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Vocational Training and Labor Market Outcomes in Rural Vietnam

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Abstract: Skill development has become a major policy priority in many developing countries, with a strong emphasis on promoting vocational training programs. This study investigates the impact of vocational training on labor market outcomes in rural Vietnam, specifically focusing on monthly earnings and formal employment. The novelty of this research lies in its comprehensive approach, which utilizes data from the 2015 and 2016 waves of the Labor Force Survey in Vietnam. By employing the propensity score matching method followed by the difference-in-differences with matching method for analysis, this study provides robust evidence on the effectiveness of vocational training programs. This study is the first to use nationally representative data to evaluate the role of vocational training in improving the wages and employment prospects of rural workers in Vietnam. The findings indicate that vocational training significantly boosts workers' wages by approximately 1,197,115 to 2,109,503 VND per month. Additionally, individuals with vocational training have a 0.39% to 2.2% higher likelihood of securing formal employment than those without such training. These results underscore the crucial role that vocational training plays in helping rural workers secure jobs and increase their incomes. These findings, based on nationally representative data, are valuable for policymakers in countries considering similar labor policies, particularly for vulnerable groups such as rural and agricultural workers.
Keywords: vocational training; labor market; rural areas; propensity score matching; difference-in-differences with matching

越南农村的职业培训和劳动力市场成果

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摘要: 技能发展已成为许多发展中国家的主要政策重点，其中重点是推广职业培训计划。本研究调查了职业培训对越南农村劳动力市场结果的影响，特别关注月收入和正式就业。这项研究的新颖之处在于其综合方法，利用了 2015 年和 2016 年越南劳动力调查的数据。通过采用倾向得分匹配法，然后采用差异匹配法进行分析，本研究为职业培训计划的有效性提供了有力的证据。本研究首次使用全国代表性数据来评估职业培训在提高越南农村工人工资和就业前景方面的作用。研究结果表明，职业培训显著提高了工人的工资，每月约 1,197,115 至 2,109,503 越南盾。此外，接受过职业培训的个人获得正式就业的可能性比未接受过此类培训的个人高 0.39%至 2.2%。这些结果强调了职业培训在帮助农村工人获得工作和增加收入方面发挥的重要作用。这些基于全国代表性数据的结论对于正在考虑类似劳工政策的国家的政策制定者来说很有价值，特别是针对农村和农业工人等弱势群体。

关键词：职业培训；劳动力市场；农村地区；倾向得分匹配；双重差分匹配法

1 Introduction

In many countries, the rural workforce has been ranked as a vulnerable group that requires focused social attention. Due to the inferior quality of education and the lack of requisite skills, those employed in rural areas are at a significant disadvantage when competing with their counterparts in the labor market. Many rural workers often engage in employment opportunities within the informal sector, which may involve farm or non-farm work. They earn a low salary and do not benefit from social security services, such as health insurance, employment contracts, and pensions. In numerous developing countries, the rural labor force continues to constitute a significant proportion of the national labor force. They have been instrumental in driving economic growth and human capital accumulation in these nations.

For instance, the rural population in Vietnam in 2015 [1] accounted for approximately 66% of the total population. In this way, Vietnam has achieved rapid economic growth among developing countries. According to the statistics of the World Bank, the GDP growth rate of Vietnam was approximately 10% per year during the last decade, and Vietnam has become one of the most attractive destinations for foreign direct investment (FDI) and has seen a boom in the private sector since the implementation of the "Doi Moi" policy in 1986. Hence, rural areas have been a vital source of labor for industrialization and modernization in Vietnam. However, in this country's rural areas, informal sector workers are pervasive, with an estimated 47% of non-farm jobs being informal [2]. These workers, who belong to the lowest income quintile, have low and very low educational levels, lack social security, and are highly vulnerable to various shocks.

Accordingly, it is imperative to enhance skilled labor to meet the demands of the market and decrease inequality among the rural labor force. However, a scarcity of research has thoroughly examined the effect of vocational training on labor market outcomes, particularly for rural workers in developing countries. Previous studies have focused on specific aspects, such as the influence of vocational training on rice production productivity in Vietnam [3] and the requirements and outcomes of vocational education in Ha Tinh Province, Vietnam [4]. Do et al. [5] used the Heckman sample selection model to evaluate the impact of vocational training on the wages of ethnic minorities in Vietnam and found that, despite their limitations, these programs have a positive impact and are crucial in boosting the incomes of ethnic minorities.

Reis [6] used the difference-in-differences matching method to examine the impact of vocational training on labor market outcomes in Brazilian metropolitan areas. The results show that vocational training increases both monthly and hourly labor earnings and the probability of securing a job. However, similar training is believed to have no impact on access to formal

sector employment opportunities.

Hillmert et al. [7] investigated the influence of local market conditions in Germany on individual transitions to vocational training. Weßling et al. [8] previously studied how the transition from lower or intermediate compulsory schooling to vocational education and training has been affected by regional unemployment in this country. Their results indicate that the likelihood of entering vocational training is negatively related to regional unemployment in the dual system.

Ahmed [9] investigated the labor market safety net as a motivator for participating in vocational education and training (VET) in India. This study analyzes post-VET labor market outcomes, including wages, unemployment, and employment status. The results revealed that individuals who completed VET courses had a higher likelihood of securing salaried work, and VET was associated with a favorable wage premium for VET holders. However, VET was estimated to be less effective in helping individuals with lower levels of general education find employment, and this group had a higher unemployment rate.

Agrawal and Agrawal [10] analyzed the effect of vocational training on labor market outcomes in India using data from a nationally representative survey on employment and unemployment. They discovered that formal training was less appealing to people aged 15–59 years. Conversely, a significant proportion of the VET-trained population consisted of non-formal trainees. Their findings also indicated that there was underutilization of human resources because a substantial number of formal trainees remained unemployed.

Zilic [11] applied a regression discontinuity design and pooled Labor Force Surveys to identify the causal effects of the educational reform implemented in 1975/76 and 1977/78 on educational and labor market outcomes in Croatia. The results imply that the reform has an insignificant effect on individuals' labor market prospects.

Hirshleifer et al. [12] conducted a randomized experiment to evaluate the effectiveness of Turkey's vocational training programs for the unemployed, which was a large-scale active labor market policy. The results showed that, despite having a positive impact, the effect on employment was close to zero and statistically insignificant, not meeting the expectations of either the program officials or the participants.

Popescu and Roman [13] examined the effect of vocational training on employment in Romania through counterfactual analysis. They found that training had a limited but positive impact, with job opportunities increasing by approximately 15% overall. However, the impact was more pronounced for women, who saw their employment opportunities improve by more than 21%. Shan et al. [14] investigated the influence of China's vocational training programs on gender equity for women in Liuzhou. The results indicate that these policies and programs not only transformed social relations for women but also enhanced their quality of life, access to resources, awareness, participation, and autonomy.

Chakravarty et al. [15] evaluated the effects of vocational training on young people's labor market outcomes in Nepal using a regression-discontinuity design. Their results showed that non-farm employment increased by 10% for youth who completed the 12-month training program and up to 31 percentage points for program completers. Kumar et al. [16] analyzed data from the Indian National Sample Survey Office (NSSO) to determine the factors that influence participation in vocational training. They also studied the impact of vocational training on wages at both the overall and sectoral levels. Their findings revealed a disparity in access to formal vocational training, with urban residents and men having better access to courses than rural residents and women. They found that individuals with formal vocational training earned 4.7% more than those without professional education, with the greatest impact seen in the primary sector (a 36.9% salary increase) and a 17.6% increase for those in the secondary sector with the same education level.

Previous studies have considered the relationship between vocational training and labor market outcomes. However, most of these studies focused on the labor market in developed countries. In developing countries, rural workers must be equipped with skills and technical knowledge to enhance their job opportunities in various sectors, including engineering, management, and artisanal fields. Furthermore, employed workers require ongoing training to achieve career stability and higher wages. This study contributes a novel perspective by examining the impact of vocational training on the wages of rural workers in Vietnam. This research systematically addresses the following questions: Have rural workers who received vocational training experienced improvements in wages and formal employment? Is there a discernible difference in labor market outcomes among these trained workers?

This study is the first to use nationally

representative data to evaluate the impact of vocational training on wages and formal employment prospects for rural workers in Vietnam. This comprehensive approach fills a significant gap in the existing literature, which has largely overlooked rural and developing contexts. By employing the propensity score matching (PSM) method followed by the difference-in-differences with matching method, this study ensures a rigorous analysis that accounts for potential biases and confounding factors. This methodological innovation strengthens the validity and reliability of the findings.

This study uniquely focuses on rural workers, a demographic often marginalized in labor market research. By highlighting the positive impact of vocational training on this group, the research underscores the importance of targeted policy interventions.

The findings provide quantitative evidence of the benefits of vocational training, showing a significant increase in monthly wages (1,197,115 to 2,109,503 VND) and a higher likelihood of securing formal employment (0.39% to 2.2%). This detailed empirical evidence is crucial for policymakers and stakeholders.

The study's conclusions offer valuable insights for policymakers seeking to design effective labor policies. By demonstrating the positive outcomes of vocational training, this research supports the development of targeted training programs that can enhance economic opportunities for rural workers, particularly vulnerable groups such as women and the elderly.

2 Materials and Methods

2.1 Methods

2.1.1 PSM Analysis

This study employs Heckman et al.'s [17] PSM technique to assess the impact of vocational training on rural labor market outcomes. The average treatment effect on the treated (ATT) in a randomized experiment is the difference in mean outcome between the group that received vocational training (treatment group) and the group that did not participate (control group).

However, given that the treatment status in our study was determined through self-selection rather than random assignment, the use of a randomized experiment was not possible. Therefore, a non-experimental approach was suggested to evaluate the impact. This approach is referred to as the ATT:

$$ATT = E(Y_{1i} - Y_{0i} \mid D_i = 1) = E(Y_{0i} \mid D_i = 1) - \mathrm{E}(\mathrm{Y}_{0i} \mid D_i = 1) \quad (1)$$

Individual *i*'s labor market outcomes with and without vocational training are denoted by *Y1i* and *Y0i*, respectively. If the individual *I* engages in vocational training, the binary dummy *Di* is 1; otherwise, it equals 0.

However, the term is not observable; therefore, additional hypotheses are required to estimate the ATT. This is classified as a counterfactual circumstance in the impact measurement literature, and it is a significant difficulty to discover an appropriate counterfactual from non-participation. To address this issue, we believe that PSM is the optimal technique. In effect evaluation, individual matching based on observable covariates may not work if the covariates have multiple dimensions. As a result, matching based on propensity scores may produce better outcomes than matching based on variables alone. PSM's efficacy is based on two assumptions: conditional independence and common support. In the absence of laborers in participation *i*, the labor market outcome of occupational training $(\mathrm{Y}_{0i} \mid D_i = 1)$ is estimated by the observable result of the equivalent non-participant $(\mathrm{Y}_{0i} \mid D_i = 0)$.

The vocational training participation model was used to calculate the propensity score, which is presented as follows:

$$\Pr(D_i = 1) = \beta_0 + \beta_1 X_i + \varepsilon_i \quad (2)$$

Xi represents the set of elements that determine participation in training. As described in the literature, these elements should be present before the treatment begins. *Xi* represents the set of noticeable characteristics. *Di* denotes treatment status (1 if participating in the training; otherwise, 0).

The need to define a common support area before matching is highlighted. Observations with extremely high or low propensity scores may be excluded from the sample. A balancing test is also applied to ensure equal mean propensity scores and X means between the treatment and control groups. The ATT PSM estimate is calculated as the difference in outcomes between the treatment and control groups, matched using the propensity score generated by the Probit model (Eq. (2)). Given this, the following function is used to estimate the effect:

$$ATT = [Y_{1i} \mid p(X_i), D = 1] - [Y_{0i} \mid p(X_i), D = 0] \quad (3)$$

2.1.2 PSM with Difference-in-Differences

In this study, PSM is the primary method of analysis, but it only takes into consideration self-selection based on observable variables and does

not control for the effect of unobservable factors and their impact on both the likelihood of participating in training and the outcome [18–20]. Therefore, it is recommended to combine PSM with Difference-in-differences (DID) to mitigate the effect of unobservable (fixed over time) variables on the results [21].

The following is written on the influence of vocational training for rural labor forces on labor market outcome growth using PSM-DID:

$$ATT = [\Delta Y_{1i} \mid p(X_i), D = 1] - [\Delta Y_{0i} \mid p(X_i), D = 0] \quad (4)$$

where ΔY_{1i} and ΔY_{0i} equal ($\Delta Y_{1i,2016} - \Delta Y_{1i,2015}$) and ($\Delta Y_{0i,2016} - \Delta Y_{0i,2015}$), respectively.

This study utilizes the Kernel matching method through the STATA module DIFF [22].

2.1.3 Variables Used in the Empirical Examination

This study required three sets of data for both the PSM and PSM-DID analyses: treatment information, outcome data, and variables related to treatment and/or outcome.

Treatment variable: Rural individuals' involvement in vocational training programs is the treatment variable in this research. Those individuals who have undergone vocational training may be placed into one of the following categories: individuals who have completed training without obtaining a diploma or certificate; individuals who have acquired a vocational skill; those who have completed a vocational course lasting less than three months; individuals who have completed a primary vocational course lasting less than three months; and individuals who have completed a mid-term vocational course.

The control variable: individuals with no technical qualification or occupational competence.

Determinants: This study does not have a predetermined set of variables that should be included in Equation (2). However, these variables should be able to predict vocational training participation and labor market outcomes. Previous research has shown that factors such as education level, age, gender, race, and place of residence are important in determining these outcomes [6]. The specific determinants included in the probit model (Equation 2) for computing propensity scores were chosen based on literature review and data availability (Tab. 2).

Outcome variables: The variables used to measure the impact of vocational training on labor market outcomes include monthly earnings and formal or informal employment status. Formal employment is defined as working as a public employee or employer, while informal employment includes self-employed workers and those who work informally. These classifications are based on prior research by Reis [6]. Fig. 1 shows a flowchart of the research methodology.

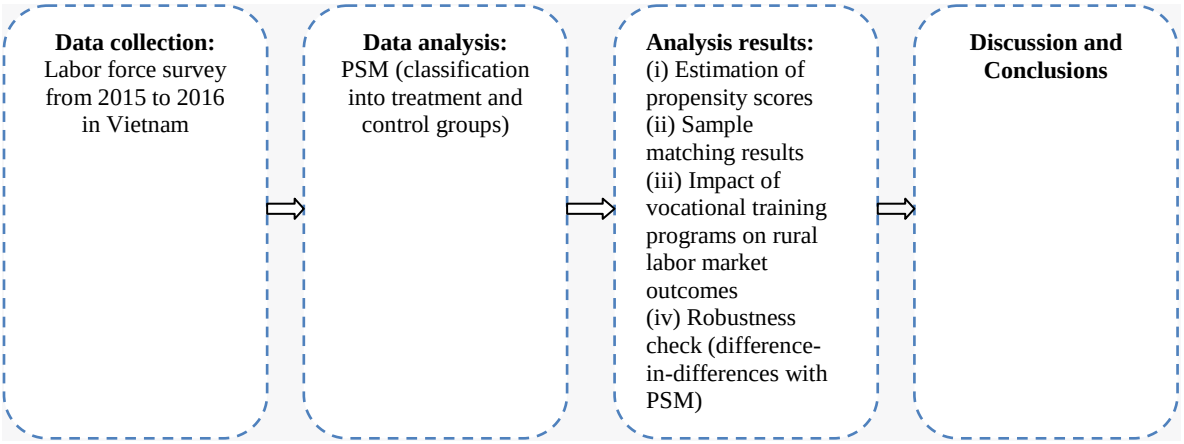

Fig. 1 Flowchart of research methodology (The authors)

2.2 Data

This study used data from two waves of a high-frequency Labor Force Survey (LFS) conducted in 2015 and 2016. This survey provides a high-quality database, a large sample size, and a wealth of information at the household and individual levels. It was carried out regularly by the General Statistics Office of Vietnam (GSO), with financial and technical assistance from the International Labor Organization. The LFS rounds in 2015 and 2016 had sample sizes of 56,340 and 50,640 households per quarter, respectively (equal to 18,780 and 16,880 households per month and totals of 819,537 and 814,611 individuals per year). The sample size was calculated and allocated to ensure the statistical significance/preventative value of quarterly aggregated statistics at the regional level and annual aggregated statistics at the province level.

To pursue the aim of the study, we filtered and used persons living in rural areas and aged 24 to 54 years as the target group [6]. The overall sample size and the factors included in our study are detailed in Tab. 1. Tab. 1 also lists some fundamental descriptive data such as the mean values and standard deviations. The variables included in the econometric model were chosen based on literature review (Tab. 1). Specifically, the selection of these variables is similar to Reis's [6] work on personal-level determinants of vocational training attendance.

Tab. 1 Descriptive statistics (The authors' calculations are based on the 2016 survey data)

Variables	Control group		Treatment group		T-test	
	Mean	SD	Mean	SD	Diff.	SD
Age (years)	39.151	8.711	35.445	8.563	3.706***	75.67
Age square	1608.755	683.695	1329.702	652.871	279.1***	72.77
Marital status (1 - married, 0 - otherwise)	0.932	0.251	0.914	0.280	0.017***	11.98
Household head (1 - yes, 0 - otherwise)	0.398	0.489	0.405	0.490	-0.006*	-2.54
Gender (1 - female, 0 - male)	0.518	0.499	0.323	0.467	0.195***	69.67
Family size	4.561	1.9120	4.565	1.872	-0.004	-0.45
Education level						
No education (1 - yes, 0 - otherwise)	0.225	0.4181	0.020	0.140	0.206***	81.74
Primary (1 - yes, 0 - otherwise)	0.320	0.466	0.111	0.315	0.209***	73.35
Secondary (1 - yes, 0 - otherwise)	0.339	0.473	0.286	0.452	0.053***	18.05
High school (1 - yes, 0 - otherwise)	0.113	0.317	0.581	0.493	-0.467***	-225.06
Ownership						
State ownership (1 - yes, 0 - otherwise)	0.014	0.118	0.249	0.432	-0.235***	-236.69
Private ownership (1 - yes, 0 - otherwise)	0.956	0.203	0.700	0.457	0.256***	185.88
FDI ownership (1 - yes, 0 - otherwise)	0.029	0.168	0.049	0.216	-0.020***	-20.09
Industry sectors						
Agriculture (1 - yes, 0 - otherwise)	0.626	0.483	0.184	0.387	0.442***	161.23
Industry (1 - yes, 0 - otherwise)	0.218	0.413	0.290	0.454	-0.072***	-30.19
Services (1 - yes, 0 - otherwise)	0.154	0.361	0.524	0.499	-0.370***	-170.26
Logarithm of working hours (per week)	3.701	0.359	3.810	0.278	-0.110***	-41.64
Regions						
Northern Midlands and Mountains (1 - yes, 0 - otherwise)	0.271	0.444	0.248	0.432	0.022***	8.99
Red River Delta (1 - yes, 0 - otherwise)	0.143	0.350	0.235	0.424	-0.092***	-45.72
North and South Central Coast (1 - yes, 0 - otherwise)	0.177	0.382	0.195	0.396	-0.017***	-7.97
Central Highlands	0.091	0.287	0.058	0.235	0.032***	20.28
Southeast (1 - yes, 0 - otherwise)	0.095	0.294	0.131	0.338	-0.035***	-21.34
Mekong River Delta (1 - yes, 0 - otherwise)	0.220	0.414	0.130	0.336	0.090***	39.31
Year - 2016 (1 - yes, 0 - otherwise)	0.496	0.499	0.492	0.499	0.004	1.46
Labor market outcomes						
Monthly labor earnings (1000 VND)	6638.234	13555.57	12238.6	47796.52	-5600.4***	-24.30
Formal employment	0.108	0.310	0.509	0.499	-0.401***	-208.41
Observations	352,948		34,631		387,579	

Notes: Diff. is a t-statistic; * Significant at the 0.1 level; ** Significant at the 0.05 level; *** Significant at the 0.01 level; SD denotes standard deviation.

Following the requirements of the analytic approach in Section 2.2, the data were separated into two subgroups (control and treatment). Each group was defined as follows:

Individuals in the treatment group are classified into the following categories:

1. Technical workers without a diploma or certificate;
2. Vocational skills acquired in less than 3 months;
3. Vocational certificates acquired in less than 3 months;
4. Primary vocational certificates;
5. Mid-term vocational certificates.

Individuals with no technical or vocational qualifications form the control group.

Tab. 1 shows some differences between the control and treatment groups. The treatment

group had a mean age that was 4 years lower than the control group, and a higher proportion of household heads. Individuals with higher education levels are more likely to engage in vocational training, whereas those who run their own businesses have the highest participation rate. Conversely, informal employees are less likely to receive vocational training than those who are employed by others. Additionally, those residing in the Northern Midlands and Mountains and Red River Delta are more likely to participate in vocational training than those living in other regions.

3 Results

3.1 Estimation of Propensity Scores

Tab. 2 presents the estimated propensity scores for vocational training participation using the Probit model. If an individual has completed a vocational training program, the dependent variable is a dummy with a value of 1. Tab. 2 shows that statistics like the LR chi2 (20) p-value yield positive results. The model's goodness of fit is met, making it appropriate for studying the determinants of vocational training completion by rural labor forces.

Tab. 2 Propensity score estimation (The authors)

Probit Specification	Marginal effect dy/dx	Robust standard errors	P_value
Age	0.0001	0.003	0.714
Age square	-0.000	0.000	0.007**
Married	0.004	0.002	0.053
Household head	-0.001	0.0008	0.079
Gender (women)	-0.029	0.0008	0.000***
Family size	-0.000	0.0001	0.647
Education dummies: High school is the reference.			
No education	-0.051	0.0007	0.000***
Primary	-0.053	0.0008	0.000***
Secondary	-0.044	0.0008	0.000***
Types of ownership dummies: The FDI sector is the reference.			
State ownership	0.110	0.006	0.000***
Private ownership	-0.010	0.002	0.000
Sector dummies: The services are the reference.			
Agriculture sector	-0.060	0.001	0.000***
Industry sector	-0.017	0.0005	0.000***
Logarithm of working hours (per week)	0.009	.001	0.000***
Region dummies: The Mekong River Delta is the reference.			
Northern Midlands and Mountains	0.001	0.001	0.076
Red River Delta	0.003	0.001	0.001***
North and South Central Coast	0.002	0.001	0.017**
Central Highlands	0.002	0.001	0.160
Southeast	0.017	0.001	0.000***
Year dummies: 2015 is the reference.			
Year - 2016	-0.018	0.0006	0.000***
Number of observations	212,302		
LR chi2(20)	38840.79		
Prob > chi2	0.000		
Pseudo R2	0.3503		

Notes: Coefficients are transformed into marginal effects; * p<0.10, ** p<0.05, *** p<0.01

The findings reveal that age, marital status, household head, and family size had little effect on rural laborers' decision to participate in a vocational training program. Female workers were less likely to participate in the training program than male workers, with a probability of approximately 0.29%.

In terms of academic achievement, rural workers with lower levels of education have a lower probability of participating in vocational training than workers in the counterpart group; for example, those with no academic achievement have a lower probability of completing the vocational training program at about 0.51% and 0.53%, respectively, than the other individuals. This can be explained by the fact that participants in Vietnam's rural worker training program must have completed secondary education or higher.

Furthermore, workers in the state ownership sector are more likely to receive vocational certificates or degrees than workers in parallel ownership. People working in the agricultural sector, on the other hand, have a negative influence on rural labor force access to vocational training in Vietnam at a rate of about 0.6%, which is highly statistically significant.

At approximately 0.09%, the logic of the

working hours variable has a considerable positive impact on vocational training participation. Furthermore, among the six areas of Vietnam, laborers in the Southeast have the highest likelihood of access to vocational training at approximately 0.17%, while the Red River Delta is placed second with 0.03%. The location of the Central Highlands does not affect the training program. The coefficient of the time variable indicates that it has a negative impact on vocational training participation in 2016 compared to 2015.

3.2 Sample Matching Results

Before assessing the effect of vocational training on rural labor market outcomes, the balance of the propensity scores must be checked to confirm that the same characteristics are present in both the treated and control groups for each propensity score value. The results of this balance evaluation are presented in Tab. 3.

Tab. 3 Balance of variables before and after matching with the balancing hypothesis test (The authors)

Variables	Unmatched	Mean		% bias	% bias reduction	t-test	
	Matched	Treated	Control			t-test	p_value
Age	U	38.27	40.039	-20.8	98.1	-13.32	0.000***
	M	38.27	38.236	0.4		0.18	0.859
Age square	U	1539.6	1672.5	-19.8	98.0	-12.61	0.000***
	M	1539.6	1536.9	0.4		0.18	0.859
Married	U	0.972	0.954	9.6	63.4	5.47	0.000***
	M	0.972	0.966	3.5		1.73	0.083
Household head	U	0.569	0.412	31.9	71.7	20.06	0.000***
	M	0.569	0.525	9.0		4.06	0.000***
Gender (women)	U	0.286	0.546	-54.6	90.9	-32.85	0.000***
	M	0.286	0.310	-5.0		-2.34	0.019**
Family size	U	4.360	4.580	-12.4	79.2	-7.39	0.000***
	M	4.360	4.406	-2.6		-1.25	0.210
No education	U	0.014	0.232	-70.3	96.2	-33.04	0.000***
	M	0.014	0.022	-2.7		-2.80	0.005**
Primary	U	0.105	0.297	-49.5	97.7	-26.74	0.000***
	M	0.105	0.100	1.1		0.65	0.514
Secondary	U	0.289	0.371	-17.5	81.0	-10.66	0.000***
	M	0.289	0.304	-3.3		-1.54	0.122
State ownership	U	0.241	0.012	73.2	90.6	103.58	0.000***
	M	0.241	0.263	-6.8		-2.24	0.025**
Private ownership	U	0.744	0.981	-73.1	89.1	-93.02	0.000***
	M	0.744	0.719	8.0		2.64	0.008**
Agriculture sector	U	0 .383	0.784	-89.1	94.8	-60.78	0.000***
	M	0 .383	0.362	4.6		1.94	0.053*
Industry sector	U	0.179	0.117	17.4	88.9	11.92	0.000***
	M	0.179	0.186	-1.9		-0.80	0.424
Working hours (per week)	U	3.715	3.680	10.1	88.0	6.16	0.000***
	M	3.715	3.719	-1.2		-0.57	0.572
Northern Midlands and Mountains	U	0.334	0.440	-21.9	93.8	-13.45	0.000***
	M	0.334	0.327	1.4		0.63	0.527
Red River Delta	U	0.182	0.135	12.8	70.8	8.52	0.000***
	M	0.182	0.196	-3.7		-1.58	0.115
North and South Central Coast	U	0.258	0.235	5.5	5.5	3.50	0.000***
	M	0.258	0.281	-5.2		-2.29	0.022*
Central Highlands	U	0.072	0.051	8.8	-23.6	5.96	0.000***
	M	0.072	0.046	10.8		5.01	0.000***
Southeast	U	0.038	0.016	13.6	94.5	10.69	0.000***
	M	0.038	0.039	-0.7		-0.28	0.776
Year	U	0.343	0.508	-33.8	91.0	-20.76	0.000***
	M	0.343	0.358	-3.0		-1.41	0.159

Notes: Kernel matching was used for the balancing test. The performance of the matching process was relatively satisfactory among the samples. A statistically significant difference between unmatched (U) and matched (M) variables is indicated by an asterisk (*) at the 90% confidence level.

The results presented in Tab. 3 are consistent with the balancing hypothesis, as evidenced by the elimination of differences in variables following matching. This suggests that the balance hypothesis was validated in this study. Tab. 4 presents the statistical evaluations used to assess the matching procedure. The propensity test showed a significant decrease in bias, which was reduced from 32.3% to 3.8% after matching. Similarly, the pseudo R2 of the predicted probit model was initially high but decreased significantly after matching. The results of the

common support assumption test are presented in Fig. 2.

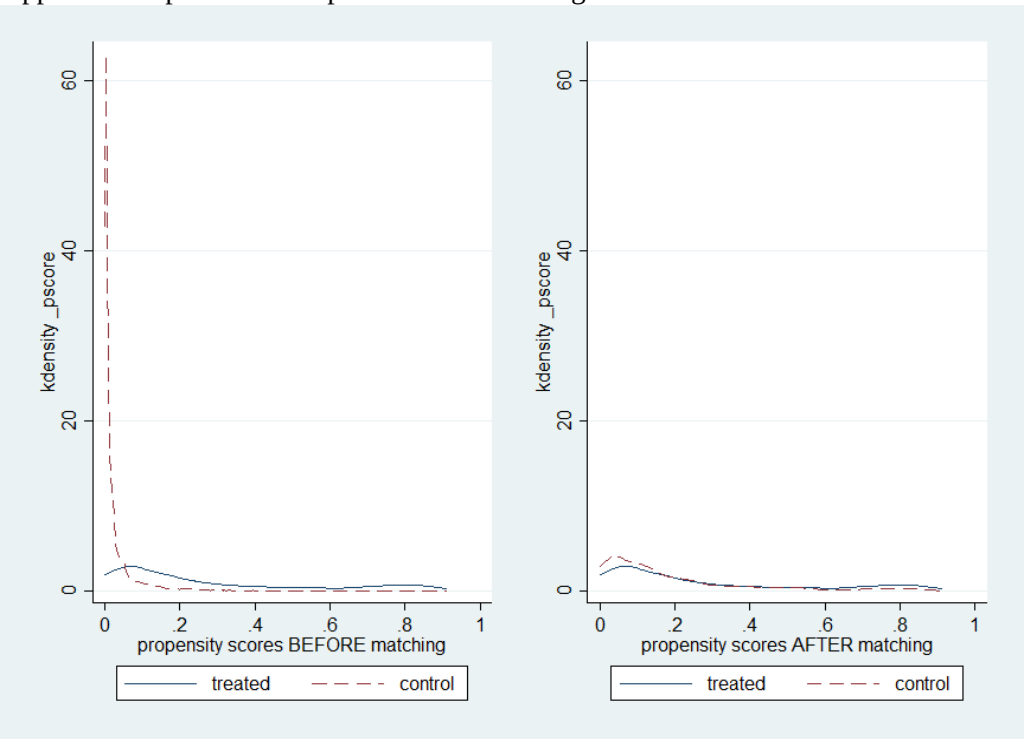

Fig. 2 Test of the common support assumption to determine the densities of pre- and post-matching p-scores (The authors)

Tab. 4 Test of selection bias after matching (The authors)

Sample	Ps R2	LR chi2	p>chi2	% Mean Bias	Med. Bias	B	R
Unmatched	0.304	10503.07	0.000	32.3	20.3	170.6*	1.75
Matched	0.007	77.87	0.000	3.8	3.2	19.5	1.11

* If B>25%, R is outside [0.5; 2].

The comparison of the pre- and post-matching kernel density functions of the two groups is depicted in Fig. 2. Before matching, significant differences were observed in the density functions of the two groups, as shown in the figures. However, after matching, the distribution density functions of the two groups became identical, with a noticeable reduction in variance. This indicates that the assumption of common support was valid in this analysis.

3.3 Impact of Vocational Training Programs for the Rural Labor Force on the Labor Market Outcomes

To assess robustness, we employed several matching techniques, starting with nearest-neighbor matching (NN1) and its subsequent version. However, NN1 may result in inaccurate matches if the nearest neighbor is located at a significant distance. To enhance matching quality, we used radius matching with a caliper, as suggested by Dehejia and Wahba [23]. Furthermore, oversampling with five matching partners (NN5) and kernel matching algorithms were employed due to the considerable proportion of comparable untreated (non-participating home) data present in the sample. For kernel matching, we used a Gaussian kernel, and the optimal capacity for the basis functions was determined following Silverman's [24] rule of thumb. We evaluated the quality of matching results for each method using the percentage reduction in pseudo R2 and mean standardized bias. The quality of the matching outputs was assessed by observing a decline in the pseudo R2, chi-square, and average standardized bias for each matching estimator. Tab. 5 presents the calculated average treatment effects (ATTs) of vocational training on labor market outcomes. The results show that trainees have a positive impact on labor market indicators such as monthly wages and formal sector occupation. All matching approaches demonstrated positive and significant projected ATTs at the 1% level. The report indicated that individuals who participated in the vocational training program earned approximately 1,197,115 to 2,109,503 VND more than those who did not participate in the program. Thus, vocational training is crucial for improving labor income. These results align with the findings of Kumar et al. [16], who found that formal education increases salaries by 4.7% compared to individuals with no training in the overall economy. The study also demonstrates

that individuals who received vocational training exhibited a significantly elevated probability of attaining a formal career, with an observed increase ranging from 0.39% to 2.2%, in comparison to non-participants.

Tab. 5 Estimated treatment effects of vocational training programs on the rural labor market outcomes (The authors)

Variable	Sample	Treated group	Control group	Difference	Std. Err.	T-stat.
			NN1			
Monthly earnings	Unmatched	4642.568	2533.065	2109.503	72.620	29.05 ***
	ATT	4642.568	3445.452	1197.115	200.545	5.97***
Formal employment	Unmatched	0.299	0.039	0.260	0.003	77.50**
	ATT	0.299	0.220	0.078	0.011	7.04***
			NN5			
Monthly earnings	Unmatched	4642.568	2533.065	2109.503	72.620	29.05***
	ATT	4642.568	3382.875	1259.692	170.050	7.41***
Formal employment	Unmatched	0.299	0.039	0.260	0.003	77.50***
	ATT	0.299	0.200	0.098	0.008	11.60***
			Kernel			
Monthly earnings	Unmatched	4642.568	2533.065	2109.503	72.620	29.05***
	ATT	4642.568	3264.693	1377.874	167.512	8.23***
Formal employment	Unmatched	0.299	0.039	0.260	0.003	77.50***
	ATT	0.299	0.196	0.103	0.007	13.75***
			Radius			
Monthly earnings	Unmatched	4642.568	2533.065	2109.503	72.620	29.05***
	ATT	4642.568	2533.065	2109.503	160.197	13.17***
Formal employment	Unmatched	0.299	0.039	0.260	0.003	77.50***
	ATT	0.299	0.039	0.260	0.007	36.42***

* Significant at 10%; ** significant at 5%; *** significant at 1%

3.4 Robustness Check: PSM Combined with DID

As stated in the preceding section, the PSM model was employed as the primary estimated technique in this study. Matching approaches, on the other hand, can only employ observable traits to form a comparison group because unobserved characteristics cannot be considered. Matching must also be performed using only attributes that are unaffected by the program. Most traits measured after the program's inception would not fit into that group. As a result, the PSM estimation may be risky and should be combined with DID to reduce the risk of bias. Tab. 6 displays projected PSM-DID values for labor market outcomes. It demonstrates that individuals who have undergone training are observed to earn a higher income than those who have not participated, with an approximate monthly gain of 4,348 VND per person. Furthermore, the table indicates that training participants are more likely to secure gainful employment than non-participants, with an estimated probability of approximately 2.82%. These discoveries are consistent with the previous data. Therefore, our findings are robust, and our estimation technique is accurate.

Tab. 6 PSM-DID results (The authors)

Outcome var.	Monthly earnings	Employed in the formal sector
DID	4348.533*** (471.316)	0.282*** (0.006)
Observations	105,801	222,996

Notes: Standard errors are in parentheses. The asterisks indicate significance levels: * p<0.10, ** p<0.05, *** p<0.01. For more information, refer to Appendix A2.

4 Discussion

The purpose of this article is to examine the impact of vocational training for rural individuals on labor market outcomes in Vietnam using two variables: monthly earnings and formal employment. Using nationwide representative data from two waves of LFS in Vietnam in 2015 and 2016, this study is the first to analyze the influence of vocational training on rural labor markets in Vietnam. Our findings demonstrate that vocational training has a strong positive impact on monthly earnings and formal employment in rural areas in Vietnam, as determined by accurate methods of PSM and DID matching. On average, workers who completed a vocational training program earned between 1,197,115 and 2,109,503 VND, more in income per person than non-trained workers. In addition, vocationally trained laborers had a higher likelihood of having a formal job, ranging from 0.39% to 2.2%, than those who did not receive training.

Furthermore, our research has revealed that various factors, including gender, academic standing, and residence, significantly influence employees' decisions to participate in training programs within rural Vietnam.

Our findings, therefore, support the conclusions of Kumar et al. [16] and Reis [6] that

vocational training plays a crucial role in improving individuals' salaries and formal job opportunities, particularly in rural areas. The findings of our study corroborate the existence of specific factors that exert a considerable influence on the decision of rural Vietnamese workers to enroll in the training program. These factors include gender, educational level, and residential region.

5 Conclusions

This study makes an original and valuable contribution to the literature on vocational training and labor market outcomes. The innovative use of comprehensive, nationally representative data and rigorous methodological approaches highlights the significant positive impact of vocational training on the economic prospects of rural workers in Vietnam. The findings offer policymakers crucial insights and contribute to the broader discourse on skill development in developing countries.

The results indicate that vocational training plays a crucial role in enhancing the wages of rural workers and positively influences their probability of obtaining formal employment. However, despite these positive outcomes, vocational training and job creation for rural workers are not without limitations and shortcomings. In light of these findings, a series of recommendations are put forth for rural laborers, enterprises, and the government to foster engagement in vocational training and enhance labor market efficiency. It is recommended that government vocational training programs address the specific needs of different worker demographics, including skill levels and industry requirements. It is recommended that policies be developed and implemented that prioritize and support vulnerable groups, such as female workers and the elderly, with the objective of ensuring their active participation in vocational training programs. It is recommended that training institutions and industries collaborate to ensure that the skills taught are aligned with current market demands, thereby enhancing employability and job stability. It is recommended that continuous training and skill upgrading be promoted for employed workers, with the objective of ensuring career stability and opportunities for wage growth. It is recommended that greater awareness be created of the benefits of vocational training, and that these programs be made more accessible to rural workers. This may be achieved through the provision of subsidies, the adaptation of flexible schedules, and the establishment of local training centers.

This paper and its analysis are not without limitations. The effects of vocational training on labor market outcomes may vary among different groups. For instance, participation in vocational training is likely influenced by factors such as gender, household income, geographical location (mountainous areas versus plains), ethnicity, and cultural and religious backgrounds. Additionally, the labor market is significantly affected by temporal, macroeconomic, and political factors.

Future research can address these limitations by using longer periods of data to conduct longitudinal studies that assess the long-term impact of vocational training on rural workers' career progression and income stability. Comparative analyses across regions and sectors can help identify best practices and successful models of vocational training. Exploring the differential impacts of vocational training on various demographic groups, with particular attention to gender and age, will enable the development of more targeted and effective training programs. Finally, evaluating the effectiveness of current government policies on vocational training and labor market outcomes is crucial for providing data-driven recommendations for policy improvements.

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Appendix

Tab. A1 Estimation of the propensity scores (The authors)

Probit Specification	Coef.	Std. Err.	P_value
Age	0.002	0.006	0.714
Age square	-0.0002	0.000	0.007**
Married	0.088	0.050	0.076*
Household head	-0.024	0.013	0.080*
Gender (women)	-0.476	0.036	0.000***
Family size	-0.001	0.003	0.647
Education dummies: High school is the reference.			
No education	-1.599	0.024	0.000***
Primary	-1.251	0.015	0.000***
Secondary	-0.905	0.012	0.000***
Types of ownership dummies: The FDI sector is the reference.			
State ownership	0.881	0.027	0.000***
Private ownership	-0.155	0.106	0.000
Sector dummies: Services is the reference.			
Agriculture sector	-0.790	0.013	0.000***
Industry sector	-0.384	0.013	0.000***
Logarithm of working hours (per week)	0.168	0.018	0.000***
Region dummies: The Mekong River Delta is the reference.			
Northern Midlands and Mountains	0.031	0.017	0.073*
Red River Delta	0.065	0.018	0.000***
North and South Central Coast	0.044	0.018	0.014**
Central Highlands	0.035	0.024	0.148
Southeast	0.250	0.020	0.000***
Year dummies: 2015 is the reference.			
Year - 2016	-0.387	0.015	0.000***
Number of observations	212,302		
LR chi2(20)	38840.79		
Prob > chi2	0.000		
Pseudo R2	0.3503		

* Significant at the 0.1 level; ** significant at the 0.05 level; *** significant at the 0.01 level

Tab. A2 Results of robustness check using the PSM-DID model (The authors)

Difference	Monthly earnings	Employed in the formal sector
Before		
Control group	3289.295	0.261
Treatment group	4429.983	0.389
Difference (T-C)	1140.689*** (302.485)	0.128*** (.003)
After		
Control group	1.5e+04	0.228
Treatment group	2.1e+04	0.638
Difference (T-C)	5489.222*** (361.444)	0.410*** (.006)
DID	4340.533*** (471.316)	0.282*** (.006)
Number of observations	105,801	222,996

Notes: Standard errors are in parentheses under coefficients; * p<0.10, ** p<0.05, *** p<0.01. In the model with the monthly earnings, the treatment group consists of 5,556 samples, including 2,716 and 2,840 before and after, respectively; the control group consists of 100,245 samples, including 49,257 and 50,988 samples before and after 2008, respectively. In the model with the employed in the formal sector, the treatment group consists of 30,132 samples, including 13,917 and 16,215 before and after 2008, respectively; the control group consists of 192,064 samples, including 142,692 and 50,172 samples before and after 2008, respectively.