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The effect of human capital on income inequality across provinces in Vietnam

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Abstract: Human capital is a nation's primary resource and an internal strength for achieving sustainable economic growth and development. Conversely, income inequality is a critical factor influencing sustainable growth and social transformation, especially in developing countries. This paper investigates the impact of human capital on income inequality at the provincial level within the Vietnamese context. Based on learning theory and the Kuznets hypothesis, we employ spatial regression, threshold regression, and instrumental variable regression to examine the effect of human capital on income inequality in Vietnam from 2016 to 2020. The findings indicate that human capital reduces income inequality across provinces in Vietnam. However, economic growth exhibits a U-shaped relationship with income inequality. Urbanization tends to decrease income inequality in disadvantaged provinces, whereas the services sector increases inequality. Foreign direct investment (FDI) tends to widen the income gap in Vietnam due to uneven benefits across provinces. These findings suggest that social policies aimed at reducing income inequality should focus on enhancing human capital and promoting urbanization. Additionally, the structure of the national economy should be balanced across sectors to attract FDI into various provinces, thereby fostering economic growth and reducing income inequality. Based on these insights, Vietnam can achieve sustainable economic growth, development, and social transformation in the future.

Keywords: *Human capital, Income inequality, Learning theory, Provinces, Vietnam.*

1. Introduction

Inequality has been a critical problem in the world. The United Nations Agenda considers inequality as one of the seventeen Sustainable Development Goals (SDGs) for a universal call to action for protecting the planet and the peace and prosperity of all people around the world. Income inequality, a difference between disparity in income between individuals or groups within a community or a country, has attracted significant attention from policymakers in recent decades. Income disparity eliminates the efficiency of social and economic policies. A policy to improve living standards should cover all individuals in a country; the wealthy and the poor should be treated equally in a national program. However, the income disparity also contributes to broader social class divisions [1-3]. On the one hand, the poor face inadequate resources to achieve their desired life. These disadvantaged individuals have been vulnerable to economic shocks such as losing jobs or macroeconomic instability. As such, they tend to react aggressively to new reforms or policy changes. These negative reactions potentially lead to a higher crime rate and social instability, adversely affecting the nation's economic and social development. On the other hand, more affluent people are willing to pay more to satisfy their demands, which puts pressure on the increased price of goods and services. Besides, the rich manipulate social norms, do not respect the law, and negatively impact social welfare [4-6]. As a consequence, income inequality increases social contradiction, leading to the probability of political conflicts and revolt, increased crime rates, and

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decreased solidarity between groups of individuals in society [7].

Having a good occupation for poor people is a common way to bridge the income gap. Nevertheless, with industrialization, modernization, and the advancement of technology, there is an even wider disparity in the current labour market depending on labour skills. Hence, employees with better skills can find high-paying jobs. Meanwhile, low-income and labour-intensive jobs have been left for low-skilled labour. As a result, the current social-economic development tends to widen income inequality. Therefore, investing in human capital is a potential solution to possess a high-paying job and sustainably thrive [8].

In Vietnam, income inequality is considered the most crucial issue. From 1993 to 2012, the average income of the bottom 40 per cent grew by 9 per cent annually [9]. The poverty rate in Vietnam reduced from 9.88 per cent in 2015 to 2.75 per cent in 2020. However, in 2022, in the global ranking of income inequality, Vietnam is still ranked 85th out of 169 countries [10]. Table 1 demonstrates that income inequality in Vietnam, measured by the Gini index, decreased gradually from 0.431 in 2016 to 0.373 in 2020 [11]. Particularly, the Northeast and Northwest regions and Central highlands have exhibited a higher income inequality than the national average during the period. Ethnic minorities comprise 15 per cent of the total population but 79 per cent of people with low incomes nationwide in 2020 [12].

Table 1.
Gini coefficient in the period of 2016-2020

	2016	**2018**	**2019**	**2020**
Country's average level	0.431	0.425	0.423	0.373
By residence				
Urban	0.391	0.373	0.373	0.325
Rural	0.408	0.408	0.415	0.373
By regions				
Red River Delta	0.401	0.39	0.387	0.317
Northeast and Northwest	0.433	0.444	0.438	0.42
North-Central Coast and South-Central Coast	0.393	0.383	0.389	0.354
Central Highlands	0.439	0.44	0.443	0.406
Southeast	0.387	0.375	0.375	0.291
Mekong River Delta	0.405	0.4	0.395	0.372

Source: Vietnam General Statistics Office (General Statistics Office of Vietnam, 2021)

Income inequality causes severe consequences related to social quality, educational access, and individual health. For instance, the elderly is reported to be less likely to be included or get access to health care treatment if they have a low level of education, live at a low-income level, or belong to an ethnicity. Besides, United Nations & Development Programme [12] reported that 15 per cent of 15-year-olds living today are predicted not to reach the age of 60, which is due to some diseases such as diabetes, cancer, cardiovascular disease, and many others.

Furthermore, as the macroeconomic strategy, the Vietnamese Politburo guided various national goals at the Central Resolution No. 23-NQ/TW regarding the national industrial development policies by 2030, with a vision to 2045. One of the most important policies with the top priority is to reduce income inequality across regions and provinces to sustain economic growth. Economic growth and development can give disadvantaged citizens more opportunities to improve their socioeconomic conditions. Income inequality has been placed at the centre of the national development goals in Vietnam, implying a significant concern of the government regarding this critical issue.

Previous studies approach income inequality in Vietnam through various aspects: economic growth [13] urbanization [14] gender [15] and many others. However, the impact of human capital on income inequality, especially at the provincial level, has yet to be investigated in the Vietnamese context. Perceiving the critical effect of income inequality on sustainable development in Vietnam, the contributions of the current paper are as follows. First, we establish a theoretical framework to explain the connection between human capital accumulation and income inequality by incorporating

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the learning theory and Kuznets hypothesis. Second, this analysis is one of the first studies in Vietnam to examine the effect of human capital on income inequality at the provincial level. We utilize survey data from Vietnam's Household Living Standard Surveys to estimate income inequality at the provincial level. We then extract provincial macroeconomic data from Vietnam's General Statistics Office (GSO). Various regression techniques, including spatial regression, panel threshold regression, and instrumental variable (IV) regression suggested by Lewbel [16] were used to examine the effect of human capital on income inequality at the provincial level in Vietnam from 2016 to 2020. As such, policy implications have emerged to address the critical issues of income inequality in Vietnam.

Following this introduction, the remainder of this paper is structured as follows. Section 2 develops a theoretical framework to establish the connection between human capital and income inequality. Section 3 presents and discusses the research method and data used in this paper. Section 4 presents empirical findings, followed by the discussion of our findings in section 5. Finally, concluding remarks and policy implications are presented in section 6 of the paper.

2. Literature Review

2.1. A Theoretical Background between Human Capital and Income Inequality

In this study, the Kuznets [17] hypothesis and learning theory are adopted to examine the effect of human capital on income disparity. Regarding economic growth and income inequality nexus, Kuznets [17] hypothesized an inverted-U pattern where income distribution is widened and converged after reaching a certain level of economic growth measured by per capita income. The Kuznets theory emphasizes the weaknesses of the modernization process in which emerging industries put significant pressure on labour demand, leading to the wage gap's expansion between traditionally agricultural sectors and modern industrial sectors. Due to this increased demand, wage gaps continuously grow along with modernization and industrialization in the early economic growth and development stage. Then, attractive salaries force labour to shift from agricultural sectors to modern industrial ones. Consequently, labour supply in industrial sectors is filled by labour forces from the agricultural sector until the labour market in the industrial sectors is at equilibrium. Then, there is no upward pressure on wages in the industrial sectors. However, as labour moves away from the agricultural sector, labour shortages significantly put upward pressure on wages in the agricultural sectors. Besides, while the industrial sector reaches a certain level, the productivity of agricultural sectors has also increased due to adopting new technology. As such, wages in the agricultural and industrial sectors tend to converge later in modernization. Figure 1 describes the relationship between economic growth and income inequality.

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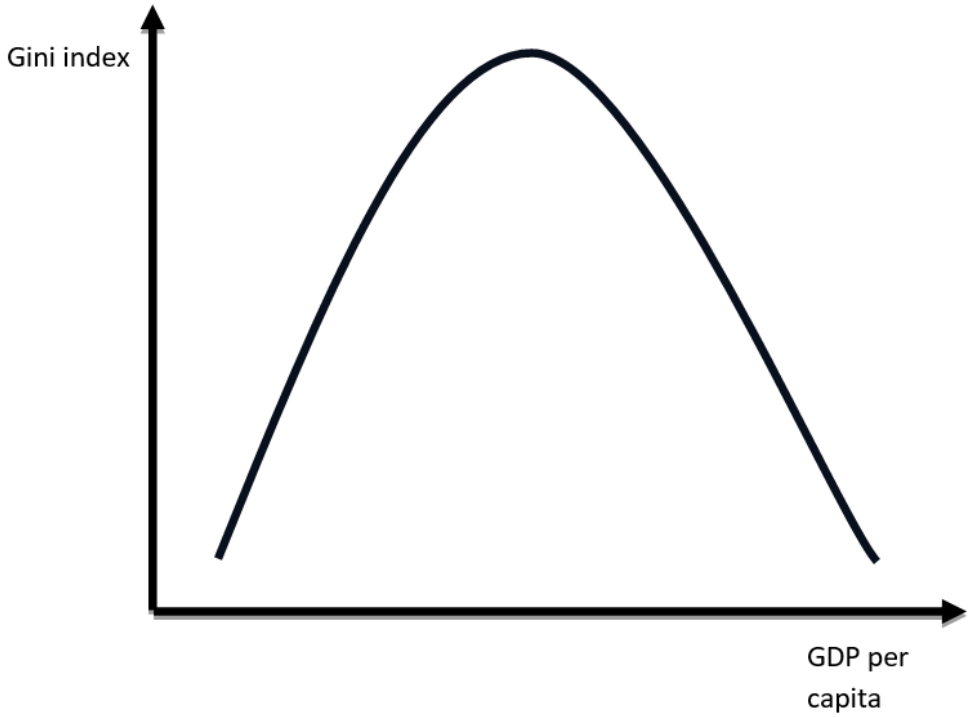

Figure 1.
Kuznets hypothesis about the relationship between economic growth and income inequality.

The literature indicates a bidirectionally causal relationship between human capital and economic development. On the one hand, Oketch [18] argued that increased human capital accumulation results from economic development. On the other hand, human capital is considered a source of economic development [19-23]. Human capital refers to the ability or capacity of individual productivity in an economy. Human capital can be improved by a learning process (learning from a general education on-the-job learning or working experience). Thus, the "learning theory" can formulate human capital accumulation. The "learning theory" has also been described in a theoretical framework explaining the poverty trap [24, 25]. Based on the S-shaped learning curve, human capital accumulation is improved in three stages. In the first stage, where the level of human capital or individual productivity is low, the relationship between investment in human capital and its return is flat. In other words, it requires a considerable investment to produce a moderate increase in human capital. In the second stage, the return shape becomes steeper as a minimal additional investment significantly increases human capital accumulation. Finally, in the third stage, the slope of the productivity line becomes smaller as it requires a considerable investment to receive a minimal increase in return.

Combining the Industrial Revolution and learning theory can explain income dispersion in a society. Because of the industrial revolution, new technology and knowledge emerge. The first stage of a learning theory emerges when people need to learn new concepts and techniques. In this stage, individuals at the top income distribution have the advantage of achieving these new creations and achievements from the Industrial Revolution. Thus, the first stage of a learning theory for these advantageous groups starts earlier. Meanwhile, disadvantageous groups face barriers to achieving new knowledge, and their first stage begins later. It might require more time or investment to reach the second stage. As a result, income dispersion appears in the second stage of a learning theory. On the one hand, advantageous groups accumulate enough human capital and quickly adapt to new industries. Their income increases vertically by improving their productivity in the second stage of the learning theory. On the other hand, disadvantageous groups reach the second stage, at which

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their productivity and income are low. Finally, in the third stage of a learning theory, when new knowledge and technology become more accessible to society, the advantageous groups reach their learning limit and improve their productivity. Meanwhile, the disadvantageous groups are still in the second stage. As a result, the productivity or income of these groups approaches the leading groups, meaning the reduction of income gaps. Figure 2 describes the various stages between a learning theory and income distribution.

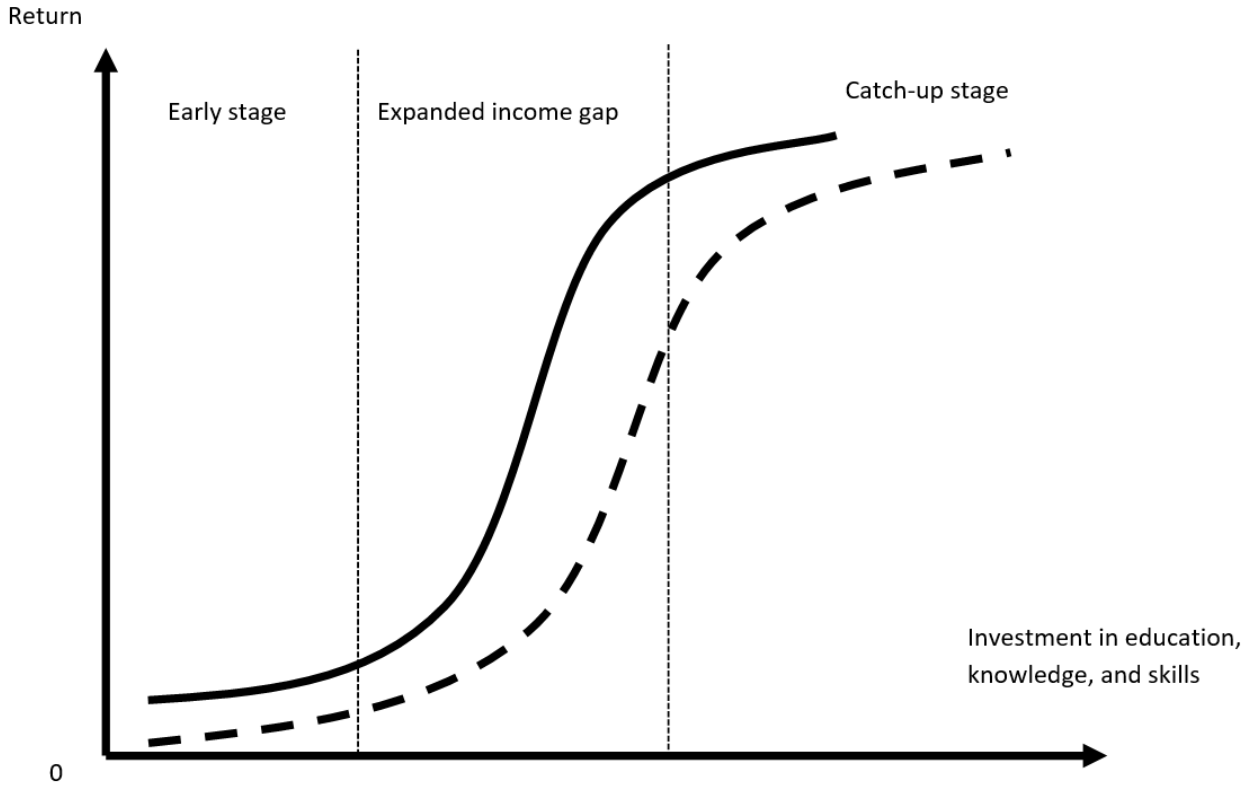

Figure 2.
Learning theory and income distribution.

In conclusion, while the Kuznets [26] hypothesis focuses on income inequality directly between the industrial and agricultural labour markets, the learning theory does not. The learning theory helps explain the process and the rationale for decreasing the income gap. Although there is a distinction between these two theories, they have similarities that are yet to be discussed in empirical research. In this study, we develop a connection between human capital and income inequality based on a learning theory and the Kuznets hypothesis. Based on the learning theory, we consider a non-linear relationship between human capital and income inequality. However, the catching-up mechanism for human capital formation may occur later in economic growth.

2.2. Empirical Evidence of the Effect of Human Capital on Income Inequality.

Hu [27] examined how income inequality affects human capital inequality. The authors considered increased income inequality associated with increased human capital inequality. When discussing the impact of human capital inequality on income inequality, Lin [28] considered the effect of an individual's educational inequality on an individual economic inequality and confirmed that higher education reduces income inequality in Taiwan. This result is in line with Hu [27]and Santos [25]. Also, Castelló-Climent and Doménech [29] argued that human capital inequality has a

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direct effect on reducing income inequality.

Regarding the impact of human capital on income inequality, Lee and Lee [30] tested the effect of human capital, measured by educational attainment, on income distribution. The authors concluded that educational and income disparities are reduced when education expands. In addition, this result was also affirmed by Odoardi, et al. [31]. Furthermore, according to Becker and Chiswick [32] education aims to improve skills to increase personal and social income, decreasing income distribution dispersion. However, based on the theoretical analysis of the relationship between human capital and inequality developed by Mincer [33] on-the-job training, proxied for human capital, is the main factor influencing an unequal income distribution. Also, Becker and Chiswick [32] and Odoardi, et al. [31] confirmed the positive impact of human capital on income inequality. However, Ram [34] provided insignificant effects regarding the effect of education on income inequality. Besides, Moyo, et al. [35] applied the pooled mean group (PMG) estimator and found that increased human capital leads to decreased poverty. However, human capital positively affects income inequality, which indicates unequal economic opportunities and inequality in the education system. Therefore, the effect of human capital on income inequality needs to be clarified in the current literature.

Based on the above considerations, this paper contributes to the current literature on the relationship between human capital and income inequality in two aspects. First, we combine the learning theory and a Kuznets hypothesis to explain the relationship between human capital and income inequality. Second, we examine the effect of human capital on income inequality in Vietnam by utilizing the Vietnamese Household Living Standard Survey (VHLSS) and provincial statistics data.

3. Data and Methodology

In this study, we examine the effect of human capital on income inequality across 63 provinces in Vietnam. First, we start with the Kuznets [26] hypothesis, which argues the inverted U-shaped relationship between economic growth and income inequality [26]. The hypothesis is described below:

$$GINI_{it} = + GDPpc_{it} + GDPpc^{2}_{it} + C_{it} + e_{it} \quad (1)$$

where: GINI is the Gini coefficient measuring income inequality, GDPpc is GDP per capita, GDPpc2 is the square of GDP per capita, and C is the vector of control variables, e is the error term, and the subscript "t" and "i" are cross-sectional dimension and time-series dimension, respectively.

Current literature indicates that human capital is considered to have a non-linear relationship with income inequality [36]. In particular, the relationship between human capital and income inequality follows the quadratic form. Then, the presence of human capital in equation (2) is described as follows:

$$GINI_{t} = + GDPpc_{it} + GDPpc^{2}_{it} + HDI_{it} + HDI^{2}_{it} + Z_{it} + u_{it} \quad (2)$$

Where *HID* and HDI^{2} are human capital and squared terms of human capital, respectively. Z is a vector of control variables, and u is the error term.

However, a squared term of GDP per capita and human capital can yield a serial correlation in the regression. A more comprehensive approach is required to allow us to use the original form of GDP per capita and human capital and imply the quadratic relationship between the two variables (GDP per capita and its squared variable) and income inequality. As such, we utilize a threshold regression to examine the effect of human capital on income inequality. Threshold regression can estimate the effect of GDP per capita and human capital on income inequality across different income levels (as income is used as the threshold variable). Then, the non-linear relationship between the two pairs of variables (i.e., between GDP per capita – income inequality and human capital – income

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inequality) can be examined when there are different findings between a lower and a higher income threshold. Regardless of the potential advantages of the threshold regression, we cannot assure that the quadratic form of the relationship only appears between the lower and upper thresholds. As such, we consider incorporating the squared terms of GDP per capital and human capital in our threshold regression.

Besides, for a within-country analysis, there could be a potential spatial effect between neighbouring provinces. Especially in the case of Vietnam, provinces sharing borders always have close relationships in economic and social development [37-41]. As such, we employ a spatial analysis to estimate the effects of human capital on income inequality in Vietnam while considering spill-over effects between neighbouring provinces. The general function of a spatial regression is illustrated as follows:

$$y_{it} = \delta y_{i,t-1} + \zeta \sum_{i \neq j} w_{ij} y_{i,t-1} + \rho \sum_{i \neq j} w_{ij} y_{it} + \sum_{k=1}^{K} \beta_k x_{kit} + \sum_{i \neq j} \sum_{k=1}^{K} \theta w_{ij} x_{kit} + u_i + \alpha_i + \gamma_t$$

$$u_{it} = \lambda \sum_{i \neq j} w_{ij} u_{jt} + \varepsilon_{it}$$

Where: w_{ij} is the weighted matrix representing the correlation between province "i" and province "j"; y is the dependent variable; x is the independent variable; ζ and ρ are the spatial effects of the dependent variable; β is the regression coefficient; θ is the spatial effect of independent variables; u is provincial fixed or random effects; γ is time effect; λ is the correlated effect of unobservable; and u and ε are error terms.

Spatial regression includes various types of subcategories such as the Spatial Autocorrelation Model (SAC), Spatial Durbin Model (SDM), Spatial Autoregressive Model (SAR), Spatial Error Model (SEM), and Generalised Spatial Panel Random Effects Model (GSPRE). The appropriate model is determined using Akaike's information criterion (AIC) and Bayesian information criterion (BIC) test statistics. The lowest absolute value of the AIC or BIC indicates the appropriate model for our analysis. In addition, there is a random or fixed provincial effect in the spatial regression (u_i). We employ the Hausman test to choose between random or fixed spatial effects. Besides, in spatial regression, we control for potential geographical effects from neighbouring provinces. We employ a contiguity-weighted matrix rather than the distance-based weighted one.

Furthermore, we also employ instrumental variable regression (IV regression), as suggested by Lewbel [16] to deal with potential endogenous issues of reversed causality from income inequality to human capital. The IV regression is advantageous if the literature cannot specify appropriate instrumental variables. The new IV regression by Lewbel [16] identifies instrumental variables by utilizing heteroskedasticity of the model errors. In conclusion, threshold and IV regression provide linear estimation, while spatial regression estimates the geographical effects of neighbouring provinces. Then, the three regression methods can provide robustness and different angles for our discussions regarding the effect of human capital on income inequality across provinces in Vietnam.

To estimate the effect of human capital on income inequality in Vietnam, we employ data from the Vietnam Household Living Standard Survey (VHLSS) and Vietnam's General Statistics Office (GSO). VHLSS provides information about household incomes to calculate the Gini coefficient proxied for the provincial income inequality index. The GSO annual data reports collect human capital and other control variables. Because VHLSS is collected biannually, we use three waves of World Bank [9] to incorporate with GSO to conduct panel data for our analysis.

Household incomes used to calculate the Gini coefficient include all income sources, including labour incomes, income from household productions and any other related household income. The Gini coefficient was developed by Gini [42] and has then been widely used in research on income inequality [15, 43, 44]. Starting from the Lorenz curve, which visualizes the shape of inequality (in

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Figure 3 below, a dashed line represents the shape of inequality), the Gini coefficient is a significant measurement of income inequality. The Gini coefficient is calculated as $Gini = 1 - \sum_{i=1}^{N}(x - x_{i-1})(y - y_{i-1})$.

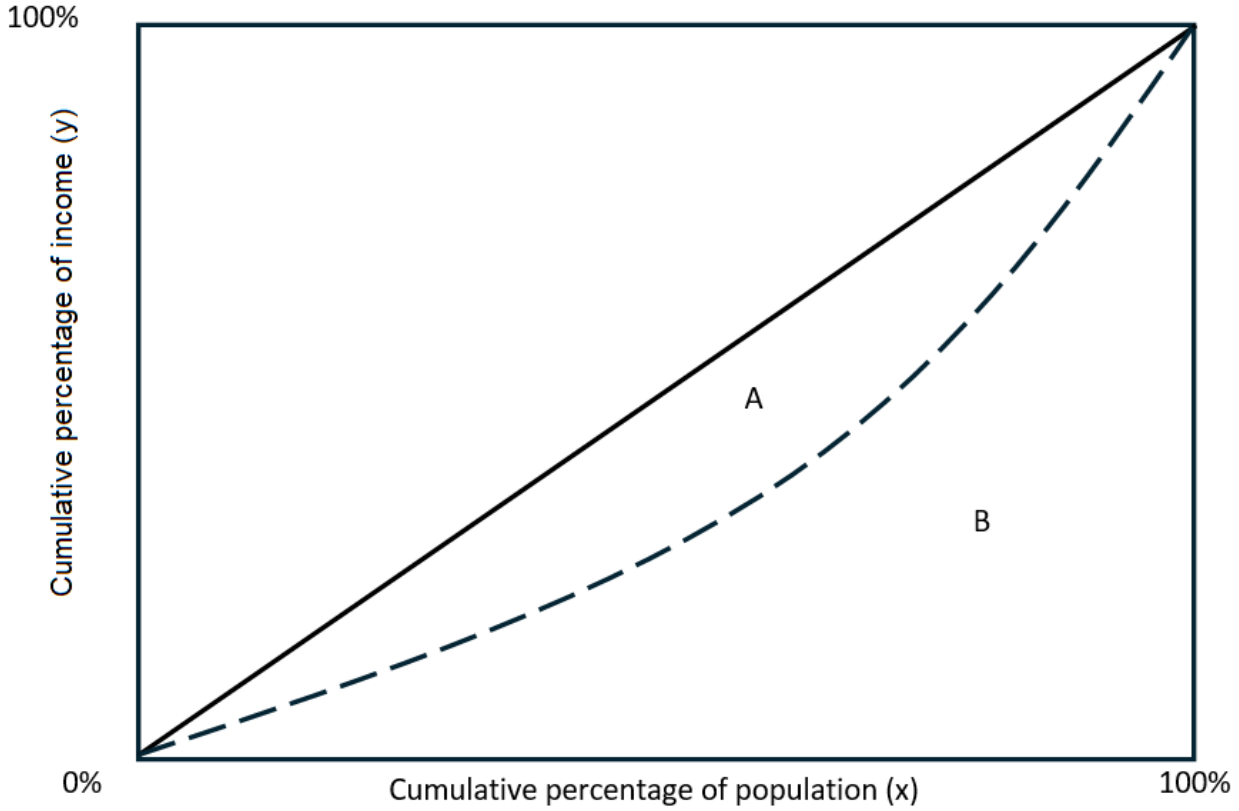

Figure 3.
The Lorenz curve and the proportion of income within a society.
Source: Handbook of Poverty and Haughton and Khandker [45].

Human capital is proxied by the Human Development Index (HDI), which GSO reports annually. HDI is proposed by the United Nation [46] as follows:

$$HDI = \sqrt[3]{H.E.I}$$

Where HDI is the human development index, H is the health index, E is the educational index, and I is the income index.

For control variables, Kuznets [26] considered that changes in economic structure from rural agriculture to urban industry are regarded as one of the primary sources of income inequality [14, 45, 47-49]. Therefore, we use the contribution of agriculture, industry, and services to provincial GDP as proxies for changes in economic structure. Besides, urbanization represented by a proportion of the urban population can also be used as a proxy for industrialization and urbanization [46, 50]. Easterly and Fischer [51] argued that inflation can cancel the government's efforts to reduce income inequality. Therefore, we use the average of the monthly Consumer Price Index (CPI) as a proxy for inflation. Besides, we employ government expenditure as a proxy for the government's efforts to improve social-economic conditions. Furthermore, Vietnam has been opening to attract foreign direct investment (FDI) to foster its economy since 1986. However, many reports exhibited a negatively

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unexpected effect of FDI on income inequality [52-55]. Therefore, we also consider the effect of FDI on income inequality in our analysis. Missing data have been found for seven provinces. As such, the final sample contains 56 (out of 63) provinces in three years (2016, 2018, and 2020). Table 2 presents the descriptive statistics. Figure 4 exhibits the analytical framework.

Table 2.
Descriptive Statistics.

	N	Mean	Median	Min.	Max.
GINI Index	168	0.41	0.403	0.299	0.576
HDI Index	168	0.684	0.674	0.559	0.799
GDP per capita (VND million)	168	59.465	48.941	20.55	295.34
Proportion of urban population	168	0.294	0.244	0.098	0.878
Contribution of agriculture to GDP	168	0.22	0.223	0.007	0.501
Contribution of industry to GDP	168	0.342	0.308	0.131	0.785
Contribution of services to GDP	168	0.372	0.376	0.027	0.665
Inflation (Consumer Price Index, %)	168	100.463	100.246	99.785	106.755
Government expenditure (VND million)	168	8,886	6,971	742	46,045
Foreign direct investment (VND million)	168	7,497	1,357	0.2	61,257

In Table 2, income inequality and human capital vary across provinces with moderate variation. However, GDP per capita, urban population, and contribution of agriculture, industry, and services to GDP have exhibited a relatively wide range. This observation implies the unbalance of the social and economic structures between provinces in Vietnam. Figure 4 illustrates our analytical framework regarding the effect of human capital on income inequality in Vietnam by incorporating the learning theory and Kuznets hypothesis.

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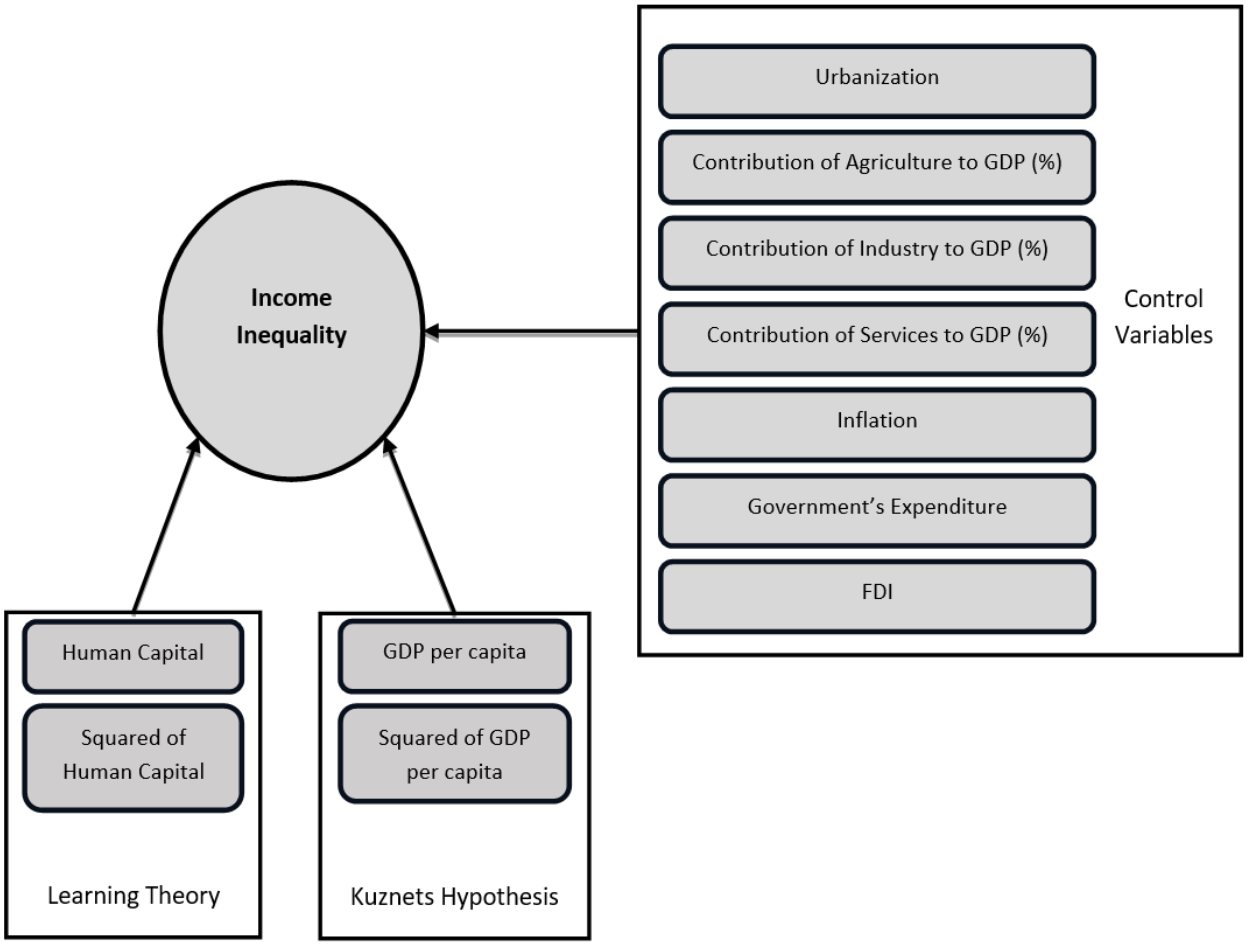

Figure 4.
The analytical framework.

4. Empirical Results and Discussions

4.1. Empirical Results

Figure 5 and Figure 6 present a distribution of human capital and income inequality across 63 provinces in Vietnam in 2016, 2018, and 2020. In Figure 5, the development of human capital measured by the HDI index has been maintained consistently from 2016 to 2020 across provinces in Vietnam. There is a wide dispersion of human capital levels across provinces in Vietnam from 2016 to 2020. Notably, the highest level of human capital, represented by the darkest blue colour, has been linked to the Red River area (the middle east of the north region) and four provinces [4] in the east of the southern region. They are key economic and industrial provinces in Vietnam. Notably, provinces near these two regions tend to have higher human capital than farther provinces, represented by the change from dark blue to lighter blue when moving far from the two central areas. Besides, the lowest level of human capital, presented by the light blue, concentrates in the west of the northern and middle highland regions. These provinces are economically disadvantaged and bordered regions. Regardless of the consistent trend of human capital development from 2016 to 2020, there are some minimal changes in human capital levels in the west and east of the northern region and in the south of the middle region (which is a highland region and coastal areas).

Figure 6 exhibits the distribution of income inequality measured by the GINI index across 63 provinces in Vietnam in 2016, 2018, and 2020. Generally, there is also a wide dispersion of income inequality across provinces in Vietnam. A mixed trend of income inequality from 2016 to 2020 has

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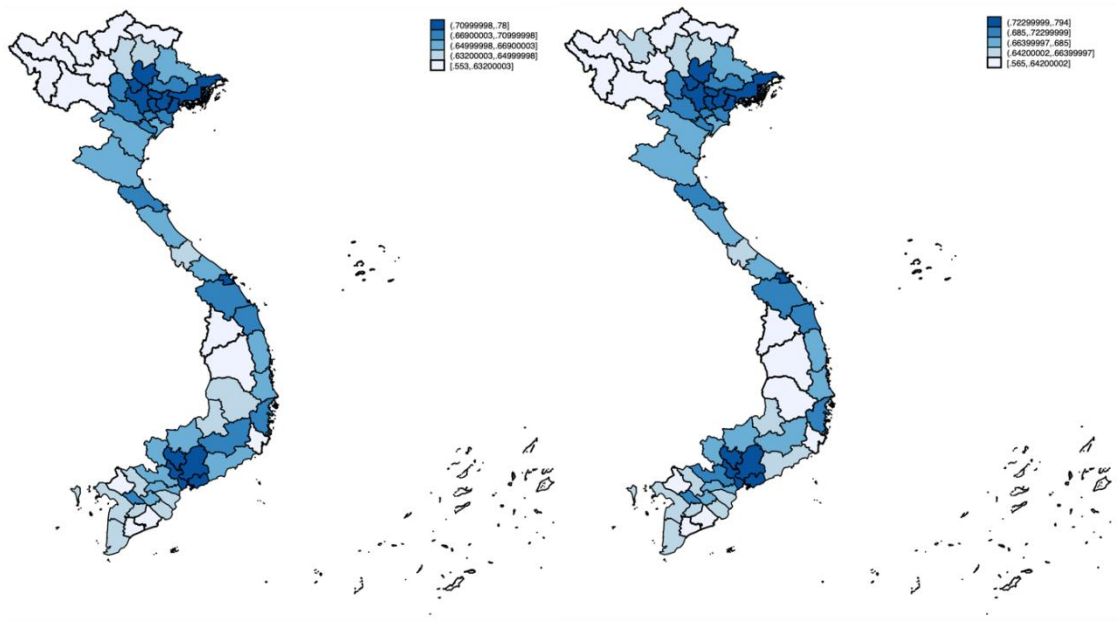
been revealed. Provinces in the north and the south of the middle region experienced the critical issues of income inequality as the colour became darker. These provinces are mostly located in the cross-bordered regions. Furthermore, provinces with high level of income inequality are located within an area. Moving farther from the central regions of income inequality, the level of inequality tends to be lower with a lighter orange colour. Provinces with lower levels of income inequality have been found in the south of the central region. On the other hand, many provinces maintained their income distribution level, as their colours stayed the same from 2016 to 2020. Combining the two figures, a general picture exhibits a potential correlation between a low level of human capital and a high level of income inequality.

Table 3 presents the Hausman test for our selection between random versus fixed spatial effect and the AIC and BIC test for the appropriate spatial regression models. From the Hausman test, the result rejects the null hypothesis of the non-systematic difference between regression coefficients. Therefore, the spatial fixed effect is selected. While using the spatial fixed effect, GSPRE is not appropriate. Then, we used AIC and BIC to decide on the appropriate models for SAC, SAR, SDM, and SEM. AIC and BIC do not provide consistent results of the proper spatial regression model. AIC indicates SEM is the most appropriate model, while BIC prefers SAR as the most appropriate model. We use both SEM and SAR to process the spatial regression.

Table 3.
Hausman test and spatial model selection by AIC and BIC.

Panel A: Hausman test between spatial random effect and fixed effect	**Chi² test statistics**	**P-value**
Null hypothesis: difference in coefficients is not systematic	49.88	0.001
Panel B: Model selection	**AIC**	**BIC**
Spatial Autocorrelation Model (SAC);	-849.673	-805.94
Spatial Autoregressive Model (SAR);	-848.471	**-807.86**
Spatial Durbin Model (SDM);	**-882.576**	-807.6
Spatial Error Model (SEM)	-848.165	-807.55



2016 2018

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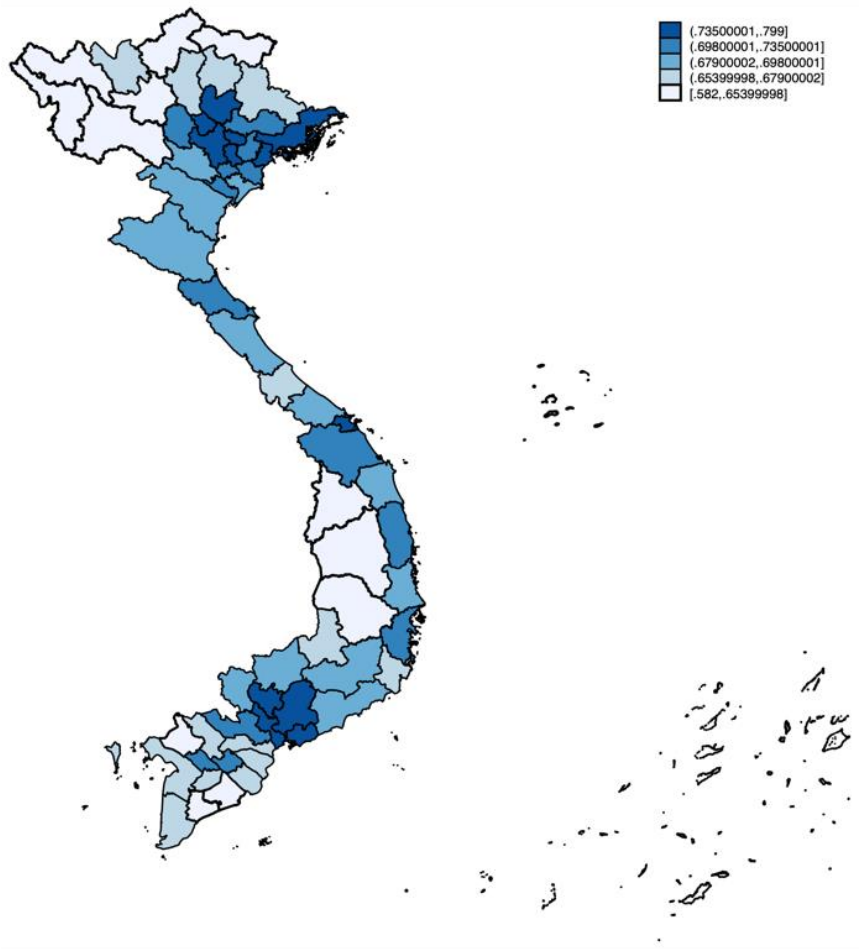

2020

Figure 5.
Distribution of human capital levels measured by the HDI index across 63 Vietnamese provinces in 2016, 2018, and 2020.
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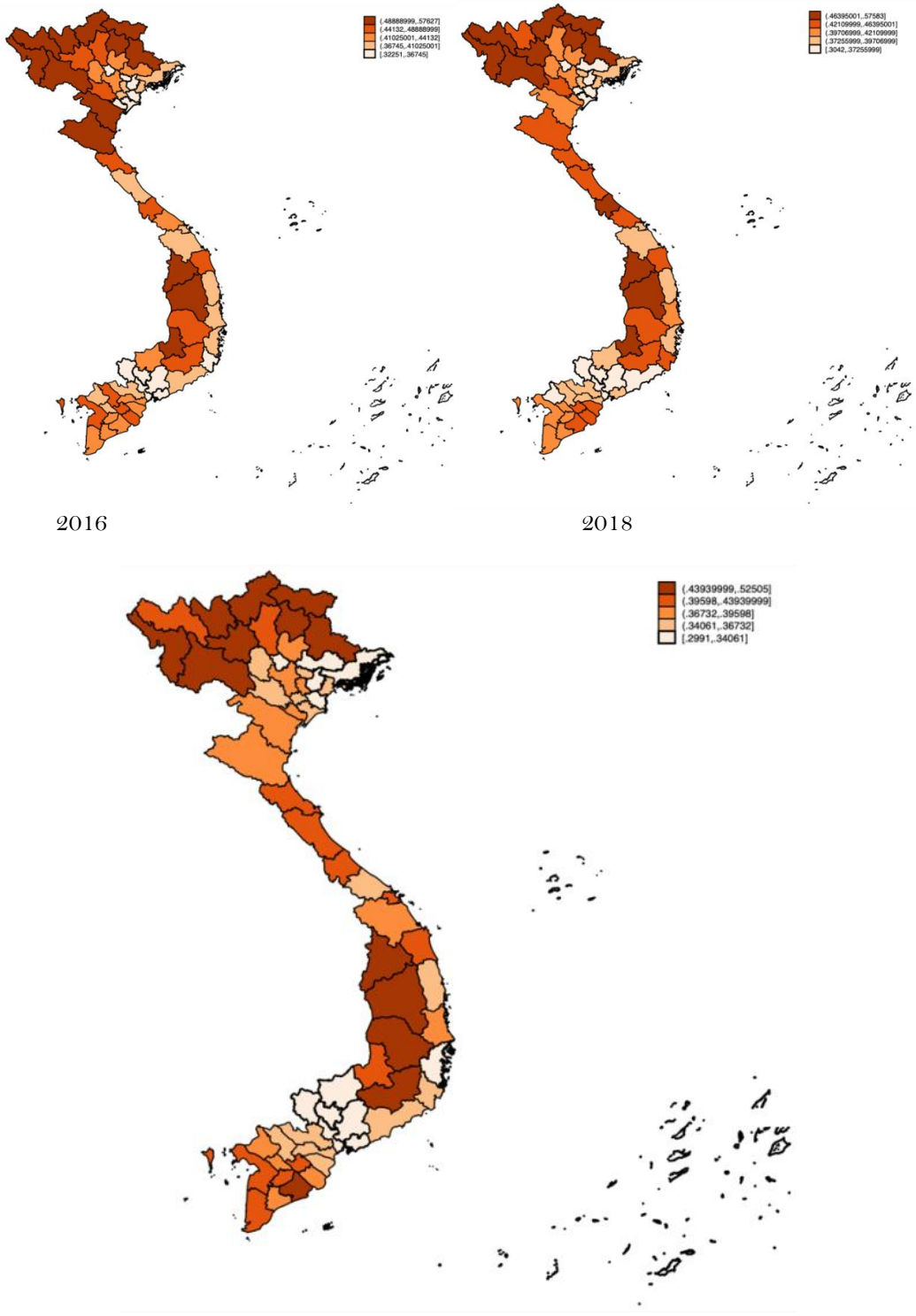

Figure 6.
Distribution of income inequality levels measured by the GINI index across 63 Vietnamese provinces in 2016, 2018, and 2020.
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Table 4 exhibits spatial regression with provincial fixed effect using the SDM and SAR models. The two models rejected the significant effect of human capital on income inequality and their nonlinear relationship. However, both SDM and SAR confirmed the U-shaped relationship between economic growth represented by GDP per capita and income inequality in Vietnam. In the SDM regression, urbanization and economic structure significantly affected income inequality. According to the SDM model, urbanization directly and indirectly reduces income inequality. In other words, the urbanization process in its neighbouring provinces affects the income inequality of a current province. Besides, SDM also presents the indirect effects of economic structure on income inequality. On the one hand, a more significant contribution of agriculture to provincial GDP in neighbouring provinces is negatively associated with income inequality in a current province. On the other hand, contributions of industry and services to the GDP of neighbouring provinces tend to increase income inequality in certain provinces. Surprisingly, inflation has a positive effect on reducing income inequality. At the same time, FDI tends to increase regional income inequality in both SDM and SAR models. Last but not least, the "Zeta (ζ)" value confirms the spatial effect of the independent variable, meaning that income inequality in a particular province can be affected by income inequality in its neighbours. (ζ) It is not significantly significant in the SDM model but in the SAR model.

Table 4.
Spatial regression by SDM and SEM models.

The dependent variable is income inequality (GINI index)	**SDM**	**SDM**	**SAR**
	Direct effects	**Indirect effects (Spatial-weighted effect of dependent variables)**	
Human capital (HDI)	3.975	4.333	2.476
	-4.073	-4.653	-4.427
Squared of Human capital (HDI)	-3.406	-2.828	-2.726
	-3.044	-3.371	-3.24
GDP per capita (in log)	-0.415**	0.052	-0.356*
	-0.163	-0.242	-0.192
Squared of GDP per capita (in log)	0.050**	-0.013	0.043*
	-0.02	-0.03	-0.024
Urbanization	0.004	-0.679***	0.055
	-0.08	-0.202	-0.092
Contributions of Agriculture to GDP (%)	0.002	-0.078	-0.053
	-0.097	-0.188	-0.102
Contributions of Industry to GDP (%)	-0.032	0.089	-0.015
	-0.04	-0.084	-0.049
Contributions of Services to GDP (%)	-0.014*	0.051**	-0.008
	-0.008	-0.022	-0.008
Inflation (CPI)	-0.003	-0.002	-0.004*
	-0.002	-0.004	-0.002
Government expenditure (in log)	0.009	0.002	0.009
	-0.009	-0.017	-0.012
FDI (in log)	0.004**	0.016***	0.004*
	-0.002	-0.005	-0.002
Zeta (ζ)		-0.028	0.119*
		-0.109	-0.071
Squared of idiosyncratic errors		0.000***	0.000***
		0	0
Observations	168	168	168
R-squared	0.035	0.035	0.35
Number of provinces	56	56	56

Note: Provincial fixed effect is reported; Zeta (ζ) is the spatial effect of income inequality of neighbour provinces; robust standard errors in parentheses; ***, **, and * are statistically significant at 10, 5, and 1 per cent, respectively.

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Table 5 presents empirical results from threshold regression and IV regression. Generally, we find consistent results between threshold and IV regression, except for the regression coefficient of FDI. In the threshold regression, we perform two alternatives (with and without squared terms of human capital and GDP per capita) as described in the methodology section. The threshold regression does not provide evidence for the significant non-linear relationship between two pairs: human capital and income inequality and economic growth and income inequality. There is a consistently and significantly negative effect of human capital on income inequality across threshold regions in the first set-up of threshold regression (the second and third of Table 5). Besides, the effect of squared human capital on income inequality is insignificant (the fourth and fifth column of Table 5). However, the IV regression provides the significant effects of squared human capital and squared GPD per capita on income inequality. This evidence confirms a U-shape relationship between human capital and income inequality and between economic growth and income inequality in Vietnam. This evidence contradicts Kuznets's hypothesis of the inverted U-shape relationship between economic growth and income distribution.

Regarding other control factors, threshold regression proves that urbanization significantly negatively affects income inequality at lower income thresholds. Furthermore, IV regression statistically confirms the result. Besides, the contribution of services to provincial GDP is positively and significantly associated with income inequality in provinces at the lower GDP per capita threshold. At the same time, a negative but insignificant relation is presented for those provinces at the upper threshold. However, there is a contradiction between threshold regression and IV regression regarding the results of FDI. Threshold regression reveals a weakly significant effect of FDI on increasing income inequality in provinces at the upper threshold. Meanwhile, IV regression presents FDI's enormous negative impact on income inequality. This result from threshold regression is similar to the outcomes of spatial regression in Table 4.

Table 5.
Threshold regression and IV regression results.

The dependent variable is income inequality (GINI index)	**Threshold regression**				**IV regression**
	GDP per capita < VND 39.99 million	**GDP per capita > VND 39.99 million**	**GDP per capita < VND 39.99 million**	**GDP per capita > VND 39.99 million**	
Human capital (HDI)	-1.563***	-0.886**	-0.456	-2.224	-3.808**
	-0.326	-0.353	-4.02	-4.367	-1.909
Squared of Human capital (HDI)			-0.708	1.086	2.533*
			-2.932	-3.254	-1.396
GDP per capita (in log)	0.038	-0.019	-0.879	-0.3	-0.246**
	-0.038	-0.024	-0.731	-0.207	-0.11
Squared of GDP per capita (in log)			0.131	0.032	0.026**
			-0.104	-0.025	-0.013
Urbanization	-0.172**	0.004	-0.175**	-0.002	-0.054*
	-0.066	-0.033	-0.071	-0.033	-0.029
Contributions of Agriculture to GDP (%)	0.08	0.032	0.09	0.032	-0.113*
	-0.118	-0.065	-0.121	-0.065	-0.061
Contributions of Industry to GDP (%)	0.148	0.007	0.139	0.007	-0.073*
	-0.107	-0.043	-0.109	-0.043	-0.039
Contributions of Services to GDP (%)	0.131*	-0.009	0.137*	-0.013	-0.006
	-0.07	-0.013	-0.07	-0.013	-0.011
Inflation (CPI)	-0.002	-0.003	-0.001	-0.003	-0.003
	-0.003	-0.002	-0.006	-0.003	-0.002
Government expenditure (in log)	0.012	-0.004	0.015	-0.006	0.005
	-0.013	-0.012	-0.014	-0.012	-0.006
FDI (in log)	0.004	0.005	0.004	0.005*	-0.008***
	-0.003	-0.003	-0.003	-0.003	-0.002

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Constant	1.366***	2.405*	2.461***
	-0.313	-1.288	-0.546
Test for the existence threshold	54.16**	52.65*	
	[0.027]	[0.080]	
Observations	168	168	168
R-squared	0.588	0.608	0.5430.543

Note: The threshold level of the threshold regression is the annual income per capita at 39.99 million VND provided by the software analysis; robust standard errors in parentheses; p-value in square brackets; ***, **, and * are statistically significant at 10, 5, and 1 per cent, respectively.

4.2. Discussions

Our study combines the Kuznets theory and a learning theory to establish the relationship between human capital and income inequality. Besides, we use spatial, threshold, and IV regression to investigate the effect of human capital on income inequality at a provincial level in the Vietnamese context.

First, the effect of a learning theory on income inequality cannot be confirmed using all regressions. However, human capital has a linear effect on reducing income inequality across provinces in Vietnam. The finding is confirmed using the threshold regression and IV regression in Table 4 but not by a spatial regression, as presented in Table 3. However, other studies have found a significant effect of education as an element of human capital on income inequality using SAR in Turkey's context [56] and spatial-clustered regression in the US [57]. Regarding the threshold regression in Table 4, human capital proxied by the HDI (human capital index) significantly impacts income inequality below and above the threshold (columns 2 and 3 of Table 4). Similarly, Molla [58] pointed out that education, a key proxy for human capital in various academic studies, has a statistically significant and negative association with income inequality. Besides, our findings, in which human capital significantly reduces income inequality, are consistent with previous research in the literature [29, 30, 59].

On the Kuznets hypothesis, the U-shaped relationship between economic growth and income inequality is found using a spatial regression and IV regression. This result contradicts Kuznets's theory of the inverted U-shaped relationship between per capita GDP and income distribution. Our results confirm the U-shaped relationship between economic growth and income inequality, which implies that income inequality may be reduced at the early stage of economic growth. However, when income inequality reaches a certain level, it increases as the economy grows further. This finding is consistent with Hung, et al. [60] but contradictory with Nguyen [39]. Both Hung, et al. [60] and Nguyen [39] examined the effect of economic growth on income inequality. Our paper uses different econometric models and data. Our current paper and Hung, et al. [60] found a U-shaped relationship between economic growth and income inequality. In contrast, Nguyen [39] found an inverted U-shaped relationship. The mixed findings in the literature on the growth-inequality nexus still open the potential for further research.

Furthermore, urbanization reduces income inequality using spatial regression (Table 4) and threshold regression (Table 5). Especially the effect of urbanization on income inequality is statistically significant in poorer provinces where the provincial GDP per capita is below VND 39.99 million (the second and fourth columns in Table 5). This finding confirms that urbanization and industrialization help narrow income distribution in disadvantaged regions. Particularly, the urbanization process results in changes in the economic structure, which are more toward modernization and industrialization. This process potentially increases labour demand, which leads to improved income per capita in disadvantaged provinces. Especially in underprivileged provinces, most of the labour force is unskilled, mainly involving industries with labour intensity. Urbanization in these provinces improves unskilled labour income, narrowing income distribution. However, the development of capital-intensive industries such as services requires skilled labour. On the one hand, skilled labourers have already acquired higher incomes than unskilled labourers. On the other hand,

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developing services in specially disadvantaged provinces (where a supply of skilled labour is limited) pushes demand for skilled labour even higher, resulting in a widened income gap between skilled and unskilled labour in disadvantaged provinces. As such, service sectors increase income inequality at a lower threshold, but no evidence is related to agriculture and industry. However, other studies regarding the effect of urbanization from Wu and Rao [61] suggested that urbanization has an inverted U-shaped relationship with income inequality in the Chinese context. Additionally, our findings contradict with Adams and Klobodu [62] in which the authors found that urbanization expands income inequality in 21 Sub-Saharan African countries. Different socioeconomic structures and macroeconomic orientations between Vietnam and Sub-Saharan African countries might cause different findings.

Notably, government expenditure has an insignificant association with income inequality. This finding rejects government expenditure's effort to reduce income inequality in the Vietnamese context. In accordance with our findings, Anderson, et al. [63]; Anderson, et al. [64] and Muinelo-Gallo and Roca-Sagalés [65] confirmed that the effect of government expenditure on income inequality varies depending on proxies for government expenditure and income inequality. Therefore, various forms of government expenditure might affect income inequality differently.

Finally, FDI is positively associated with income inequality using spatial regression (Table 3) and threshold regression in advantaged provinces (column 4 of Table 4). However, the IV regression (column 5 of Table 4) reveals a contradictory result: FDI statistically reduces income inequality. On the one hand, Vietnam's Ministry of Planning and Investment reported that 19 out of 21 sectors had received FDI [66] and among these, processing and manufacturing sectors accounted for the most significant proportion, followed by real estate and electricity production and distribution. These are industries requiring skilled labour and higher labour discipline than domestic enterprises. Therefore, labour incomes in the sectors receiving FDI might be higher than those in other sectors. Thus, the income gap can potentially be widened. On the other hand, the effect of FDI on income inequality can be affected by socioeconomic activities from neighbouring provinces, which is confirmed by a statistically significant effect using spatial regression (in Table 4). Therefore, when considering IV regression, the method cannot incorporate the effect of neighbouring provinces in its analysis, which might lead to a misleading conclusion. Compared with previous studies, the expanding effect of FDI on income inequality is consistent with Taylor and Driffield [67] for the United Kingdom but contradictory with Chen [68] for China. This evidence reveals that the effect of FDI on income inequality might vary from country to country and depends on the invested sectors.

5. Conclusions

The current paper focuses on explaining the effect of human capital on improving income inequality across 63 provinces in Vietnam using three cross-sectional data in 2016, 2018, and 2020. We utilize two separate fundamental theories, namely the Kuznets hypothesis and a learning theory, to develop our theoretical framework. Besides, we employ spatial, threshold, and IV regression to conduct our empirical analysis to examine the effect of human capital on income inequality at the provincial level in Vietnam.

Key findings from our analysis can be summarized as follows. *First*, based on the learning theory, we do not confirm a non-linear effect of human capital on income inequality. However, we find a linear effect of human capital development on income inequality in Vietnam using threshold regression. *Second*, based on Kuznets's hypothesis, we found a U-shaped relationship between economic growth represented by GDP per capita and income inequality. The result contradicts the original Kuznets hypothesis but is consistent with previous research on growth-inequality nexus in developing countries. *Third*, urbanization is revealed to significantly reduce income inequality in poorer provinces whose GDP per capita is lower than VND 39.99 million. Fourth, the contribution of services tends to increase income inequality in disadvantaged provinces. Fifth, foreign direct investment also widens income inequality in Vietnam.

Based on these findings, policy implications have emerged. *First*, promoting the development of human capital is a priority mission for Vietnam to not only reduce income inequality but also improve

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economic and social development. *Second*, policies focused on improving economic growth should consider income inequality, as inequality tends to increase with economic growth in the Vietnamese context. *Third*, urbanization is good for disadvantaged provinces to reduce income inequality. However, the Vietnamese government should consider appropriate sectors and industries when investing in these provinces because the contribution of services in these disadvantaged provinces increases income inequality. Finally, attracting FDI is a good way to improve domestic capital for short-term development. However, FDI tends to increase income inequality. Therefore, the government should prepare an appropriate national plan to accumulate the country's internal capital sources; then, the country can step in to reduce its dependence on FDI as external support to foster economic development and reduce the effect of FDI on increasing income inequality. Incorporating the effects of urbanization and FDI, the Vietnamese government can initiate and implement various strategies to allocate FDI to disadvantaged regions and provinces to support their economic growth and simultaneously reduce income inequality.

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