional year of formal schooling increases per capita income by 4%, keeping

all other factors in the models constant. We find that ethnicity plays a major role in explaining income differentials in rural Vietnam. Per capita income is about 25% higher for a household whose head belongs to the Kinh/Hoa (ethnic majority) group than for one whose head comes from an ethnic minority group. Household size and dependency ratio are also found to be negatively linked with household income, suggesting that more family members and dependents lower household welfare in rural Vietnam. Similar results are also reported in previous studies in Vietnam (Nguyen & Tran, 2013).

Finally, the current study reveals that some commune-related factors play a significant role in household welfare. The results from the OLS estimator suggest that households living in a commune with road access have higher income (11%) than those living in a commune without. Being prone to natural disasters also reduces household income (about 8%), while those residing in poor communes have much lower income than those residing in non-poor communes, with an income gap of about -33%. Households living in high mountain areas earn much lower incomes than those living in other regions. This suggests that geographic region is a major factor explaining income differentials among rural households.

5. Conclusion and policy implication

Vietnam presents a particularly interesting case for investigating land fragmentation, as this is a consequence of land policy reform carried out in the early 1990s. Land reform is considered the most important cause of land fragmentation, and this issue persists until the present day. Although there have been several studies investigating whether fragmentation hinders or is beneficial to crop production, no evidence exists for the

impact of fragmentation on household income in rural Vietnam. Thus, our study fills a gap in the literature on Vietnam by investigating the consequences of land fragmentation for household income.

Our study provides the first evidence that fragmentation has a negative effect on household income, even after controlling for other factors in the models. Notably, using the instrumental variables (IV) method, we find that the negative effect is much greater after addressing the endogeneity of land fragmentation. IV analysis, therefore, suggests that a conventional approach which often uses the OLS method, ignoring the endogeneity of land fragmentation, is likely to underestimate the impact of land fragmentation on rural households.

In order to answer the question as to what may be the potential causes of the negative effect of land fragmentation on household income, we further examine the effect of fragmentation on crop income, using an IV estimator. The result confirms that higher levels of fragmentation are closely linked with lower levels of crop income, which suggests that land fragmentation reduces household income possibly through its negative effect on crop income. The finding thus suggests that reducing land fragmentation or increasing land consolidation can be expected to increase crop income, thereby improving household income in rural Vietnam.

Our study also identified a number of other factors making a substantial contribution to household income. Specifically, the occupation of household heads was found to play a major role in explaining income differentials. Household heads who have

jobs that are non-manual or require higher skills help their households earn much higher income. Such jobs usually require better education, suggesting that educational policies should be prioritized and made a major approach for improving living standards in rural areas. This suggests that policies improving the access of rural households to better education, together with efforts to increase the demand for skilled labour, should be of practical use in rural areas. Finally, we found evidence that some commune factors, such as the availability of roads and the prevalence of natural calamities, have an influence on household income. A policy implication here is that the local government can minimize the negative effects of natural disasters by improving preparedness and mitigation measures for various natural disasters. Also, increasing the access of rural households to roads in their villages can be expected to increase their income.

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Table 1: Descriptive statistics of the household sample

Variable	Mean	Std. Dev.	Min	Max
Education of household heads (years of schooling)	7.22	3.80	0	16
Gender of household head (1=male; 0=female)	0.82	0.38	0	1
Age of household head (years)	50.22	13.98	16	105
Marital status of household head (1=married; 0=single)	0.02	0.13	0	1
Ethnicity of household head (1=major; 0=minor)	0.75	0.43	0	1
Dependency ratio (ratio)	0.36	0.29	0	1
Household size (total number of family members)	4.00	1.62	1	11
Unskilled job (1=yes; 0=other)	0.62	0.49	0.62	1
Skilled manual job (1=yes; 0=other)	0.29	0.45	0.29	1
Low-skilled non-manual job (1=yes; 0=other)	0.07	0.25	0.07	1
High-skilled non-manual job (1=yes; 0=other)	0.03	0.16	0.03	1
Annual cropland: m^2	4937	8020	0	140000
Perennial cropland: m^2	860	4230	0	100000
Forestland: m^2	2260	12324	0	400000
Water area for aquaculture: m^2	279	4200	0	200000
Residential land and gardens: m^2	530	938	0	21000
Number of annual cropland plots	2.88	2.27	1	18
Annual cropland fragmentation (ratio)	0.39	0.31	0	0.93
Access to roads (1=yes; 0=not)	0.94	0.24	0	1
Natural disaster prone (1=yes; 0=no)	0.59	0.49	0	1
Coastal areas (1=yes; 0=other)	0.04	0.19	0	1
Inland delta (1=yes; 0=other)	0.48	0.50	0	1
Hills/midlands (1=yes; 0=other)	0.05	0.22	0	1
Low mountains (1=yes; 0=other)	0.21	0.41	0	1
High mountains (1=yes; 0=other)	0.21	0.41	0	1
Poor commune (1=yes; 0=no)	0.22	0.42	0	1

Source: Author's estimation using data from the 2014 VHLSS.

Table 2: Descriptive statistics of annual cropland fragmentation

Region	No of plots		Size of plot		Land fragmentation		Total area	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Red River Delta (RRD)	2.98	2.26	947	3379	0.41	0.32	2104	3671
East Northern Mountains (ENM)	4.04	2.84	1280	2052	0.54	0.28	3908	6425
West Northern Mountains (WNM)	3.06	1.95	3783	4359	0.43	0.27	9553	10139
North Central Coast (NCC)	3.10	2.06	1461	2185	0.47	0.28	3510	3446
South Central Coast (SCC)	2.88	2.17	1419	2709	0.41	0.31	3613	6403
Central Highlands (CH)	1.82	1.03	6103	9692	0.23	0.23	9640	11698
Southeast (SE)	1.41	0.96	6703	8777	0.12	0.22	8594	10699
Mekong Delta (MK)	1.44	0.82	7150	9815	0.14	0.24	9682	12286
Total	2.88	2.27	2573	5584	0.39	0.31	4937	8020

Source: Author's estimation using data from the 2014 VHLSS.

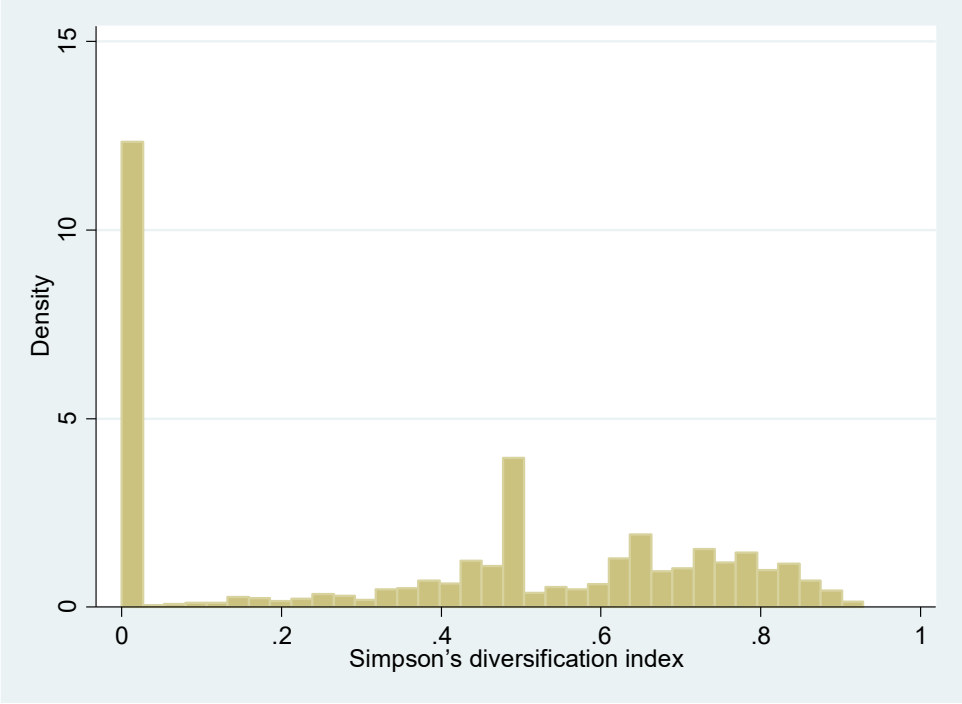

Figure 1: Distribution of land fragmentation

Source: Author's estimation using data from the 2014 VHLSS.

Table 3: The impact of land fragmentation on household income

	IV estimator		OLS estimator	
Explanatory variables	Coefficients	SE	Coefficients	SE
Land fragmentation	-0.34***	(0.098)	-0.08**	(0.038)
Education	0.04***	(0.004)	0.04***	(0.003)
Gender	0.00	(0.036)	0.00	(0.035)
Age	0.01***	(0.001)	0.01***	(0.001)
Marital status	-0.19**	(0.090)	-0.18**	(0.089)
Ethnicity	0.25***	(0.054)	0.26***	(0.052)
Dependency ratio	-0.40***	(0.043)	-0.37***	(0.041)
Household size	-0.06***	(0.008)	-0.06***	(0.008)
Skilled manual job	0.17***	(0.027)	0.17***	(0.027)
Low-skilled non-manual job	0.37***	(0.043)	0.37***	(0.042)
High-skilled non-manual job	0.32***	(0.066)	0.34***	(0.063)
Annual cropland	0.09***	(0.013)	0.08***	(0.012)
Perennial cropland	0.04***	(0.010)	0.05***	(0.009)
Forestland	0.00	(0.010)	0.00	(0.010)
Aquaculture land	0.07***	(0.015)	0.06***	(0.015)
Coastal	0.24***	(0.070)	0.25***	(0.070)
Inland delta	0.40***	(0.050)	0.41***	(0.049)
Hills/midlands	0.34***	(0.063)	0.31***	(0.065)
Low mountains	0.28***	(0.052)	0.25***	(0.052)
Poor commune	-0.33***	(0.047)	-0.32***	(0.047)
Natural disaster prone	-0.08***	(0.025)	-0.08***	(0.024)
Road access	0.14***	(0.051)	0.11**	(0.051)
Constant	6.42***	(0.095)	6.45***	(0.095)
Observations	3,265		3,265	
Centered R2/R-squared	0.26		0.37	
Excluded instrumental variables:			The Southeast; Mekong Delta	
Weak identification test (Cragg-Donald Wald F statistics)			172.82	
[Stock-Yogo weak ID test critical value at 10%]			19.93	
Hansen J statistic (*p-value*)			0.97	
Endogeneity test of land fragmentation (*p-value*)			0.00	

Robust standard errors (SE) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimates accounted for sampling weights.

Appendix 1: The impact of land fragmentation on crop income (IV estimator)

VARIABLES	Coefficient	SE
Land fragmentation	-0.63***	(0.238)
Education	0.01**	(0.006)
Gender	0.18***	(0.056)
Age	0.00	(0.002)
Marital status	0.12	(0.140)
Ethnicity	0.11	(0.071)
Dependency ratio	-0.42***	(0.075)
Household size	0.08***	(0.012)
Skilled manual job	-0.09**	(0.043)
Low-skilled non-manual job	-0.25***	(0.076)
High-skilled non-manual job	-0.37***	(0.132)
Annual cropland	0.60***	(0.024)
Perennial cropland	0.23***	(0.017)
Forestland	0.01	(0.012)
Aquaculture land	0.13***	(0.026)
Coastal	-0.11	(0.116)
Inland delta	0.12	(0.083)
Hills/midlands	-0.05	(0.108)
Low mountains	0.16**	(0.076)
Poor commune	-0.22***	(0.060)
Natural disaster prone	-0.12***	(0.040)
Road access	0.03	(0.074)
Constant	6.70***	(0.161)
Observations	3,113	
R-squared	0.415	
Weak identification test (Cragg-Donald Wald F statistics)		157.19
[Stock-Yogo weak ID test critical value at 10%]		19.93
Hansen J statistic (*p-value*)		0.71
Endogeneity test of land fragmentation (*p-value*)		0.00
Excluded instrumental variables:	The Southeast; Mekong Delta	

Robust standard errors (SE) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimates accounted for sampling weights.