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ORIGINAL ARTICLE

The role of education in the livelihood of households in the Northwest region, Vietnam

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Abstract
Using the updated data from the 2016 Vietnam Household Living Standard Survey, this study examines the role of education in the livelihood of households in the Northwest region, the poorest region in Vietnam. Our micro-econometric analysis shows that education has a positive effect on choosing better livelihoods, household income and poverty reduction, even after controlling for all other factors in the models. However, our quantile regression analysis reveals that the returns on education are substantially heterogeneous across percentiles of income distribution and tend to be higher for better-off households. This implies that education has an increasing effect on within-level income inequality. The finding suggests that a conventional approach employing only mean regression to study the effect of education on income could miss heterogeneity of interest to policymakers.

Keywords Education · Heterogeneous · Inequality · Rural livelihoods · Quantile regression

JEL Classification I 21 · J 31

1 Introduction

Education has played a major role in making development a success in Vietnam (WB 2015). Achieving rapid economic growth, by 2010 the country was transformed from one of the world's poorest nations into a lower-middle-income country (World Bank and Ministry of Planning and Investment of Vietnam 2016) with one of the fastest poverty reduction rates (WB 2015). Over the last decades, Vietnam's focused investments in developing primary education, combined with greater access to all levels, have paid off and have enabled an increasing proportion of the population to exploit the advantages of expanding economic opportunities (WB 2015). Numerous studies have found positive effects from education,

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among other factors on poverty reduction and household (Cloutier et al. 2008; Nguyen et al. 2015) and wage income (Doan et al. 2018).

Vietnam's socioeconomic achievements, however, have not been even across regions. While many regions have made significant improvements in household welfare and education, others have lagged behind (Oxfam 2017; WB 2013, 2015). An overwhelming majority of the country's ethnic minority population lives in the Northwest region, which has much lower income and education levels and higher poverty and inequality levels than other regions (GSO 2015). To the best of our knowledge, little evidence exists for the effect of education on the livelihood of rural households in the Northwest region. A thorough understanding of the role of education on choice of livelihoods, income, poverty and inequality is very important when designing policy interventions for the poor in this region. The current study was conducted to fill this gap in the literature.

Our study has several strong points. First, we provide the first econometric evidence for the role of education in the livelihoods of local households in terms of choice of occupation, household income and poverty reduction the Northwest region—the poorest region of Vietnam. Second, previous studies (e.g., Lekobane and Seleka 2017; Tran 2015) often used a standard linear regression approach (e.g., ordinary least squares/fixed or random effects estimators) to investigate the mean effect of education on average household welfare (income or consumption expenditure). This approach, however, provides only a partial view of the relationship (Koenker and Hallock 2001). In our study, we use a quantile regression approach to account for the heterogeneous effects of education on different percentiles of income distribution. This allows us to consider the role of education on the entire distribution of household welfare, not merely its conditional mean (Koenker 2005). In particular, this approach enables us to evaluate whether education has an increasing effect on within-level income inequality.

2 Literature review

The concept of treating investment in education as capital investment was proposed in a seminal work by Becker (1962) who postulated that education is an investment in human capital that improves a worker's productivity and impacts future income by raising a worker's lifetime earnings. Becker's theory linked workers' knowledge levels to their formal schooling attainments, which implies that more years of schooling would enhance productivity and wages (Kavuma et al. 2015). Following the human capital theory, many studies have employed the Mincerian earnings function to estimate the returns to education (e.g., Björklund and Kjellström 2002; Card 2001; De Brauw and Rozelle 2008; Doan et al. 2018).

Conventionally, benefits of education have often been investigated in terms of increased productivity, and numerous studies have focused on quantifying the contribution an individual's education has on the level of his or her wages. This approach, however, disregards other benefits of education on self-employed workers and households. Better education offers gains resulting from a variety of work-related sources, namely stable and interesting jobs, high-autonomy jobs, better working conditions and good relationships, etc. (Vila 2000). In addition, education not only brings private returns to the individual who hold them, but also has positive externalities such as improving intra-family productivity and social cohesion (Dziechciarz-Duda and Król 2013; Venniker 2000) and the productivity of those with whom the individual's workforce interacts (Ranis et al. 2000). All of these benefits, in turn, can lead to increased productivity of self-employed workers and households.

The role of education in improving income or poverty reduction has been subject to numerous studies through diverse methods and data in many countries. In general, the main finding of many of these studies confirms that there is a positive and significant relationship between education and income growth, which also has a positive impact on education in both developed and developing countries (Yardimcioglu et al. 2014). Evidence from many developing countries also points out that that education helps reduce poverty (Bilenkisi et al. 2015; Rigg 2006). For instance, a cross-country study by Janjua and Kamal (2011) shows that the net enrollment for formal secondary education was a main contributor to poverty alleviation. The education levels of household heads were found to have a positive effect on household income and poverty reduction in Turkey (Bilenkisi et al. 2015), Vietnam (Tran 2015; Tran et al. 2015), Nigeria (Okojie 2002) and South Africa (Maitra 2000).

Most previous studies (e.g., Lekobane and Seleka 2017; Maitra 2000; Tran 2015) used a standard linear regression approach (e.g., ordinary least squares/fixed or random effects estimators) to investigate the mean effect of education on average household welfare (income or consumption expenditure). However, the average effect might not be useful for policy purposes. It would be interesting to estimate the variance in returns around this mean (Alves 2012; Sakellariou et al. 2006). Thus, a number of studies have employed a quantile regression approach to examine heterogeneous impacts of education on household income (Alves 2012; Pede et al. 2012) or wage incomes (Fasih et al. 2012; Sakellariou et al. 2006).

Alves (2012) estimated the impact of education on household income among Portuguese households using a quantile regression estimator. The study found that the effect of education is significantly higher for higher percentiles of the income distribution than that at the lower end of the income distribution. This suggests that education contributes to increasing within-level income inequality in Portugal. The finding confirms that the pattern of the distribution of wage returns to education normally found in the literature is transmitted to the income returns to education at the household level (Alves 2012). Similar findings were also observed in South Africa for the period 1993–1998 (Maitra and Vahid 2006). By contrast, a study by Pede et al. (2012) in the Philippines revealed that the effect of education significantly reduces along the conditional income distribution. This finding implies that education offers higher income returns for poorer households, thereby lowering within-level income inequality in the Philippines.

The aforementioned literature indicates that previous studies (e.g., Lekobane and Seleka 2017; Tran 2015) in Vietnam often used a standard linear regression approach to analyze the mean effect of education on average household welfare. This approach, however, gives only a partial view of the impact (Koenker and Hallock 2001). In addition, little evidence exists for the impact of education on household livelihoods in the Northwest region, which has the highest level of poverty and inequality and the lowest level of education in Vietnam. The gap in the literature motivates us to conduct the current study.

In this study, we used various regression models to examine the impact of education on household income and the incidence and intensity of poverty, controlling for other factors. Notably, we employed a quantile regression approach to examine the heterogeneous effects of education on various percentiles of income distribution. In particular, this approach enables us to consider whether education has an increasing effect on within-level income inequality.

3 Data and analytical methods

3.1 Data

In this study, household data were taken from the Vietnam Household Living Standard Survey (VHLSS) of 2016. The VHLSS was conducted by the General Statistics Office of Vietnam (GSO) with technical assistance from the World Bank. The 2016 survey covers around 46,000 households in 10,339 communes/wards. The VHLSS sample was selected in a way to represent the entire country at the national, regional, urban, rural and provincial levels. The sampling methods followed five different layers or aggregation levels (see more in "Appendix 1").

Data on households and individuals include basic demography, employment and labor force participation, education, health, income, housing, fixed assets and durable goods, and the participation of households in poverty alleviation programs. In this study we used data for the Northwest region, including about 3300 households that were surveyed in six provinces, namely Hoa Binh, Lai Chau, Lao Cai, Son La, Dien Bien and Yen Bai. Household income data were calculated from various sources (both cash and in kind), namely crops, forestry, animal husbandry, aquaculture, wage work, non-farm self-employment, pensions, rentals, interests, transfers, remittances and other sources. It should be noted that both income and expenditures were measured accounting for own consumption of products produced by households.

3.2 Classifying household livelihoods

Empirical evidence indicates that Vietnamese rural households engage in a diverse range of income-generating activities (Tran 2016; Tran et al. 2014). In the current study, this requires us to employ the cluster analysis method to classify livelihood strategies at the household level. This is a technique that is used to identify meaningful, mutually exclusive subgroups of observations from a larger aggregate group (Hair et al. 1998).

Empirical studies have commonly used income contribution by source as the main criterion to classify household livelihood strategies (Nielsen et al. 2013; Tran et al. 2014). This approach is appropriate because incomes from various sources are the result of work and livelihood assets that are allocated to various economic activities. This suggests that livelihood strategy identification using an appropriate cluster technique is needed for the current study. The contributions of five income sources are used as input variables for clustering livelihoods, including agricultural income, nonfarm-self-employment income, wage income, rental and other incomes.

Following suggestions by Punj and Stewart (1983), a two-stage procedure was used for cluster analysis. First, data on contributions to income for each household were used to apply a hierarchical method, using the Duda-Hart stopping rule to identify the optimal numbers of clusters (Halpin 2016). The results show that the largest Duda-Hart Je (2)/Je (1) stopping-rule value is 0.9916, corresponding to three groups. The cluster analysis was then rerun with the optimal cluster number, which had been identified using k-mean clustering. Three livelihood strategies were identified, namely (1) farmwork livelihoods, (2) wage-paying work livelihoods (wage-paying work in both private and public sectors) and (3) non-farm self-employment livelihoods. Once households were partitioned into three groups, we employed a first-order stochastic dominant analysis and pairwise comparison, using the Bonferroni method to compare which household livelihood offered higher outcomes in terms of per capita income (Nielsen et al. 2013).

3.3 Econometric models

We used a multinomial logit model (MLM) to examine factors affecting the likelihood of a household choosing a given livelihood. The MLM is the most commonly used specification for nominal outcomes because of its simple estimation and straightforward interpretation (Cheng and Long 2007; Tran et al. 2018). As already explained, household livelihoods are distinct because they are clustered into three mutually exclusive groups. This implies the appropriateness of the choice of the MLM for identifying factors influencing the probability of a household head choosing a given livelihood. There have been numerous studies using the MLM to examine factors affecting livelihood or occupational choice (e.g., Hinks and Watson 2001; Tran et al. 2014, 2018; Tsukahara 2007).

Let P_{ij} ($j=1, 2, 3$) denote the likelihood of a household head choosing a given livelihood i with $j=1$ if the livelihood is farmwork, $j=2$ if the livelihood is wage-paying work and $j=3$ if the livelihood is from nonfarm self-employment. Then the ML model is:

$$P_{ij}(j = k|X_i) = \frac{\exp(\beta_k X_i)}{\sum_{j=1}^{3} \exp(\beta_j X_i)} (j = 1, 2, 3) \tag{1}$$

According to Cameron and Trivedi (2005), β_j should be set to zero for one of the categories, and coefficients are then interpreted with respect to that category, called the reference category. Hence, set β_j to zero for one livelihood group (say, a farmwork livelihood), and then the MLM for each group can be rewritten as:

$$P_{ij}(j = k|X_i) = \frac{\exp(\beta_k X_i)}{1 + \sum_{j=1}^{3} \exp(\beta_j X_i)} (j = 2, 3) \quad \text{and} \quad P_{ij}(j = 1|X_i) = \frac{1}{1 + \sum_{j=1}^{3} \exp(\beta_j X_i)} \tag{2}$$

Following Tran et al. (2014), Eq. (3) was used to estimate factors associated with livelihood choice among households, where X_{ij} is a vector of household characteristics, such as household size, dependency ratio and age, education, gender and the ethnicity of household heads; λ_{ij} represents some types of land; D_j is the dummy variable of provinces, and ε_{ij} is an error term.

$$P_{ij}(j = k|X_i) = \beta_0 + X_{ij}\beta_1 + \lambda_{ij}\beta_2 + D_j\beta_3 + \varepsilon_{ij} \tag{3}$$

We assume that household per capita income is a reduced function of household characteristics and assets, as given in Eq. (4), where $\mathrm{Ln}(y_{ij})$ is the natural logarithm of per capita income of household i in province j. Thus, an ordinary least squares (OLS) estimator is used to examine factors affecting household income.

$$\mathrm{Ln}(y_{ij}) = \beta_0 + X_{ij}\beta_1 + \lambda_{ij}\beta_2 + D_j\beta_3 + \varepsilon_{ij} \tag{4}$$

Factors associated with the incidence of poverty were modeled using a probit model in Eq. (5), where the dependent variable P_{ij} is a binary variable that has a value of one if a household was classified as poor and a value of zero otherwise.

$$P_{ij} = \beta_0 + X_{ij}\beta_1 + \lambda_{ij}\beta_2 + D_j\beta_3 + \varepsilon_{ij} \tag{5}$$

Standard linear regression techniques (e.g., ordinary least squares or fixed/random effects estimators) have been commonly used for considering the effect of education on household income or wage income (e.g., Doan et al. 2018; Lekobane and Seleka 2017; Psacharopoulos and Patrinos 2004; Tran 2015). This mean approach looks at the average relationship between education and economic welfare based on the conditional mean of the outcome distribution. This gives us only a partial view of the relationship. However, a quantile regression

(QR) estimator allows us to investigate the relationship at different points in the conditional distribution of household welfare (e.g., at the 25th and 75th percentiles) (Buchinsky 1994). Another advantage of the QR estimator is that this method is more robust to non-normal errors and outliers, whereas a linear regression estimator can produce inefficient estimates if the errors are highly abnormal (Koenker 2005).

It should be noted that the QR estimator is not a regression estimated on a quantile, or subsample, of data as its name may suggest (Lê Cook and Manning 2013). While the goal of the OLS estimator is to minimize the differences between the observed and fitted values provided by the model, the QR estimator differentially weights the differences between the observed values and those predicted by the regression line; then, it tries to minimize the weighted differences (Buchinsky 1994; Koenker 2005).

Thus, we use the QR estimator to investigate the possible effect of education and other independent variables on household income across various points in the conditional distribution of household income. As given in Eq. (6), the model specifies the θth quantile ($0<\theta<1$) of conditional distribution of the dependent variable, given a set of covariates X_{ij} and assuming that residual distributions of each quantile are normal. We used the income level model instead of the log income model for the QR estimator. This is because it would be a mistake to use the log income results to infer conclusions about the distribution of income (although it is widely used in practice) (Lingxin and Daniel 2007).

$$Q_\theta(y_i|x_i) = \beta_0 + X_{ij}\beta_1 + \lambda_{ij}\beta_2 + D_j\beta_3 + \varepsilon_{ij} \tag{6}$$

Interestingly, the QR estimator enables us to evaluate whether education increases income inequality. If the returns on education increase by quantile, this suggests that education has an increasing effect on within-level income inequality (Alves 2012). In contrast, when the returns on education are the same across the quantiles considered, education has no effect on within-level income inequality, as the income distribution depending on the different levels of education would vary only through their means and not through their dispersions (Buchinsky 1994). In addition, the income distribution reflects not only education but also other unobservable factors, namely unobservable ability and other skills. Those at the bottom of the income distribution tend to attain lower levels of education but also a lower endowment of unobservable skills (Sakellariou et al. 2006). A quantile regression approach allows researchers to examine whether the impacts of education are independent of these unobservable factors or whether education compensates for or complements them. The effect of education is independent of unobservable skills if the effect is the same along the income distribution. A larger effect for poorer households suggests that education compensates for low skills, while a greater effect for better-off households implies that education complements the unobservable skills (Sakellariou et al. 2006).

Empirical research on family or household welfare has found that the social and economic welfare of a household is often based on the characteristics of its household head, such as his or her age, race and education, in both developed (Alves 2012; Biddlecom and Kramarow 1998; Santi 1990; Tsukahara 2007) and developing countries (Gustafsson and Yue 2006; Lekobane and Seleka 2017; Maitra and Vahid 2006; Nguyen and Tran 2013; Tran et al. 2015, 2018). Thus, the current study focuses on the characteristics of household heads as main factors affecting household livelihoods. Following the literature on education economics (Alves 2012; Doan et al. 2018; Sakellariou et al. 2006), we measure the education levels of a household by the number of formal schooling years and the highest qualification attained by the head. Following Doan et al. (2018) and Psacharopoulos and Patrinos (2004), we do not include many other variables (e.g., occupation, sector, etc.) because they would deflect attention from the effect of education on income and poverty. Equations (4)–(6) use the same

explanatory variables as those in Eq. (3). The explanatory variables were selected based on previous studies in rural Vietnam by Tran et al. (2014) and Tran (2015). Definitions and measurements of included variables are given in Table 1.

4 Results and discussion

4.1 Background on household livelihoods

Table 1 shows that there are substantial differences in the study area between poor and better off in the mean values of most household characteristics. The poor have a larger household size and much higher dependency ratio than the better off. The differences between the two groups in the age and education of heads of household were also statistically significant. On average, the heads of better-off households were about 3 years older and had about 3 years more formal schooling than those of poor households. Unsurprisingly, the percentage of households depending on wage or nonfarm self-employment is much higher for the better off (42% and 14%) than for the poor (12% and 0%).

The differences between the two groups in their use of some types of land were statistically highly significant. The area of annual cropland owned by poor households was much larger than that owned by better-off households. However, better-off households had much more perennial cropland and forestland than did poor households. The poor earned a very low level of per capita income, equivalent to only a quarter of that earned by those better off. Also, Table 4 shows that the percentage of households with livelihood strategies based on non-farmwork (both wage paying or self-employed) was much higher for the better off than for the poor. Remarkable dissimilarities in household characteristics and assets between the two groups were expected to be closely linked with variations in household affluence.

As shown in Table 2, the average per capita income for the whole sample was estimated at about 1.87 million VND per month. However, the per capita income for the Kinh and Hoa is nearly three times that for ethnic minorities. In addition, the incidence and intensity of poverty remain much higher for ethnic minorities than for the Kinh and Hoa. The data also indicate that there are differences in living standards across provinces. Households in Lao Cai, Yen Bai and Hoa Binh attained a higher level of per capita income and had a lower poverty rate than those in other provinces.

Figure 1 reports the mean income contribution for the whole sample as well as for each livelihood group. For the whole sample, it indicates that wage income accounted for the largest proportion of total household income (41%) followed by agricultural income (31%), nonfarm self-employment income (19%) and other sources (9%). However, there are considerable differences in the mean income contribution across livelihood groups. Income from agricultural activities contributed about 70% of total income for households with farmwork livelihoods, while wage income made up about 78% of total income for those depending on wage-paying work. Nonfarm self-employment accounted for about 78% of total income for those dependent on nonfarm self-employment.

Figure 2 shows that about 35% of all household heads lacked formal schooling. However, the percentage of those without formal schooling was much higher for ethnic minorities (58%) than for Kinh and Hoa (26%). The difference between the two groups in primary education was negligible but much greater at higher levels of education. For instance, the proportion of household heads with lower secondary education was about 16% for the poor compared with 23% for the better off. However, the percentage of household heads who completed

Table 1 Household characteristics by poverty status

Variables	Non-poor		Poor		Whole sample		*p* value
	Mean	SD	Mean	SD	Mean	SD	
Gender (1 = male; 0 = female)	0.79	0.41	0.88	0.32	0.81	0.39	***
Age (of household head)	46.76	12.77	42.24	13.78	45.51	13.21	***
Marital status (1 if the household head is married; 0 = otherwise)	0.01	0.12	0.01	0.10	0.01	0.11	
Schooling years (household head's years of formal schooling)	8.76	4.20	5.94	2.99	8.16	4.14	***
Ethnicity (of the head: 1 = Kinh and Hoa; 0 = ethnic minorities)	0.40	0.49	0.04	0.19	0.30	0.46	***
Urban/rural (1 = urban; 0 = rural)	0.28	0.45	0.05	0.22	0.21	0.41	***
Dependency ratio[a]	0.34	0.25	0.44	0.21	0.37	0.24	***
Household size (total household members)	4.08	1.54	5.23	1.97	4.40	1.75	***
Farmwork livelihood (1 = yes; 0 = other)	0.44	0.50	0.88	0.33	0.55	0.50	***
Wage-paying livelihood (1 = yes; 0 = other)	0.42	0.50	0.12	0.32	0.35	0.49	***
Nonfarm self-employment livelihood (1 = yes; 0 = other)	0.14	0.35	0.00	0.07	0.10	0.30	***
Annual cropland (m^2)	5313	9013	9560	9079	6486	9227	***
Perennial cropland (m^2)	876	3565	263	1103	707	3100	***
Forestland (m^2)	3651	13,275	2422	6970	3311	11,885	***
Residential land (m^2)	109	21	29	4	87	16	**
Monthly per capita household income[b]	2385	2312	523	123	1870	2135	***
Observations	2388		911		3299		

Authors' calculation from the 2016 VHLSS
SD standard deviation
*Significant at 10%; **significant at 5%; ***significant at 1%
[a]This ratio is calculated by the number of members aged under 15 and over 59 years divided by the number of members aged 15–59 years
[b]Calculated in thousands of Vietnamese dong (VND)

Table 2 Household economic welfare by ethnicity and province

Livelihood outcomes	All	Ethnic minorities	Kinh and Hoa	Lao Cai	Dien Bien	Lai Chau	Son La	Yen Bai	Hoa Binh
Household income per capita[a] (SD)	1870	1206	3433	2132	1591	1553	1603	2139	2195
	2135	2897	1208	2299	2352	1546	1933	2551	1873
Poverty head count	0.28	0.38	0.03	0.20	0.46	0.32	0.37	0.17	0.14
Poverty gap	0.07	0.10	0.00	0.05	0.12	0.07	0.11	0.04	0.04
Observations	3294	2313	981	510	510	509	628	569	568

Authors' calculation from the 2016 VHLSS

Poverty head count and gap indexes are estimated using the updated poverty line for the period 2016–2020 (700,000 VND and 900,000 VND per person per month in rural and urban regions, respectively)

SD standard deviation

[a]Monthly income in thousands of Vietnamese dong (VND)

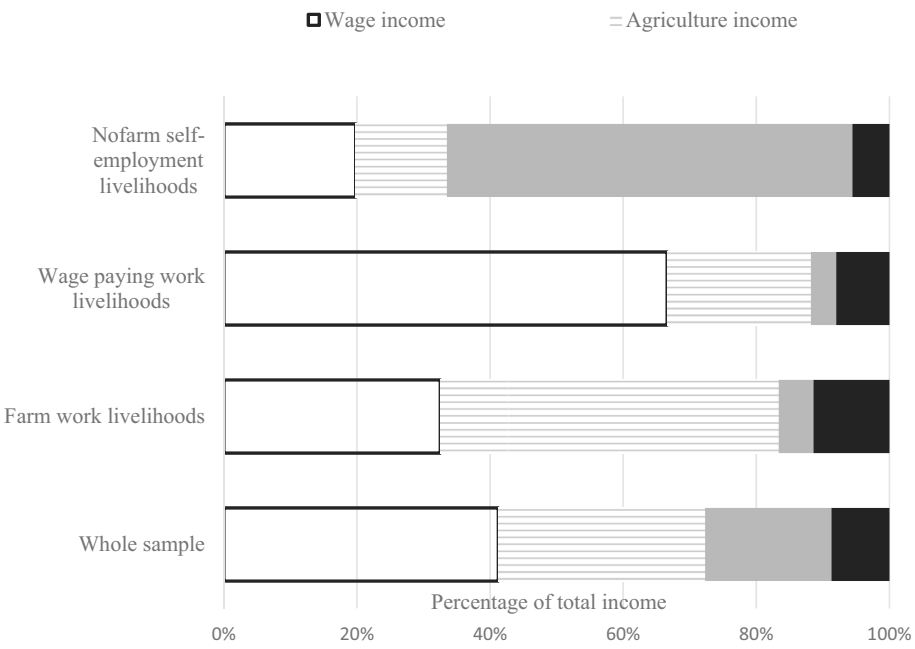

Fig. 1 Household income sources by livelihood. *Source*: Authors' calculation from the 2016 VHLSS

vocational education was about 1% and 13% for the poor and the better off, respectively. Figure 3 suggests that the better educated a household head, the more likely it is that the household will earn higher income. It shows that households whose head has a college or university degree would achieve the highest per capita income, while those whose head lacks formal schooling would earn the lowest per capita income. The findings imply that the level of education of household heads plays an important role in household affluence in the study area.

The estimates in Fig. 4 also reveal the importance of livelihood strategies for household affluence. The highest per capita income was observed for households choosing nonfarm self-employment livelihoods followed by those with wage-paying occupations and finally by those depending on farmwork. Table 4 shows that on average households with nonfarm self-employment would earn a monthly per capita income of 2.6 million VND and 1.276 million VND higher, respectively, than the income earned by those whose livelihoods consisted of farm and wage-paying work. In addition, the estimates in Table 4 indicate that households living from wage-paying work would obtain a level of monthly per capita income about 1.324 million VND higher than those whose livelihoods depended on farmwork. Once again, the findings confirm the important role of the type of livelihood in the economic well-being of households (Table 3).

4.2 Impact of education on household livelihoods

Table 4 presents the estimation results from the multinomial logit model in which education was measured by the household head's highest qualification in model 1 and the number of formal schooling years in model 2. Both models show that many explanatory variables are statistically significant at the 5% level or lower, with their signs as expected. Finally, the

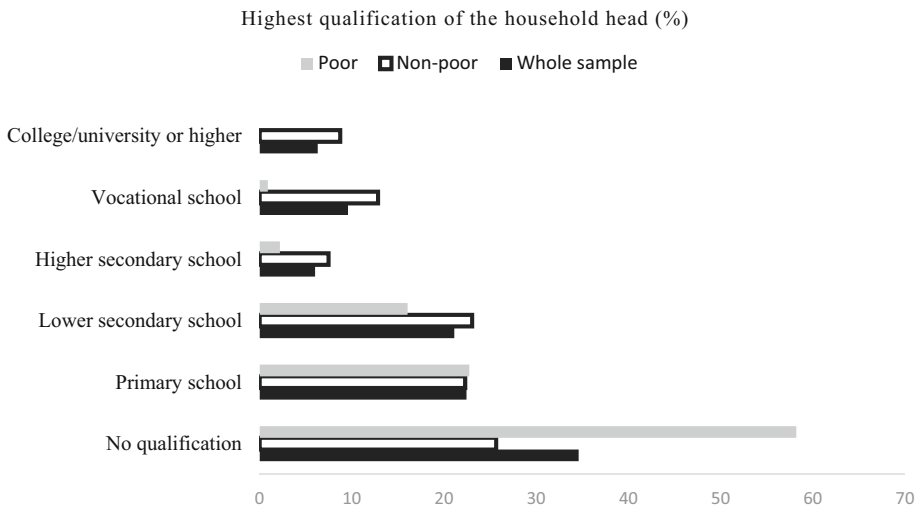

Fig. 2 Percentage of household heads according to level of qualifications. *Source*: Authors' calculation from the 2016 VHLSS

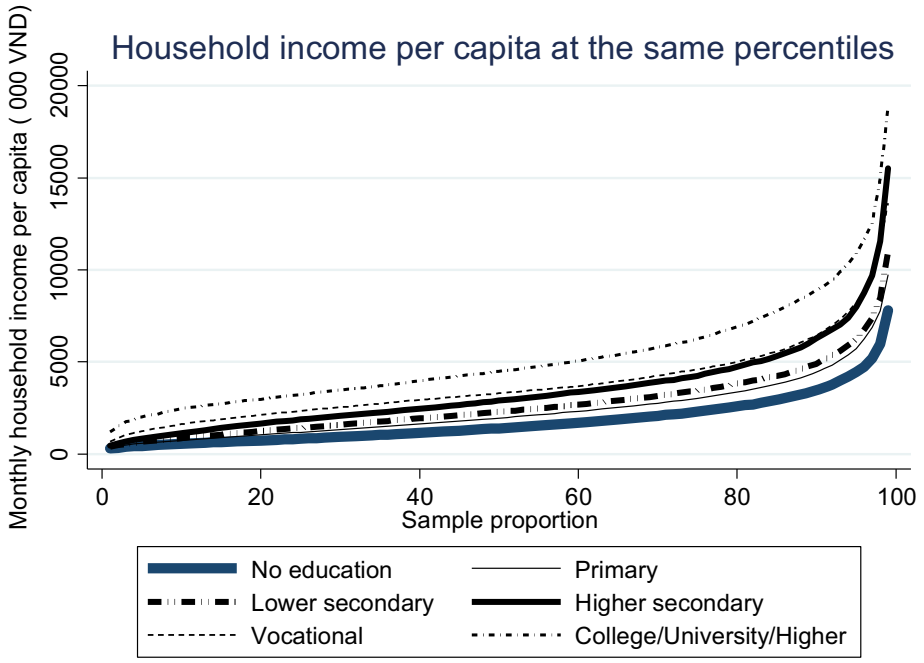

Fig. 3 Pen's parade for comparing per capita income according to level of qualifications. *Source*: Authors' calculation from the 2016 VHLSS

pseudo-$R^2 = 0.29$ and is highly significant, indicating that this model has strong explanatory power.[1]

[1] An extremely good fit for the model is confirmed if the value of the pseudo-R^2 ranges from 0.2 to 0.4 (Louviere et al. 2000).

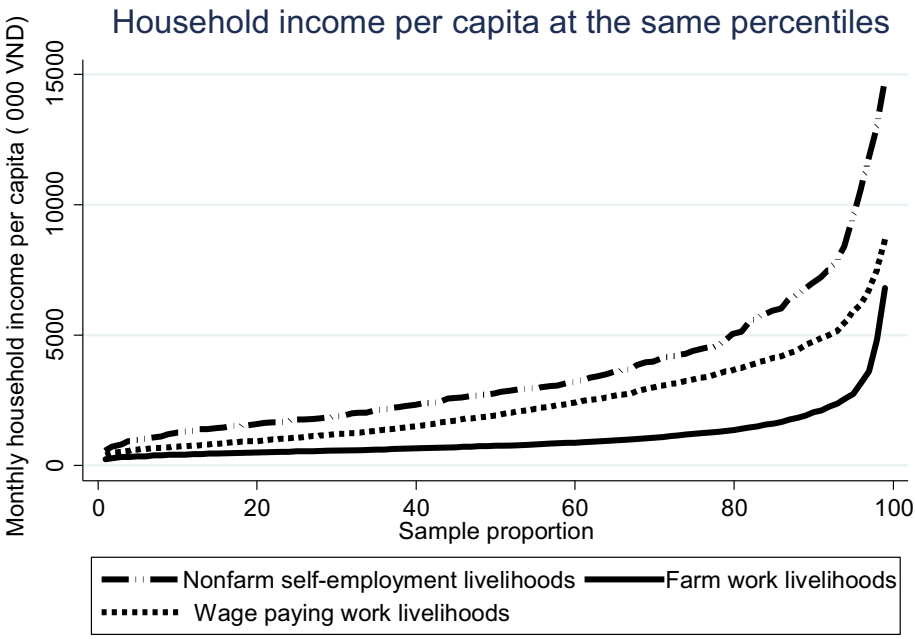

Fig. 4 Pen's parade for comparison of per capita income across livelihood groups. *Source*: Authors' calculation from the 2016 VHLSS

With respect to the role of education in livelihood choice, the results indicate that better education of household heads has a positive association with adopting a livelihood strategy based on wage employment. Keeping all other variables constant, the results from model 2 in Table 4 show that an additional year of formal schooling increases the likelihood of a household choosing a livelihood from wage-paying work by about 15.6%. Model 1 in Table 4 reveals that a household whose head has achieved higher levels of qualification is much more likely to have a better livelihood. For instance, the likelihood of choosing nonfarm self-employment is 3.22 times higher for a household whose head has primary education than for a household whose head has no education. Similar but much larger effects are observed with higher secondary education (7.05 times), vocational education (9.40) and college/university or higher (24.30 times). The findings imply that education plays an important role in pursuing lucrative livelihoods and that households with low educational levels may be hindered from adopting better livelihoods. Our findings are consistent with previous studies in Vietnam's peri-urban areas (Tran et al. 2014) and rural Vietnam (Pham et al. 2010; Van de Walle and Cratty 2004).

We also find that other household characteristics have a close link with livelihood choice. The gender evidence suggests that the probability of adopting a wage-paying livelihood is about 1.6 times higher for a household with a male head than for a household whose head is female, assuming that the remaining variables in the model are held constant. In addition, Kinh and Hoa households are more likely than ethnic minority households to choose nonfarm self-employment livelihoods. We find evidence that the only type of land associated with livelihood choice is annual cropland. In accordance with other findings in several developing countries (Rigg 2006; Winters et al. 2009), our research shows that cropland is negatively associated with the choice of both wage-paying work and nonfarm self-employment livelihoods. The

Table 3 Pairwise comparison of household income across livelihood groups using the Bonferroni method. *Source*: Authors' calculation from the 2016 VHLSS

	Whole sample	Group		
		Farmwork livelihood	Wage-paying work livelihood	Non-farm self-employment livelihood
Observations	3294	1789	1164	341
Monthly per capita income				
Mean	1870	1132	2457	3733
Standard deviation	2134	1492	1978	3397

Comparing income across groups	Wage-paying work livelihood	Non-farm self-employment livelihood
Farmwork livelihood	1324	2601
	(0.00)	(0.00)
Wage-paying work livelihood		1276
		(0.00)

Results reported are mean differences in monthly per capita household income, and p values are in parentheses. Unit: 1000 VND and 1 USD equated to about 22,000 VND in 2016

results show that the likelihood of choosing various livelihoods varies significantly across provinces. For instance, holding all other variables constant, households in Dien Bien and Son Lan are less likely to adopt a strategy based on nonfarm activities, including both wage paying and self-employment, than households in Lao Cai. However, households in Lai Chau are more likely to choose wage-paying and nonfarm self-employment livelihoods than those in Lao Cai.

Table 5 reports the results from the household income model with model 1 using the highest qualification and model 2 using the number of formal schooling years. Both models explain roughly 50% of the variation in household income. In addition, many coefficients are statistically highly significant ($p < 0.05$), with their signs as expected. As shown in model 2, the coefficient of schooling years indicates that on average and holding all other variables constant, an additional year of formal schooling would increase household per capita income by about 5%. Model 2 in Table 5 indicates that a higher level of qualifications would have an increasing effect on household per capita income, and the effect significantly increases with the level of education. For instance, per capita income would be about 16% and 87% higher, respectively, for a household whose head had a primary diploma and one with a college/university or higher degree. Similar findings were also found in previous studies in peri-urban Vietnam (Tran et al. 2014) and rural Vietnam (Nguyen and Tran 2013).

Table 6 provides the estimation results from the quantile regression analysis. It shows that education has a positive and statistically significant effect on household per capita income for all quantiles. Interestingly, the results in Table 6 and Fig. 5 indicate that the effect is substantially heterogeneous across the quantiles considered and increases when moving up the conditional income distribution. For instance, holding all other factors constant, an additional year of formal schooling would lead to an increase of about 29,000 VND in monthly per capita income for those in the 10th quantile. However, the corresponding figures for those in the 50th, 75th and 90th quantiles are about 56,000 VND, 76,000 VND and 110,000 VND, respectively. This finding shows education to be more profitable at the top of the distribution,

Table 4 MNL estimates for the effect of education on livelihood choice

Explanatory variables	Model 1: Schooling years		Model 2: Highest qualification	
	Group 2	Group 3	Group 2	Group 3
Gender	1.576**	0.797	1.645**	0.944
	(0.302)	(0.119)	(0.344)	(0.136)
Age	0.986	0.977	0.973	0.966
	(0.065)	(0.027)	(0.042)	(0.022)
Age squared	1.000	1.000	1.000	1.000
	(0.001)	(0.000)	(0.000)	(0.000)
Marital status	0.425	1.282	0.477	1.147
	(0.356)	(0.647)	(0.395)	(0.452)
Urban/rural	3.170***	2.853***	3.263***	3.263***
	(0.934)	(0.654)	(0.547)	(0.547)
Ethnicity	5.000***	1.150	1.429**	1.429**
	(1.234)	(0.214)	(0.201)	(0.201)
Dependency ratio	0.210***	0.336***	0.305***	0.305***
	(0.094)	(0.084)	(0.072)	(0.072)
Household size	1.240***	1.165***	1.137***	1.137***
	(0.060)	(0.038)	(0.035)	(0.035)
Annual cropland	0.646***	0.733***	0.711***	0.711***
	(0.030)	(0.028)	(0.018)	(0.018)
Perennial cropland	0.905***	0.916***	0.918***	0.918***
	(0.034)	(0.022)	(0.016)	(0.016)
Forestland	0.912***	0.966*	0.966***	0.966***
	(0.028)	(0.017)	(0.013)	(0.013)
Residential land	1.065	0.962	0.981	0.981
	(0.042)	(0.025)	(0.023)	(0.023)
Dien Bien	0.450**	0.496**	0.497***	0.497***
	(0.171)	(0.155)	(0.088)	(0.088)
Lai Chau	0.774	0.627	0.601***	0.601***
	(0.307)	(0.187)	(0.102)	(0.102)
Son La	0.329***	0.332***	0.365***	0.365***
	(0.127)	(0.094)	(0.065)	(0.065)
Yen Bai	0.791	0.914	0.975	0.975
	(0.276)	(0.256)	(0.158)	(0.158)
Hoa Binh	1.059	0.926	1.211	1.211
	(0.389)	(0.286)	(0.198)	(0.198)
Years of schooling	1.035	1.156***		
	(0.025)	(0.020)		
Primary education			3.222***	1.202

Table 4 continued

Explanatory variables	Model 1: Schooling years		Model 2: Highest qualification	
	Group 2	Group 3	Group 2	Group 3
			(0.746)	(0.147)
Lower secondary education			3.802***	1.429***
			(0.865)	(0.185)
Higher secondary education			7.056***	1.199
			(2.125)	(0.288)
Vocational education			9.436***	4.900***
			(2.842)	(1.127)
College/university or higher			24.279***	38.906***
			(28.806)	(41.994)
Constant	2.822	5.556**	1.498	17.124***
	(4.578)	(4.648)	(1.683)	(10.948)
Pseudo R^2	0.29		0.29	
Observations	3294		3294	

Estimates are relative risk ratio (RRR) and robust standard errors in parentheses
Group 1: farmwork livelihood forms the base group; group 2: nonfarm self-employment livelihood; group 3: wage-paying work livelihood. The omitted categories in the dummy variable analyses are: female sex; unmarried; rural; ethnic minorities; Lao Cai; no education
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

which implies that education increases within-level income inequality in absolute terms.[2] Similar results were also found when education was measured by the highest qualification (see "Appendix 3"). Our findings are consistent with those of a study in Portugal by Alves (2012).

The greater influence of education on higher quantiles may be explained by the fact that better-off households have more resources or a better ability to use their human capital more efficiently or, for the same number of years of schooling, the better off received better quality education than those worse off, which in turn can lead to higher income levels. As noted by Sakellariou et al. (2006), those at the bottom of the income distribution tend to have lower levels of education but also a lower endowment of unobservable skills. Thus, the larger effect of education at the top of income distribution implies that richer households have a higher endowment of unobservable ability and skills than do poorer households. These results suggest that a mean regression approach has obscured the role of education in improving household welfare at different points of outcome distribution.

The results from probit regression analysis are given in Table 7, which indicates that better education is strongly associated with a lower likelihood of a household remaining in poverty. Model 2 in Table 7 reveals that an additional year of formal schooling would have a marginal effect of − 2% on the probability of a household falling into poverty, holding all other variables constant in the model. Similarly, the results from model 1 in Table 7 confirm

[2] The absolute gap between "rich" and "poor" rather than the proportionate gap.

Table 5 OLS estimates for the effect of education on household per capita income

Explanatory variables	Model 1 Highest qualification			Model 2 Years of schooling		
	Coefficient	SE	*p* value	Coefficient	SE	*p* value
Gender	0.069	0.030	**	0.046	0.031	
Age	0.023	0.006	***	0.026	0.006	***
Age squared	0.000	0.000	***	0.000	0.000	***
Marital status	0.039	0.107		0.047	0.107	
Urban/rural	0.302	0.077	***	0.322	0.075	***
Ethnicity	0.342	0.047	***	0.319	0.048	***
Dependency ratio	− 0.518	0.056	***	− 0.513	0.056	***
Household size	− 0.064	0.006	***	− 0.057	0.007	***
Annual cropland	− 0.036	0.007	***	− 0.041	0.007	***
Perennial cropland	0.019	0.006	***	0.016	0.007	**
Forestland	0.004	0.004		0.004	0.004	
Residential land	0.020	0.006	***	0.018	0.006	***
Dien Bien	− 0.128	0.063	**	− 0.126	0.063	**
Lai Chau	− 0.029	0.057		− 0.019	0.059	
Son La	− 0.171	0.061	***	− 0.181	0.062	***
Yen Bai	− 0.079	0.056		− 0.094	0.058	
Hoa Binh	0.020	0.066		− 0.030	0.067	
Primary education	0.157	0.031	***			
Lower secondary education	0.249	0.035	***			
Higher secondary education	0.429	0.054	***			
Vocational education	0.621	0.045	***			
College/university or higher	0.869	0.057	***			
Years of schooling				0.049	0.003	***
Constant	6.750	0.163	***	6.615	0.164	***
Observations	3294			3294		
R-squared	0.53			0.53		

Robust standard errors in parentheses
The omitted categories in the dummy variable analyses are female sex, unmarried, rural, ethnic minorities, Lao Cai, no education
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Table 6 QR estimates for the effect of education on household per capita income

Explanatory variables	Simultaneous quantile regression estimator				
	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
Years of schooling	28.862***	37.736***	55.940***	76.068***	109.387***
	(3.636)	(3.878)	(3.855)	(5.514)	(10.753)
Gender	− 14.528	− 9.518	− 16.412	63.403	123.742
	(41.461)	(45.253)	(35.733)	(61.748)	(117.812)
Age	13.718**	27.693***	41.829***	35.419***	43.667***
	(6.461)	(6.508)	(7.392)	(8.195)	(13.627)
Age squared	− 0.119	− 0.246***	− 0.353***	− 0.261***	− 0.339***
	(0.072)	(0.070)	(0.078)	(0.081)	(0.129)
Marital status	69.679	4.566	18.477	130.787	382.728
	(183.509)	(114.201)	(174.791)	(270.385)	(3080.414)
Urban/rural	410.517***	567.857***	673.950***	961.327***	862.607***
	(61.187)	(56.341)	(106.078)	(156.924)	(289.073)
Ethnicity	348.192***	486.490***	579.928***	905.169***	1408.618***
	(45.890)	(57.372)	(63.905)	(143.736)	(225.062)
Dependency ratio	− 284.350***	− 316.573***	− 627.089***	− 1006.560***	− 1804.555***
	(56.288)	(75.200)	(61.341)	(110.922)	(159.876)
Household size	− 6.509	− 15.821**	− 35.729***	− 61.672***	− 73.702***
	(7.114)	(7.750)	(9.444)	(10.628)	(16.341)
Annual cropland	− 37.457***	− 53.374***	− 88.293***	− 101.828***	− 161.100***
	(7.642)	(7.820)	(10.686)	(15.626)	(26.370)
Perennial cropland	− 8.030*	− 7.190	7.820	27.641***	69.884***
	(4.511)	(4.914)	(5.737)	(9.359)	(14.672)
Forestland	1.743	2.514	6.745**	7.348	9.516
	(3.386)	(2.666)	(3.322)	(5.282)	(9.970)
Residential land	13.749***	9.471*	9.831	26.837**	8.481
	(4.354)	(5.110)	(6.684)	(10.629)	(22.810)
Dien Bien	− 111.050***	− 127.555***	− 48.070	− 144.958**	− 138.984
	(31.909)	(40.094)	(53.332)	(73.512)	(107.527)
Lai Chau	− 22.492	− 11.078	59.714	− 52.558	− 134.998
	(34.360)	(38.844)	(41.275)	(56.977)	(88.318)
Son La	− 154.188***	− 141.098***	− 69.971	− 202.521***	− 365.567***
	(43.959)	(49.008)	(58.642)	(72.718)	(94.154)
Yen Bai	− 142.684***	− 163.706***	− 155.240***	− 226.419***	− 170.503
	(50.199)	(41.602)	(47.548)	(71.681)	(132.016)
Hoa Binh	− 126.195***	− 111.935**	− 1.624	− 11.434	− 214.302

Table 6 continued

Explanatory variables	Simultaneous quantile regression estimator				
	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
	(47.708)	(56.250)	(55.110)	(81.992)	(136.588)
Constant	515.401***	496.057***	747.555***	1496.651***	2605.122***
	(140.827)	(168.450)	(199.374)	(251.971)	(436.752)
Pseudo R^2	0.15	0.22	0.32	0.37	0.38
Observations	3294	3294	3294	3294	3294

Bootstrapped standard errors (1000 replications) in parentheses. The omitted categories in the dummy variable analyses are female sex, unmarried, rural, ethnic minorities, Lao Cai
*Significant at 10%; **significant at 5%; ***significant at 1%

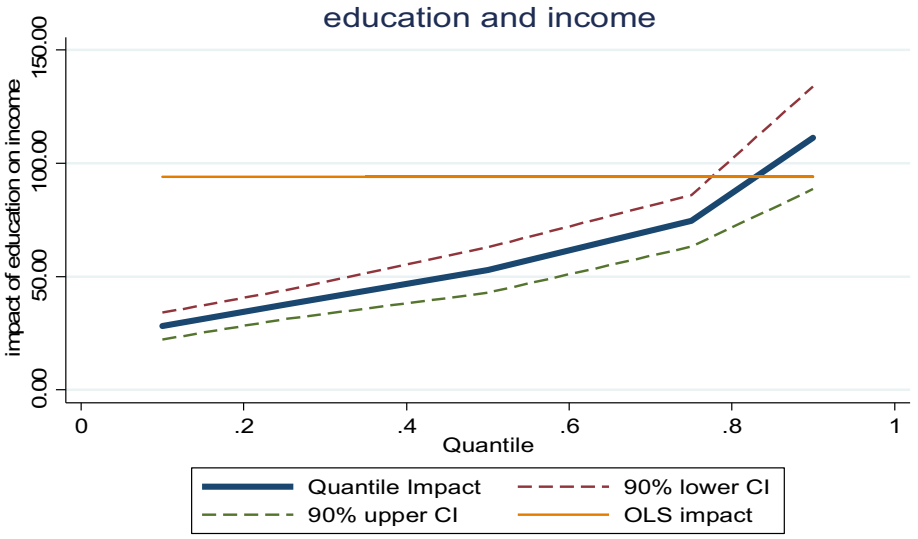

Fig. 5 Heterogeneous effects of education on income across percentiles. *Note* Figure 2 reflects the varying effects of years of schooling on per capita income across different points in the income distribution and also indicates that the effect is greater for better-off households. *Source*: Authors' calculation from the 2016 VHLSS

that a household whose head had no college/university or higher degree would, on average, be more likely to be poor than would a household whose head had such a qualification. Specifically, model 1 predicts a marginal effect of 95%, 116%, 118%, 122% and 128% in the case of vocational education, higher secondary, lower secondary, primary and no education, respectively.[3] The results from both models in Table 7 confirm that better education helps reduce poverty in the study area. The findings are congruent with those from several studies in Vietnam (Tran et al. 2015) and other developing countries (Biddlecom and Kramarow 1998; Lekobane and Seleka 2017; Rigg 2006).

[3] We use the highest qualification (those with college/university/higher qualifications) as the reference group in model 1 instead of using the group with no education because there are no poor households in the group with the highest qualification. Consequently, the education variable "highest qualification" predicted failure and had to be dropped, leaving 208 observations unused.

Table 7 Probit estimates for the effect of education on the incidence of poverty

Explanatory variables	Model 1 Highest qualification			Model 2 Years of schooling		
	Marginal effect	SE	*p* value	Marginal effect	SE	*p* value
Gender	−0.046	0.021	**	−0.032	0.021	
Age	−0.014	0.003	***	−0.016	0.003	***
Age squared	0.000	0.000	***	0.000	0.000	***
Marital status	−0.056	0.062		−0.060	0.060	
Urban/rural	−0.078	0.048		−0.075	0.046	
Ethnicity	−0.191	0.039	***	−0.178	0.038	***
Dependency ratio	0.224	0.035	***	0.226	0.035	***
Household size	0.033	0.004	***	0.031	0.004	***
Annual cropland	0.008	0.005	*	0.010	0.004	**
Perennial cropland	−0.007	0.003	**	−0.006	0.003	
Forestland	−0.002	0.002		−0.002	0.002	
Residential land	−0.016	0.004	***	−0.015	0.004	***
Dien Bien	0.148	0.046	***	0.144	0.045	***
Lai Chau	0.021	0.041		0.016	0.041	
Son La	0.136	0.038	***	0.138	0.038	***
Yen Bai	0.051	0.041		0.058	0.041	
Hoa Binh	0.017	0.044		0.041	0.045	
No education	1.282	0.045	***			
Primary education	1.222	0.047	***			
Lower secondary education	1.182	0.048	***			
Higher secondary education	1.116	0.055	***			
Vocational education	0.955	0.056	***			
Years of schooling				−0.019	0.002	***
Observations	3294			3294		
Pseudo R^2	0.30			0.29		

Robust standard errors in parentheses
The omitted categories in the dummy variable analyses are female sex, unmarried, rural, ethnic minorities, Lao Cai, college/university or higher degree
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

Regarding the role of other household characteristics in household affluence, we find that both the household size and dependency ratio reduce per capita income and increase the likelihood of being poor. Similar findings are also reported in several developing countries (Jansen et al. 2006; Lekobane and Seleka 2017; Winters et al. 2009) and rural Vietnam (Tran 2015; Tran et al. 2015). The current study also shows that people whose households are headed by men, are Kinh or Hoa, and live in urban areas would, on average, have higher per capita income and be at lower risk of falling into poverty. However, the results from the quantile regression suggest that the effect of the aforementioned factors is quite heterogeneous at various points of income distribution. For instance, the negative effect of the household size and dependency ratio on household income tends to be larger for better-off households, while the regional (urban) and ethnicity (Kinh and Hoa) factors bring greater benefits for richer households.

Regarding the role of assets in household welfare, the study found that not all types of land are positively associated with household affluence. While both residential and perennial croplands have a positive effect on household income and poverty reduction, this effect is negative for annual cropland and not statistically significant in the case of forestland (Tables 5, 7). An increase of 1% in perennial cropland would increase per capita income by about 0.02% and reduce the probability of falling into poverty by 0.007%. Interestingly, using a quantile regression analysis, our study provides the first evidence that the income effect of land is substantially heterogeneous at different points of income distribution (Table 6). The negative effect of annual cropland tends to be greater for richer households. Notably, the effect of perennial cropland is statistically significant and positive only for households with per capita income above the median, but is negative for those in the 10th quantile. Also, forestland is positively associated with per capita income for those at the median. This suggests that such findings would be hidden if we only reported the results from a mean regression analysis.

Finally, Table 5 shows that some coefficients of province dummy variables are negative and statistically significant, suggesting that, on average, households with equal lands, education and other characteristics would have lower per capita income levels in Dien Bien and Son La than in Lao Cai. The disparities in per capita income across provinces suggest that livelihood outcomes are also affected by provincial factors.

5 Policy implication and conclusion

For the first time, this study considers the role of education in livelihood choice, household income, poverty and inequality in the Northwest region, the poorest region in Vietnam. The extensive empirical literature, which estimates the influence of education on household income using a mean regression approach, disregards variation in the effect for households with the same levels of education. Going beyond the current literature, our study is the first to employ a quantile regression (QR) estimator to investigate the returns on education for the entire distribution of household income, not merely its conditional mean. This approach enables us to measure inequality within groups, since quantile returns represent the income differential between households in the same education group but in different income quantiles.

In the current study, education is measured by the number of years of formal schooling and the highest qualification attained by household heads. We find that the poor have much lower levels of education than do the better off. The results from a multinomial logit model show that education plays a significant role in securing well-paying livelihoods, even after controlling for other factors in the models. In addition, the findings from OLS and probit

models confirm that households with better education would, on average, have higher per capita income and a greater chance of escaping poverty. Given that the poor have much lower levels of education than those better off, our research finding suggests that increasing the access of the poor to education, combined with improvements in its quality, could have a substantial effect on livelihood choice, income and poverty in the study area.

Notably, we provide the first evidence that there is a significant variation in the returns on education across income distribution, with higher returns for households with higher levels of per capita income. This implies that education has an increasing effect on within-level income inequality in absolute terms and raises challenges for the conventional view of investment in education, in which education improves income equality in the long run, other things being equal (Sakellariou et al. 2006). Higher returns on education for better-off households can be explained by the fact that they have more resources or a better ability to use their human capital more efficiently, which in turn can lead to higher income levels. Another possible reason is that for the same number of schooling years, richer households receive better quality education than do those worse off. These results suggest that a mean regression approach that looks only at the effect of education on mean household affluence and does not investigate differences in the distribution of household wealth may miss heterogeneity that is of interest to policymakers.

We find a number of other factors affecting household income, poverty status and the choice of better livelihoods. Households with male heads or of Kinh and Hoa ethnicity were more likely to have lucrative livelihoods. These households and those living in urban areas also have higher per capita income and a lower likelihood of falling into poverty. The study shows that not all types of land are positively associated with income and poverty alleviation. Both income and poverty reduction are positively linked with perennial cropland and residential land, but are negatively associated with annual cropland. However, the results from the QR estimator show that these factors have heterogeneous effects across points of income distribution. The negative effects of household size and dependency ratios tend to be smaller for poorer households, whereas the positive effects of gender, ethnicity and regional variables tend to increase for richer households. This suggests that a mean regression approach has obscured the role of household characteristics in improving household welfare at different points of outcome distribution.

We acknowledge that our study does have some limitations regarding use of cross-sectional data. We are unable to examine factors affecting household income changes over time because of lack of longitudinal data. The use of panel data in estimating a household welfare equation reduces the bias because it controls for time-invariant unobservable household characteristics. However, this approach might fail to address the role of education as education seems to be fixed over a short time, so it requires panel data for a longer time period. This suggests that further research is needed to address this issue.

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Appendix 1

1. Vietnam as a whole is the first aggregate on the national level.
2. Sixty-three provinces of Vietnam make up the second level. Households from all 63 provinces were interviewed during the survey.

3. The third layer is the commune level, and 10,340 communes are located across the 63 provinces of Vietnam. Households from 3100 of these communes were interviewed. The households from the remaining 7240 communes were not interviewed.
4. Three enumeration areas (EAs) in each of the 3100 communes were chosen for interviewing (the master sample). These 9000 EAs are known as the fourth level of aggregation.
5. A total of 46,500 individual households make up the fifth and most disaggregated level. Households from 3100 of 9000 EAs (located in 3100 different communes) were interviewed for the VHLSS 2016 in clusters of 15 with 1 cluster from each EA. The households of the remaining 5900 EAs were not interviewed.

Appendix 2

See Table 8.

Table 8 Household characteristics by ethnicity

Variables	Ethnic minorities		Kinh and Hoa		Whole sample	
	Mean	SD	Mean	SD	Mean	SD
Gender	0.88	0.32	0.65	0.48	0.81	0.39
Age	43.54	12.75	50.16	13.12	45.51	13.21
Marital status	0.01	0.11	0.01	0.11	0.01	0.11
Schooling years	5.12	4.33	10.40	4.00	6.70	4.90
Dependency ratio	0.37	0.23	0.36	0.28	0.37	0.24
Household size	4.74	1.79	3.60	1.34	4.40	1.75
Wage employment	0.56	0.50	0.74	0.44	0.61	0.49
Nonfarm self-employment	0.23	0.42	0.42	0.49	0.29	0.45
Annual cropland	86.62	97.44	13.51	49.53	64.86	92.27
Perennial cropland	5.81	24.49	10.03	42.45	7.07	31.00
Forestland	37.48	127.45	22.82	94.79	33.11	118.85
Residential land	0.65	3.10	1.38	15.66	0.87	8.94
Urban/rural	0.08	0.27	0.53	0.50	0.21	0.41
Per capita income	1207	1208	3432	2895	1870	2134
Poverty head count	0.38	0.48	0.034	0.018	0.27	0.45
Observations	2313		981		3294	

Appendix 3

See Fig. 6.

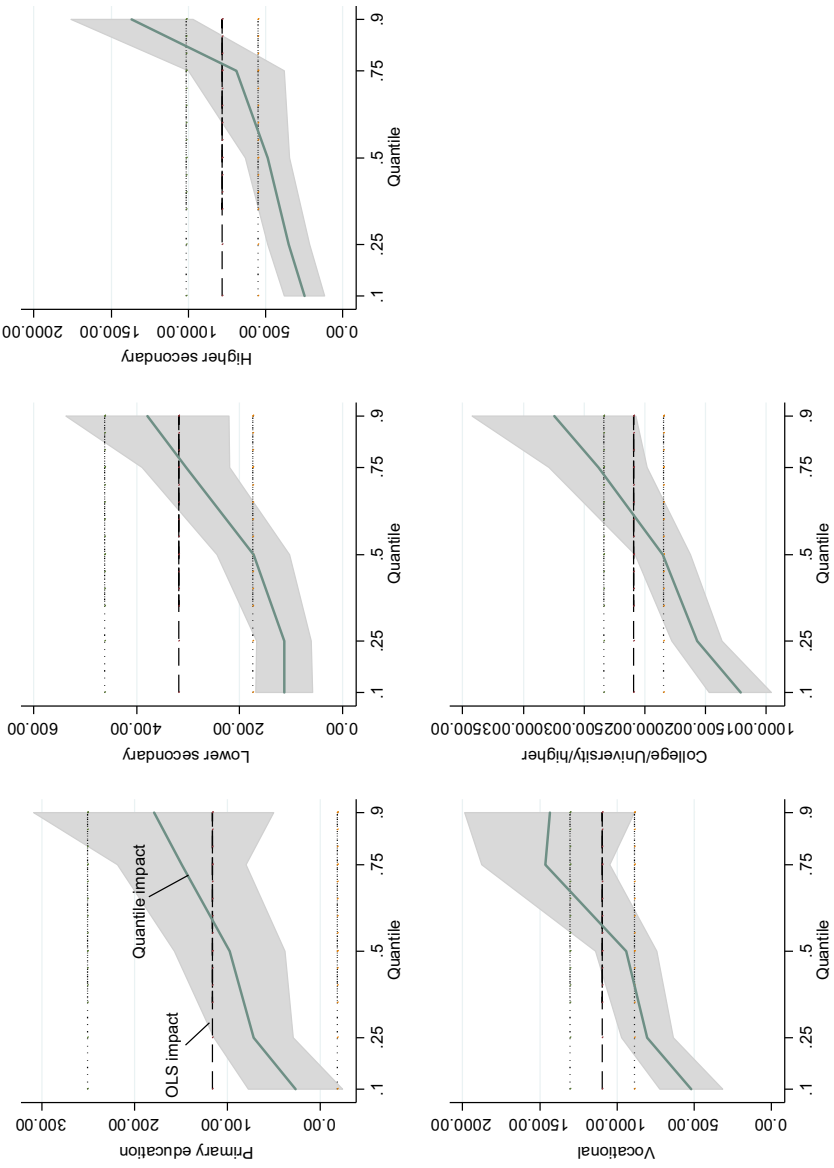

Fig. 6 Heterogeneous impacts of the highest qualification on income across percentiles. *Note* "Appendix 2" shows the varying effects of the highest qualification on per capita income across different points in the distribution of income and also indicates that the effect is greater for better-off households. No education is the reference group. *Sources*: Authors' calculation from the 2016 VHLSS

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