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The Role of Nonagricultural Income in Poverty Alleviation in Rural Vietnam

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Abstract

This study uses the 2018 Vietnam Household Living Standard Survey census dataset and a combination of binary logistic regressions and Blinder–Oaxaca decomposition to elucidate the role of nonagricultural income on poverty alleviation in rural Vietnam. The results demonstrate a strong positive effect of nonagricultural income on the probability of being a nonpoor household. Specifically, the probability of poor households with nonagricultural income being nonpoor is significantly higher than that of poor households without nonagricultural income. The direct and indirect effects of nonagricultural income (95.7%) primarily contribute to this difference. Nonagricultural income significantly increases the probability of being a nonpoor household among households with many members, a female householder, a Kinh ethnic householder, a young householder, households receiving a subsistence allowance, and those participating in social groups. These findings offer compelling evidence for integrating the nonagricultural economy into rural poverty reduction strategies, which have traditionally predominantly relied on bolstering the agricultural economy.

Keywords: households, nonagricultural income, rural, poverty alleviation, Vietnam.

1. Introduction

Poverty alleviation is consistently a crucial objective for many nations to reach the goals of equality and prosperity, including Vietnam (Canare, 2020; Devkota et al., 2021; Eyasu, 2020; Imai et al., 2008; Lanjouw, 2001; Lanjouw & Murgai, 2009). To reach these objectives, since 1993, the Vietnamese government has promulgated multiple poverty alleviation strategies, such as poverty credit, health care, education, and employment support for the poor (Work Bank, 2022). These initiatives allowed the country to achieve the millennium target of poverty reduction ten years ahead of schedule; however, a considerable portion of the population still lives in economically vulnerable conditions. The World Bank (2022) reported that one in five Vietnamese people lives below the economic security line of $5.5 per day, and one in ten people is vulnerable to slipping beneath the poverty line due to a shock, such as illness or bad weather, particularly in rural areas. A total of 62.9% of Vietnam's population lives in rural areas, and the majority of them rely on agricultural livelihood. Most of the country's poor population (86.4%) lives in rural areas. These figures indicate that poverty alleviation remains an essential concern for Vietnam, which aspires to conquer the country's upper-middle and high-income aspirations within the next two decades.

For decades, Vietnam has shared a common perspective that rural areas have inherent natural resources and are conducive to agricultural production; thus, policymakers have endeavored to alleviate rural poverty by focusing on enhancing agricultural productivity (Barai, 2009; Christiaensen et al., 2006; Escobal, 2001; Koo, 2007). In the contemporary context, agriculture can no longer serve as the predominant component for reducing rural poverty since urbanization and rising population cause rural Vietnamese households to have increasingly less land area for farming (Hoang et al., 2014; Satterthwaite et al.,

2010; Yoshida, 2020). Furthermore, small households, including the poor, find it challenging to improve agricultural incomes due to the disastrous impacts of climate change (De Salvo et al., 2013; Mendelsohn, 2009) and the fierce competition in the agricultural market and rising agricultural input prices (Hemming et al., 2018; McArthur & McCord, 2017; Verschelde et al., 2013). Consequently, rural poverty alleviation initiatives based on nonagricultural income sources are gradually emerging (World Bank, 2016, 2019). In addition, research on nonagricultural activities and rural poverty has been receiving increased attention.

However, research on this topic still has many gaps that require further attention. For instance, using a census dataset in Pakistan, Arif et al. (2000) demonstrated the role of nonagricultural income in reducing poverty among rural households, determining that the nonpoor proportion of households with nonagricultural income is double that of households without nonagricultural income at 66.4% and 33.6%, respectively. Ferreira and Lanjouw (2001) also analyzed a census dataset to examine the relationship between nonagricultural activities and poverty in rural households in Brazil. The authors found that nonagricultural employment accounts for 21.8% and 31.7% of rural employment in the northeast and southeast regions, respectively, and that 30.7% of the poor's income is obtained from activities outside of agriculture. Nevertheless, these studies are not convincing enough to affirm the relationship between nonagricultural economy and rural poverty alleviation since many underlying factors influence poverty and more rigorous estimations are needed. Start (2001) argued that the impact of the nonagricultural economy on rural poverty largely varies with the costs and specialization of nonagricultural activities. Haggblade et al. (2010) asserted that nonagricultural employment has the potential to help rural households escape from poverty, but it does not work automatically without

supportive policies. Limited studies on the impact of the nonagricultural economy on poverty reduction in rural Vietnam have also been conducted. Notably, Hoang et al. (2014) used a census dataset and applied a probit model to examine the impact of nonagricultural employment on the probability of rural households' poverty. A common characteristic shared by such studies is that the researchers were unable to directly observe transitions from poverty to nonpoverty within the same household, as the sample encompassed both poor and nonpoor households at the time of data collection. Therefore, the findings tend to reveal an association between nonagricultural activities and poverty incidence rather than explain the role of nonagricultural activities in alleviating poverty. In addition, the findings only reveal the relationship between nonagricultural activity and poverty without further analysis to understand the differences in its effects across different household groups.

This study contributes to research on the role of the nonagricultural economy in reducing poverty for rural households in Vietnam. We choose nonagricultural income and status as a nonpoor household as proxies for nonagricultural economy and rural poverty alleviation. First, our study uses a 2018 census dataset, examining rural households that were classified as poor in 2017 to capture transitions from poor to nonpoor in 2018.[1] In so doing, we mitigate reverse causality[2] to elucidate the role of nonagricultural income in rural poverty alleviation more accurately, rather than the association between nonagricultural income and poverty. Compared with Hoang et al. (2014), who examined a similar topic in Vietnam, our study uses the sample from 2018, when Vietnam adopted a multidimensional poverty line, which included more criteria.[3]

[1] The census dataset contains information on households' poor and nonpoor status over a five-year period.
[2] The reverse causality referenced is that the nonpoor households are more likely to have more capital to participate in nonagricultural activities.
[3] Since 2016, Vietnam has applied multidimensional poverty lines, including primary criteria of income, employment, health care, education, housing, drinking water and sanitation, and information.

Instead of using nonagricultural employment, we use a nonagricultural income proxy that can elucidate the role of nonagricultural economy in poverty alleviation more accurately. In addition to the advantage of using a continuous form of nonagricultural income in the estimation model, rural households can engage in various nonagricultural activities to generate income, which was explicitly included in the survey data. Nonagricultural income data solely captures stable employment and neglects the prevalence of short-term jobs that last for only a few days or weeks, which are popular among poor rural households but are often excluded from survey data. Second, we apply a series of logit regression models to elucidate the general impact of nonagricultural income on poverty alleviation and the different effects across different household groups. Third, we use the Blinder–Oaxaca decomposition (Blinder, 1973; Oaxaca, 1973) to understand the effect of nonagricultural income on poverty alleviation more in-depth. Specifically, using hypothetical estimates from the decomposition, we are able to predict the probability of households without nonagricultural income being nonpoor if they had the opportunity to earn a nonagricultural income. This result reinforces the estimation of the effect of nonagricultural income from the regression models. Decomposing the difference in the probability of being a nonpoor household among households with nonagricultural income and those without nonagricultural income into endowment and residual effects allows us to observe the relationship of households' characteristics and nonagricultural income to the probability of being nonpoor.

In summary, our study provides strong evidence of the positive effect of nonagricultural income on the probability of being a nonpoor household. This is compelling evidence for integrating the nonagricultural economy in rural poverty reduction strategies, which have predominantly relied on agrarian economy approaches. Our study reveals that without nonagricultural income, the

probability of households with many members, a female householder, a Kinh ethnic householder, a young householder, households receiving a subsistence allowance, and those participating in social groups with nonagricultural income being nonpoor is lower than those with a male householder or few members. These findings suggest that policymakers should prioritize the distribution of nonagricultural income to women, households with larger family sizes, and young households. Such targeted allocation could advance households' path out of poverty. Subsistence allowance for poor households should be accompanied by additional opportunities for nonagricultural income generation. Engaging poor households in local social organizations is another solution that can help poor rural households escape poverty. In contrast, the findings also indicate that ethnic minority households and households with a householder at retirement age encounter persistent challenges in overcoming poverty; thus, it is also crucial to implement targeted policies that are specifically tailored to address the poverty circumstances of these vulnerable groups.

The remainder of this paper is constructed as follows. Section 2 presents the study's methodology, Section 3 describes the empirical results, and Section 4 summarizes the findings, limitations, and implications of the study.

2. Methodology

2.1 Data Collection

The study data are obtained from the census dataset known as the Vietnam Household Living Standard Survey (VHLSS) 2018, which is conducted by Vietnam's General Statistics Office, with technical assistance from the World Bank and funding from the United Nations Development Program. Although the dataset is comprehensively and methodologically sound, each wave's sample

selection is random, meaning that the same observations are not consistent across surveys, which is a notable disadvantage of using such data in evaluating the causal effect that previous researchers have also recognized (Hoang et al., 2014; Vu & Ho, 2021). We overcome this disadvantage by selecting households classified as poor in 2017, one year prior to the survey. To do so, we construct a sample of households reporting the same poverty status in the previous year, which enables us to effectively examine the effect of our independent variables on the probability of poverty. Since households are asked to provide information on demographics, income, aid, and other relevant details over the past 12 months, which serve as the independent variables in the study's models, the causality if the independent variable appears significantly correlated. The VHLSS 2018 census dataset contains over 46,000 households, more than two-thirds of which are rural residents, corresponding to the ratio of the rural and urban populations in Vietnam. In the dataset, 4,142 rural households were classified as poor in 2017. After excluding responses with missing data, we obtained a sample of 4,119 households for analysis.

2.2 The Role of Nonagricultural Income in Alleviating Poverty

The study elucidates the role of nonagricultural income in alleviating poverty among rural households using the binary logit model and decomposition technique that includes two steps.

In *step 1*, we conduct a series of binary logistic regressions to examine the impact of nonagricultural income and other factors (control variables) on the probability of being a nonpoor household, which is the proxy for poverty alleviation. We perform five binary logit models using the same dependent variable and control variables. Model 1 is conducted on the sample of households with nonagricultural income, allowing us to examine the impact of the control

variables on the probability of being a nonpoor household for households with nonagricultural income. Model 2 is conducted on the sample of households without nonagricultural income, which allows us to examine the impact of the control variables on the probability of being a nonpoor household for those lacking nonagricultural income. In addition to serving the decomposition technique, the estimation results of Models 1 and 2 are also used to analyze the differences in the probability of being a nonpoor household across various types of households, including the presence and absence of nonagricultural income. The remaining three models are conducted on the entire sample of households with and without nonagricultural income. Model 3 only introduces the control variables. Model 4 introduces control variables and the nonagricultural income variable. In addition to facilitating the decomposition technique, we perform Model 3 to compare the resulting estimations with those of Model 4. This comparative analysis allows us to assess whether including the nonagricultural income variable significantly alters the impact of the control variables, indicating the presence of potential multicollinearity resulting from correlations between nonagricultural income and the control variables. Model 5 introduces control variables, the nonagricultural income variable, and interactive variables between the nonagricultural income and each control variable, which are calculated by multiplying each control variable with the nonagricultural income variable. The estimated coefficients of the interactive variables in Model 5 reveal the different impacts of the control variables on the probability of being a nonpoor household between households with nonagricultural income and those without nonagricultural income. The common equation of the binary logit models is as follows:

$$Log\left(\frac{Prob\ (y=1)}{Prob\ (y=0)}\right) = \sum_{k=1}^{K} \beta_k\, X_k \quad (1)$$

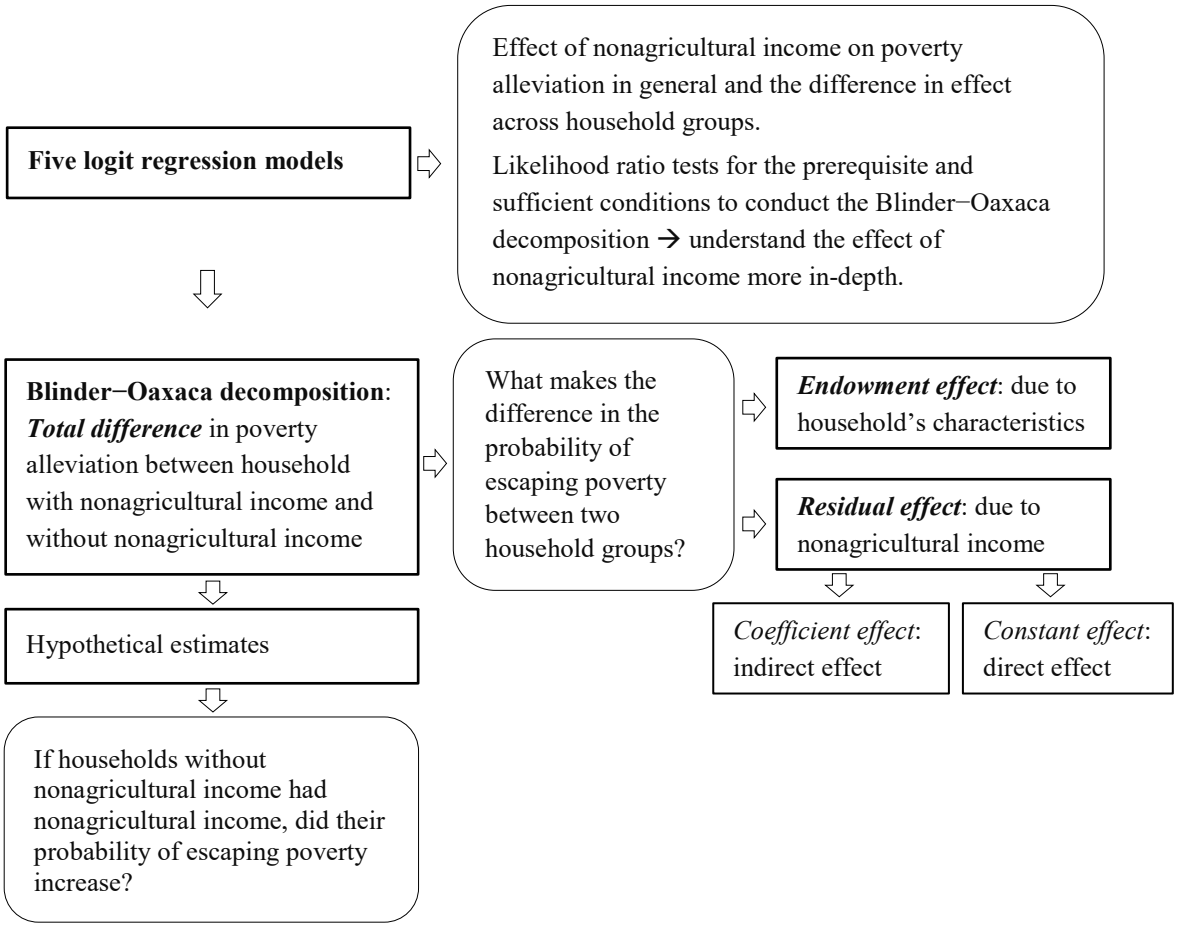
where *y*: nonpoor household (=1), otherwise (=0)*; X*: n × k independent variable matrix; and *β: k* × 1 parameters vector.

In *step 2*, we apply the Blinder–Oaxaca decomposition to elucidate the net impact of nonagricultural income on the probability of being a nonpoor household, including indirect and direct effects. Decomposition methods were first applied in labor economics, represented by two independent works of Blinder (1973) and Oaxaca (1973), to explain wage disparities between naturally distinct groups such as men and women, immigrants and indigenous populations, and black and white employees. This method has been refined and applied in a variety of economic fields; for instance, Jackson and Lindley (1989) applied it to wage discrimination, Baye (2006) examined the causes of inequality and poverty, Nguyen et al. (2007) explored urban–rural income inequality, and Huong et al. (2018) investigated changes in the consumption of macronutrients. More recently, some researchers have also applied the method to evaluate the effectiveness of policy interventions (Choi et al., 2020; Hwang & Lee, 2015; Hwang et al., 2018).

The Blinder–Oaxaca decomposition method facilitates a comprehensive analysis of the target factor's effect by disaggregating the variables' effects from the regression model. For example, Ault et al. (1991) examined the causal relationship between smoking and absenteeism using a series of tobit regressions and the Blinder–Oaxaca decomposition technique, determining that although the rate of work absences was higher among smokers than non-smokers, the analysis of the endowment and residual effects indicated that smoking was not the determinant of work absence, as the residual effects were statistically insignificant. The determinants of absenteeism were attributed to endowment effects encompassing variables such as age, gender, overtime work, occupations,

and other considerations. Similarly, in their study on the impact of a rural tourism program on nonagricultural income, Hwang and Lee (2015) found that participation in the program increased the probability of households having nonagricultural income. Through a decomposition of the contributions to the increase in nonagricultural income from the endowment effect (accounting for −7.39%) and the residual effect (accounting for 107.39%), the authors concluded that, in the absence of program participation, characteristics, including age, gender, household size, and other details, decreased the probability of households having a nonagricultural income. Conversely, constant and coefficient residual effects were the primary factors leading to an increase in the probability of households having nonagricultural income.

Figure 1. Research framework



Ault et al. (1991) suggested that prerequisite and sufficient conditions for conducting the Blinder–Oaxaca decomposition and elucidating the impact of target factors for the maximum likelihood estimations ensures balanced variances in the underlying model for considering the significance of residual, coefficient, and constant effects. If an effect is insignificant, it should not be used to explain the overall outcome. These tasks are conducted with a set of likelihood ratio tests and an asymptotic *t* test, based on the regression results from the five models introduced above.

The test to confirm the balanced variances of the underlying model (T_1) is the premise for adapting the traditional decomposition to the logit model. The rejection of the null hypothesis of the variances of the underlying model ($\sigma_1^2 = \sigma_0^2$) is compulsory prior to conducting subsequent tests. This test is constructed as follows:

$$T_1 = 2(L_5 - (L_1 + L_2)) \sim \chi^2(1) \quad (2)$$

The test for residual effect (T_2) is the sufficient condition for the logit version of the residual difference. The rejection of the null hypothesis implies that nonagricultural income significantly impacts the probability of being a nonpoor household indirectly and directly. This test can be conducted through the likelihood ratio statistic as follows:

$$T_2 = 2(L_3 - (L_1 + L_2)) \sim \chi^2(K + 1) \quad (3)$$

The two remaining tests identify whether the residual effect is direct or indirect.

The test for coefficient effect (T_3) is conducted by using the joint significance of the likelihood ratio statistic. The rejection of the null hypothesis implies a significant effect of nonagricultural income on the probability of being a nonpoor household. This test is conducted as follows:

$$T_3 = 2(L_4 - (L_1 + L_2)) \sim \chi^2(K) \quad (4)$$

The test for constant effect (T_4) is an asymptotic *t* test that measures the statistical significance of the coefficient on the nonagricultural income group dummy in Model 5. If the coefficient is statistically significant, it implies a significant effect of nonagricultural income on the probability of being a nonpoor household. Ault et al. (1991) suggested that even when this coefficient is insignificant, the significance of the individual coefficient of the interactive variables can be tested in the model. Unless the coefficient of the nonagricultural income group dummy and all interactive variables is insignificant, the direct effect of nonagricultural income on the probability of being a nonpoor household does not exist.

To employ the decomposition technique, Equation (1) is divided into the following two equations:

$$E(Y_1) = \sum_{k=1}^{K} \beta_k^1 \overline{X}_k^1 \quad (5)$$

$$E(Y_0) = \sum_{k=1}^{K} \beta_k^0 \overline{X}_k^0 \quad (6)$$

In the decomposition process, Equation (5) is for the sample of households with nonagricultural income, and Equation (6) is for the sample of households without nonagricultural income.

The decomposition process constructs a hypothetical mean rate of being a nonpoor household ($\overline{Y}_h$) for the average household with nonagricultural income if their nonpoor status responded to the changes in its determinants in a manner and magnitude identical to that of a household with nonagricultural income. This value is constructed by multiplying the coefficients of households with nonagricultural income by the mean characteristics of the household without nonagricultural income to obtain Equation .

$$E(Y_h) = \sum_{k=1}^{K} \beta_k^1 \overline{X}_k^0 \tag{7}$$

The estimation of the impact of nonagricultural income on the probability of being a nonpoor household is mathematically decomposed as follows:

$$\begin{aligned} E(Y_1) - E(Y_0) &= E(Y_1) - E(Y_h) + E(Y_h) - E(Y_0) \\ &= \left(\sum_{k=1}^{K} \beta_k^1 \overline{X}_k^1 - \sum_{k=1}^{K} \beta_k^1 \overline{X}_k^0\right) + \left(\sum_{k=1}^{K} \beta_k^1 \overline{X}_k^0 - \sum_{k=1}^{K} \beta_k^0 \overline{X}_k^0\right) \\ &= \sum_{k=1}^{K} \beta_k^1 \left(\overline{X}_k^1 - \overline{X}_k^0\right) + \sum_{k=1}^{K} \overline{X}_k^0 (\beta_k^1 - \beta_k^0) \\ &= \underbrace{\sum_{k=1}^{K} \beta_k^1 \left(\overline{X}_k^1 - \overline{X}_k^0\right)}_{\text{Endowment effect}} + \underbrace{\underbrace{(\beta_1^1 - \beta_1^0)}_{\textit{Constant effect}} + \underbrace{\sum_{k=2}^{K} \overline{X}_k^0 (\beta_k^1 - \beta_k^0)}_{\textit{Coefficient effect}}}_{\text{Residual effect}} \end{aligned} \tag{8}$$

where the left-hand side of the equation represents the total difference in the mean probability of being a nonpoor household between households with and without nonagricultural income. The first term of the right-hand side is called the endowment effect, which is caused by the differences in the mean characteristics between the two groups. The right-hand side denotes the net impact of nonagricultural income, which is called a residual effect. The residual effect includes constant and coefficient effects, as shown in Equation (8). The constant effect represents the direct impact of nonagricultural income on the probability of being a nonpoor household. The coefficient effect represents the indirect effect of nonagricultural income.

2.3 Variable descriptions

The selection of potential determinants of the probability of being a nonpoor household is based on previous research and available census data. The dependent variable is nonpoor household status, which is classified annually by

the local government.[4] Since this study endeavors to examine the role of nonagricultural income on poverty alleviation, we value the status of being a nonpoor household as 1 and 0 otherwise. Independent variables are divided into two groups, including the target variable (nonagricultural income) and control determinants.

The relationship between nonagricultural income and poverty reduction is determined through several mechanisms. Nonagricultural income offers rural households an additional income source beyond traditional agricultural activities (Haggblade et al., 2005). As poor households often have little or no arable land from which to generate agricultural income, leading to a surplus of labor, nonagricultural activities function as a means to help households escape poverty (Hoang et al., 2014). In addition, nonagricultural activities diversify income sources, acting as a form of self-insurance against adverse events such as crop loss (Danso-Abbeam et al., 2020; Ferreira & Lanjouw, 2001). Nonagricultural income also helps poor households overcome credit constraints for adopting new farming technology, which consequently improves agricultural productivity (Danso-Abbeam et al., 2020; Oseni & Winters, 2009). Empirical evidence has also demonstrated that nonagricultural income positively affects food security, and increased income has a positive relationship with health and education (Rahman & Mishra, 2020). Therefore, nonagricultural income appears to reduce poverty by lowering livelihood risks, absorbing surplus labor, increasing labor productivity, and raising household income, which affects food security,

[4] The classification of poor households is based on Decision 59/2015/QD-TTg of the Prime Minister of Vietnam, including primary criteria of income, employment, health care, education, housing, drinking water and sanitation, and information. The classification of poor households is accomplished by the local authorities after conducting an annual household survey. The questionnaire includes substantial information reflecting the above basic criteria, which is then converted into a specific score. A household is classified as poor when they have a total score at the threshold specified by the national standard. The results of the classification of poor households and subsequent policy beneficiaries are often announced in community meetings.

education, and health (Ettner, 1996; Rahman & Mishra, 2020; White et al., 2015). In this study, we use the continuous form of nonagricultural income in Model 4 to elucidate its impact on the probability of being a nonpoor household in general. We also use a binary form in Model 5 to conduct the test for the balanced variances of the underlying model (T_1) to apply the Blinder–Oaxaca decomposition to the logit version suggested by Ault et al. (1991).

The control variables are divided into demographic characteristics and socioeconomic activities. The *demographic characteristics* focus on the householder's characteristics since the head of a household is often responsible for making crucial decisions regarding household life in addition to being the primary breadwinner. First, householders' age often reflects life experience and health status for employment, which can affect poverty status (Ba et al., 2021; Bogale et al., 2005; Pattayat et al., 2022; Shete, 2010). Second, regarding householder's gender, previous research has revealed that male householders are frequently less likely to slip into poverty than females (Ba et al., 2021; Bogale et al., 2005; Pattayat et al., 2022; Shete, 2010). Third, due to barriers of language, culture, and customs, minority groups are more vulnerable (Nguyen et al., 2023) and slip into a poor status more often than majority groups (Dang, 2012; Imai et al., 2008; Tuyen, 2015). Fourth, household size refers to the number of family members. While some previous research has reported that household size reflects human resources for generating income (Wang et al., 2020) that can save the household from poverty, others have argued that households with many dependent members reflect a greater burden and likelihood of unemployment (Ba et al., 2021; Hassan & Babu, 1991; Shete, 2010) that lead to poverty. Fifth, regarding householder education, a positive correlation has been demonstrated between education and poverty reduction in several previous studies (Hassan & Babu, 1991; Shete, 2010; Wang et al., 2020).

Socioeconomic characteristics. Sixth, a social group member is a household that participates in local social associations such as farmers', women's, and veterans' associations. By participating in such associations, a household can connect to social networks and receive aid that may avoid poverty status (Pattayat et al., 2022; Pham & Mukhopadhaya, 2022). Seventh, information access refers to a household's capability to access information on policies, farming, business, and markets from mass media. Households' access to policy information allows them to obtain benefits for livelihood activities (Choi et al., 2020; Wang et al., 2020) and escape poverty. Eighth, the role of agricultural activities in reducing poverty in rural areas has been extensively documented in previous studies (Bogale et al., 2005; Christiaensen et al., 2006; Dewbre et al., 2011; Lanjouw & Murgai, 2009; Wang et al., 2020). Ninth, in this study, credit access refers to a household receiving preferential credit for the poor from government programs. Empirical evidence has illustrated the positive effect of credit access on reducing poverty in rural areas (Do & Bauer, 2016). The remaining three variables represent the main aid programs for the poor in Vietnam that aim to keep households from poverty. Tenth, farming material aid refers to government or nongovernment organizations providing aid packages such as seeds, livestock, feed, and fertilizer to facilitate the escape from poverty via agricultural production. Eleventh, housing aid refers to nonrefundable housing aid for the poor. Finally, a subsistence allowance is a monthly financial benefit from the government that is allocated to poor households.

To address the endogenous bias of the target-independent variable of nonagricultural income, which arises from its correlation with the error term, we conducted a comprehensive review of the existing literature to identify the factors that influence nonagricultural income. This review indicates that household demographic and economic characteristics primarily drive variations in

nonagricultural income. Specifically, empirical evidence has demonstrated a statistically significant association between nonagricultural income and householders' demographic characteristics, such as gender (Berdegué et al., 2001; De Janvry & Sadoulet, 2001; Lanjouw, 2001; Senadza, 2012), age (Agyeman et al., 2014; Berdegué et al., 2001; Canagarajah et al., 2001; Senadza, 2012), ethnicity (De Janvry & Sadoulet, 2001), education (Corral & Reardon, 2001; Escobal, 2001; Lanjouw, 2001; Malek & Usami, 2009), and household size (Hwang & Lee, 2015; Yúnez-Naude & Taylor, 2001), in addition to economic characteristics such as landholdings, agricultural income (Hwang & Lee, 2015; Yúnez-Naude & Taylor, 2001), and credit access (Ruben, 2001; Senadza, 2012). Notably, the factors of market access and public resources are also found to be correlated with poverty (Eyasu, 2020; Okwi et al., 2007) and nonagricultural income (Canagarajah et al., 2001; Senadza, 2012); however, we are unable to engage them in the study's model due to the unavailability of data for determining the variables of market access and public resources, although our comprehensive literature review on the factors influencing nonagricultural income indicated that these factors also influence household poverty, and we incorporate them as control variables in our model.

Our extensive review of empirical studies does not yield evidence supporting the existence of a significant determinant of nonagricultural income that operates independently of its impact on household poverty. Consequently, it is highly improbable to establish a substantial relationship between the target variable and the error term in Model 4. To confirm the exogeneity of the nonagricultural income variable, we employ an instrumental variable probit regression with the assumption that nonagricultural income is an endogenous variable and the variables of households' demographic and economic characteristics as instrumental variables to conduct the Wald test of endogeneity.

The results indicate the absence of endogenous variables in the model, suggesting exogeneity for nonagricultural income. However, a potential concern arises regarding severe multicollinearity due to the correlation between the target and control variables; therefore, we perform a regression that includes only the control variables (Model 3) to compare the model's result with nonagricultural income (Model 4) and determine whether the presence of the nonagricultural variable seriously influences the effect of control variables. We also use the variance inflation factor (VIF) to assess multicollinearity in Model 4. A detailed description of the VIF analysis is subsequently provided.

Table 1 compares the means of variables between households with nonagricultural income versus those without nonagricultural income to examine whether a significant difference exists between the two groups. Generally, variables' means differ significantly between the two groups except for gender, housing aid, and subsistence allowance, indicating that traditional statistical analyses (i.e., the *t* test or a single regression model alone) would be ineffective in elucidating the effect of nonagricultural income on alleviating poverty since the control variables between two groups differ. Combining a series of binary logistic regression and Blinder–Oaxaca decomposition is a convenient way to quantify the separate contributions of group differences in terms of observed characteristics that can explain the effect of nonagricultural income on poverty alleviation more explicitly.

Table 1. Comparison of the mean values of independent variables between the households with and without nonagricultural income

Variables	Description	Nonagricultural income		t−test
		Yes	No	
Dependent				
Nonpoor household	Classified as a poor household in 2018: being a nonpoor household (=1) or otherwise (=0)	0.16	0.09	6.44***
Independent				
Gender	Gender of householder: male (=1) or female (=0)	0.73	0.71	1.12
Retirement age	Householder's age is in retirement age: yes (=1) and no (=0)	0.21	0.37	−10.91***
Ethnicity	Householder's ethnicity: Kinh (majority ethnic group = 1) or minority (=0)	0.41	0.33	5.58***
Household size	The number of household members: person	4.16	3.73	6.90***
Education	The education years of the householder No degree = 0 Primary school = 5 Secondary school = 9 High school = 12 Intermediate = 14 Bachelor (3 years) = 15 Bachelor (4 years) = 16	3.85	3.05	6.52***
Social member	Member of local social associations: yes (=1) or no (=0)	0.46	0.50	−2.39***
Information access	Access the information relates to business or policies from mass media: yes (=1) or no (=0)	0.55	0.42	8.12***
Cropland per person	Cropland area per person: ha per person	0.18	0.31	−5.45***
Agricultural income	Household has agricultural income: million VND	3.60	5.50	−12.87***
Credit access	Access credit: yes(=1) or no (=0)	0.07	0.04	5.12***

Variables	Description	Nonagricultural income		t−test
		Yes	No	
Farming aid	Receive farming materials (seed, fertilizer,…): yes (=1) or no (=0)	0.11	0.21	−8.30***
Housing aid	Receive house for the poor: yes (=1) or no (=0)	0.02	0.01	0.48
Subsistence allowances	Receive monthly subsistence allowances: yes (=1) or no (=0)	0.13	0.13	0.21

Note: *p < 0.1, **p < 0.05, ***p < 0.01.

3. Empirical results

3.1 The effect of nonagricultural income and its interaction

Table 2 presents the regression results on the impact of control variables (households' demographic and socioeconomic characteristics) and the nonagricultural income variable on the probability of being a nonpoor household for the households examined. Model 3 presents the impact of the factors of households' demographic and socioeconomic characteristics, and Model 4 presents the impact of such factors and the nonagricultural income variable. The regression results demonstrate that the control variables in both models appear similar in terms of the sign and order of coefficient magnitude in Models 3 and 4. This result indicates that the inclusion of the nonagricultural income variable in Model 4 does not significantly influence the effect of the control variables. This finding suggests that the nonagricultural income variable does not introduce a serious multicollinearity issue. To further investigate the presence of multicollinearity, we assess all variables' VIF values. The result demonstrates that all VIF values are below 2 (see Appendix Table A.2), indicating that including the nonagricultural income variable does not lead to biased results due to serious multicollinearity. The most notable point in Model 4 is that the nonagricultural income variable has a strong and significant correlation with the

probability of being a nonpoor household, suggesting that nonagricultural income is a significant determinant of rural households' poverty alleviation. The question is how the influence of nonagricultural income is presented in households with different demographic and socioeconomic characteristics. The answer will have crucial implications for reducing rural households' poverty through the effective combination of nonagricultural income with households' characteristics.

Notably, the significance of many of the control variables between Models 1 and 2 is the opposite. When examining separate samples of households with and without nonagricultural income, the impact of control variables on the dependent variable differs. This result highlights the substantial influence of nonagricultural income on the probability of being a nonpoor household. Specifically, first, householders' gender has an insignificant impact on the probability of being a nonpoor household in the regression results of the pooled samples (Models 3 and 4); however, it has a significantly positive impact in Model 2 and an insignificantly negative impact in Model 1. This implies that without nonagricultural income (Model 2), the probability of being a nonpoor household for male householders is significantly higher than that of female householders. The regression result in Model 5 shows a significantly negative impact of its interactive variable, implying that the effect of female householders' nonagricultural income on the probability of being nonpoor is more significant than that of a male householder. In other words, nonagricultural income reduces the difference in the probability of being a nonpoor household between male and female householders. The rationale for this change is likely that nonagricultural income reduces the probability of being nonpoor for male householders but increases for female householders, or nonagricultural income boosts the probability of female householders being nonpoor more than that of male

householders. Observing the strong positive impact of the nonagricultural income variable in Model 4 and the descriptive analysis (see Table A.1, which demonstrates that the probability of being a nonpoor household for groups with nonagricultural income is higher than for those without nonagricultural income), we conclude that nonagricultural income allows female householders to access the same opportunities to be nonpoor households as male householders. Similar to householders' gender, the remaining variables are interpreted based on the regression results and the descriptive analysis (see Table A.1).

Second, while retaining the significance in Model 1, the retirement age variable loses significance in Model 2, signifying that without nonagricultural income, the probability of householders being nonpoor in retirement age differs insignificantly from that of younger householders. In other words, nonagricultural income helps younger householders escape poverty more effectively. Third, the ethnicity variable remains significant in Model 1 but loses power in Model 2, implying that without nonagricultural income, the difference in the probability of being a nonpoor household of Kinh ethnic householders and minority households is insignificant. The presence of nonagricultural income helps Kinh households become nonpoor more effectively. Fourth, household size has a significance and negative coefficient in Model 2 but not in Model 1, and its interactive variable in Model 5 is significantly positive. This result implies that without nonagricultural income, the more members the household has, the lower the probability of being a nonpoor household, whereas nonagricultural income helps households with many members become nonpoor. Fifth, although participating in local social associations does not improve the probability of being a nonpoor household for those without nonagricultural income (Model 2), it is shown to help the group with nonagricultural income to improve poverty. Sixth, agricultural income consistently demonstrates a positive and significant effect in

all models, indicating that agricultural income still has a significant influence on rural poverty alleviation. Finally, the subsistence allowance variable retains a negative coefficient in both models but drops its magnitude in Model 1, and its interactive variable switches to a positive coefficient in Model 5, signifying that if poor households receive subsistence allowance and have nonagricultural income, they can escape from poverty more expediently than those receiving subsistence allowances only without nonagricultural income.

Table 2. Series of binary logistic regressions on the probability of being a nonpoor household

Dependent variables	Model 1	Model 2	Model 3	Model 4	Model 5
	Nonagricultural income	Without nonagricultural income	Pooled group	Pooled group with nonagricultural income	Pooled group with interaction
Constant	**−2.002*** **	**−2.280*** **	**−2.180*** **	**−2.456*** **	**−2.280*** **
Demographic characteristics					
Gender (male)	−0.069	**0.428** **	0.049	0.074	0.428**
Retirement age	**−0.323** **	−0.172	**−0.419*** **	**−0.254** **	−0.172
Ethnicity (Kinh)	**0.472*** **	0.122	**0.481*** **	**0.304** **	0.122
Household size	−0.018	**−0.206*** **	−0.049	−0.048	−0.206***
Education	0.023	0.033	**0.031** **	**0.025** **	0.033
Socioeconomic characteristics					
Social member	**0.289** **	0.175	**0.231** **	**0.285*** **	0.175
Information access	−0.024	0.038	0.060	0.030	0.038
Cropland per person	−0.261	−0.161	−0.232	−0.200	−0.161
Agricultural income	**0.051*** **	**0.053*** **	**0.044*** **	**0.055*** **	**0.053*** **
Credit access	−0.243	0.016	−0.075	−0.076	0.016
Farming aid	−0.147	−0.008	−0.178	−0.118	−0.008
Housing aid	0.104	0.687	0.324	0.276	0.687
Subsistence allowance	**−0.444** **	**−1.440*** **	**−0.649*** **	**−0.622*** **	**−1.440*** **
Nonagricultural income				**0.033*** **	0.278

Interactive					
Nonagricultural income × Gender					**−0.497****
Nonagricultural income × Age					−0.151
Nonagricultural income × Ethnicity					0.351
Nonagricultural income × Household size					**0.188****
Nonagricultural income × Education					−0.010
Nonagricultural income × Social member					0.114
Nonagricultural income × Information access					−0.062
Nonagricultural income × Cropland per person					−0.100
Nonagricultural income × Agricultural income					−0.002
Nonagricultural income × Credit access					−0.258
Nonagricultural income × Farming aid					−0.139
Nonagricultural income × Housing aid					−0.583
Nonagricultural income × Subsistence allowance					**0.995****
n	2,352	1,767	4,119	4,119	4,119
−2 Log likelihood	1986 *(L_1)*	1012 *(L_2)*	3053 *(L_3)*	3011 *(L_4)*	2998 *(L_5)*
Cox & Snell R square	0.023	0.037	0.025	0.035	0.038
Nagelkerke R square	0.039	0.081	0.047	0.066	0.071
Overall percentage	84.4	90.8	87.1	87.2	87.0

Note: *p < 0.1, **p < 0.05, ***p < 0.01

The regression results elucidate the significant impact of nonagricultural income and its interactive variables on the probability of being a nonpoor household. Could households without nonagricultural income improve the probability of nonpoor if they had nonagricultural income? What makes the difference in the probability of being a nonpoor household between two household groups? The answers to these questions are elucidated using the Blinder–Oaxaca decomposition, which reveals the endowment and residual effect of nonagricultural income on the probability of being a nonpoor household.

3.2 Decomposition of the effect of nonagricultural income

To legitimize the application of the decomposition technique, as noted previously, a series of likelihood ratio tests are conducted. Table 3 reveals that the null hypothesis of the balanced variances of the underlying models ($\sigma_1^2 = \sigma_0^2$) cannot be rejected; thus, the prerequisite of the decomposition procedure is satisfied. Notably, the null hypothesis of residual effect is rejected, confirming a significant impact of nonagricultural income on the probability of being a nonpoor household. The remaining two tests track coefficient (indirect) and constant (direct) effects. The test results reject the null hypothesis of the coefficient effect at a 5% significance level. Although the null hypothesis of the nonagricultural income variable in Model 5 is not rejected, three of its interactive variables are significant, implying that the constant effect is significant. Such likelihood ratio tests enable us to apply the decomposition procedure to examine the role of nonagricultural income on the probability of being a nonpoor household in the logit version.

Table 3. Testing hypothesis for the decomposition method

Hypothesis		Test statistics	DF	$\chi^2_{0.05}$	
T_1	$\sigma_1^2 = \sigma_0^2$	0	1	3.84	Not reject
T_2	There is no residual effect	112	14	23.58	Reject
T_3	There is no coefficient effect	27	13	22.36	Reject
T_4	There is no constant effect				Reject*

Note: * There are three interactive variables of the nonagricultural income variable that are significant at 1%, 5%, and 10%

Table 4 reveals that the observed mean of the probability of being a nonpoor household in the group with nonagricultural income is much greater than that of the group without nonagricultural income. The observed difference in the probability of being a nonpoor household between the two groups is 7%, and the estimated difference is 6.5%. Of the estimated differences, the endowment effect, explained by the difference in household characteristics (the independent variables between Models 1 and 2), accounts for only 4.3%. This positive effect implies that the impact of household characteristics of the group with nonagricultural income on the probability of being nonpoor is higher than that of the group without nonagricultural income. This means that based on household demographics and socioeconomic characteristics only (without nonagricultural income), the probability of being a nonpoor household of the group with nonagricultural income is 4.3% higher than that of their counterparts, but minimal. The hypothetical estimate value reveals the probability of the group without nonagricultural income being a nonpoor household had they had nonagricultural income, demonstrating that the probability of the group without nonagricultural income being a nonpoor household from the hypothetical

estimate value (14.5%) is much higher than the observed value (9.0%) and the estimated value (9.1%). This implies that if the households without nonagricultural income had been offered opportunities to generate nonagricultural income, the probability of being a nonpoor household would significantly increase.

Table 4. Decomposition of the probability of being a nonpoor household

	Nonagricultural income		
	Yes		No
Observed	0.160		0.090
Difference		0.070	
Estimated	0.156		0.091
Hypothetical estimates		0.145	
Difference		0.065	
Endowment effect		0.003	
Residual effect		0.063	
Coefficient effect		*0.040*	
Constant effect		*0.023*	
Gap (%) explained by			
Endowment effect		4.3	
Residual effect		95.7	
Coefficient effect		*63.15*	
Constant effect		*36.85*	

The residual effect, which expresses the indirect and direct effects of nonagricultural income, explains 95.7% of the probability of being a nonpoor household, of which the coefficient effect accounts for 60.4% and the constant effect accounts for 35.3%. The contribution of the coefficient effect primarily comes from the variables household size, gender, subsistence allowance, ethnicity, social member, and retirement age, at 93.1%, −47.1%, 16.9%, 15.3%,

7.5%, and −7.4%, respectively (Table A.3). This implies that nonagricultural income significantly increases the probability of being a nonpoor household for households with many members, households with a woman householder, households receiving a subsistence allowance, households with a Kinh ethnic householder, younger householders, and households participating social groups.

4. Conclusion

This study provides empirical evidence of the crucial influence of nonagricultural income in alleviating rural poverty in Vietnam with the key findings as follows. Nonagricultural income significantly, indirectly, and directly boosts the probability of rural households being nonpoor. Nonagricultural income can generate opportunities to escape from poverty for all groups of households with different demographic and socioeconomic characteristics, particularly those with many members, a woman householder, a Kinh ethnic householder, a young householder, households receiving a subsistence allowance, and those participating social groups.

These findings provide credible evidence of the influence of nonagricultural income in rural poverty alleviation that is beneficial to developing new strategies to alleviate rural poverty that no longer only rely on the agrarian economy. Policymakers should promote a rural nonagricultural economy that generates opportunities for households to earn nonagricultural income. Since nonagricultural income is essential for vulnerable groups such as women and households without agricultural income, policymakers should prioritize generating opportunities to earn nonagricultural income for poor rural households. Our findings also suggest that policymakers should prioritize the distribution of nonagricultural income to the identified groups. Such targeted

allocation can accelerate their path out of poverty. Subsistence allowance for poor households should be accompanied by additional nonagricultural income generation opportunities. Engaging poor households in local social organizations is also one of the solutions that can help poor rural households escape poverty. In addition, policymakers should focus on groups that do not take advantage of nonagricultural income to escape poverty, such as minority households and those of retirement age, since they are still less likely to escape from poverty than their counterparts despite having nonagricultural income. Since the availability of credit access, housing, and farming are less effective than nonagricultural income, it is essential to reform such aids and prioritize strategies for generating nonagricultural income for poor rural households. In addition to providing credible evidence, this study constructs a scientific tool to elucidate the influence of nonagricultural income in poverty alleviation in rural Vietnam, offering a representative example for further research in other regions.

Our study still has some limitations. Since we used the available data from the 2018 VHLSS census, possible variables influencing the probability of being a nonpoor household cannot be included in the regression models due to a lack of data; therefore, in addition to the indicators used in this study, future studies could pursue other potential factors such as local infrastructure or psychological characteristics that this study could not capture. Research methods such as interviews and empirical experiments can overcome these limitations. In addition, including information such as local infrastructure or psychological characteristics in the VHLSS census questionnaire would also be helpful for subsequent research.

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Appendix

Table A.1. The mean of the probability of being nonpoor household across the groups of households

Groups (variables)	Nonagricultural income	
	Yes	No
Householder's gender		
Male	0.15	0.10
Female	0.16	0.08
Householder's Age		
Retired	0.14	0.10
Not retired	0.16	0.09
Householder's ethnicity		
Kinh	0.19	0.12
Minority	0.13	0.07
Social member		
Yes	0.17	0.10
No	0.14	0.08
Household size		
Over 4 members	0.14	0.60
4 and below	0.16	0.10
Subsistence allowance		
Yes	0.11	0.03
No	0.16	0.10

Table A.2. Test for variance inflation factor of independent variables

Variables	Variance inflation factor
Gender	1.31
Retirement age	1.44
Ethnicity	1.54
Household size	1.37

Education	1.13
Social member	1.09
Information access	1.11
Cropland	1.06
Agricultural income	1.16
Credit access	1.02
Farming aids	1.11
Housing aids	1.01
Subsistence allowances	1.01
Nonagricultural income	1.21

Table A.3. Contribution of variables for the difference in the probability of being nonpoor household between households with nonagricultural income and without nonagricultural income

	Endowment effect (%)	Residual effect (%)
Total difference	4.25	95.75
Difference due to		
Gender (male)	−0.18	−47.06
Retirement age	8.40	−7.39
Ethnicity (Kinh)	6.65	15.31
Household size	−1.29	93.08
Education	3.16	−3.95
Social member	−1.81	7.49
Information access	−0.51	−3.47
Cropland per person	5.33	−4.07
Agricultural income	−16.29	−1.56
Credit access	−1.47	−1.32
Farming aid	2.40	−3.92
Housing aid	0.03	−1.14
Subsistence allowance	−0.16	16.88
Constant		36.85