

Influence of Human Relations on the Economic Development – The Case of Border Areas in the Vietnamese Northern Mountainous Provinces in the Doi Moi period

Dr. Luong Quang Hien

Academy of Finance, Hanoi, Vietnam -10000

Email address: luongquanghien@hvtc.edu.vn

Abstract—Developing the digital economy involves leveraging digital technology and data to create innovative business models that transform traditional production processes into ecosystem-based operations. This integration enhances productivity and responds effectively to consumer needs. Learning from the experiences of developed countries is crucial for Vietnam as it formulates policies for its own digital economy amidst global integration. This article analyzes international digital economy development experiences, assesses Vietnam's current status, identifies existing advantages and challenges, and recommends policies to foster the growth of Vietnam's digital economy.

Keywords—Human relations, economic development, mountainous provinces.

I. INTRODUCTION

In the current era of globalization and digital transformation, ensuring sustainable and inclusive development across all regions and demographic groups - particularly among ethnic minorities residing in border and mountainous areas - has become an essential priority in national development strategies. The northern mountainous provinces of Vietnam, characterized by rugged terrain, underdeveloped infrastructure, and a highly diverse ethnic population, have long been among the country's most disadvantaged regions. Despite numerous government interventions aimed at socio-economic upliftment, persistent disparities in income, living standards, and access to public services between highland and lowland areas continue to underscore the structural limitations of existing policies. Against this backdrop, a systematic inquiry into the unique ethnic configurations and the role of socio-cultural indicators - such as gender, education, marital age, and digital access - on regional economic performance is both timely and necessary.

Beyond its empirical urgency, this topic reveals a notable academic gap. The majority of prior studies concerning ethnic minorities and borderland development in Vietnam tend to be qualitative and descriptive in nature, with limited analytical focus on the causal relationships between socio-cultural factors and economic growth outcomes. Moreover, the integration of socio-demographic variables - such as female labor force participation, female teacher ratios, the number of female students, marital age, and internet accessibility - into econometric models remains underdeveloped. Consequently, this research not only responds to practical development concerns but also aims to contribute to the scholarly discourse on ethnic-inclusive development and gendered economic policy through a quantitatively grounded, interdisciplinary framework.

One of the key practical contributions of this research lies in its potential to inform and enhance evidence-based policy formulation. In an era of fiscal discipline and strategic resource allocation, development policies targeting ethnic and mountainous regions must be underpinned by robust data and context-sensitive analysis. By exploring the empirical linkages between social indicators and provincial economic growth, this study provides actionable insights for policymakers - particularly in determining whether investment in female education, gender equity in employment, or marital age reform would yield optimal development returns in specific regions.

Furthermore, this study supports the design of contextually tailored interventions by local authorities, international development agencies, and civil society organizations. Rather than applying one-size-fits-all programs, development initiatives can be more precisely adapted to the socio-cultural fabric of specific ethnic communities. In doing so, this research helps mitigate the risk of "automating inequality" during the digital transformation process, and instead supports the creation of inclusive, culturally sensitive development pathways.

From an academic standpoint, this research advances theoretical understanding in at least three intersecting domains: inclusive development theory, new institutional economics, and human capital theory. By quantifying the effects of gendered educational attainment, social norms surrounding marriage, and access to digital infrastructure on economic growth, the study illuminates how cultural variables mediate the productivity and resource allocation processes that underpin regional development. These dimensions are often excluded from traditional growth models that prioritize physical capital and aggregate labor inputs.

Additionally, by employing cross-sectional and panel data methods to analyze the ethnic-economic nexus at the provincial level, the study contributes to the underdeveloped but increasingly important literature on borderland and

periphery economies. Its interdisciplinary nature - drawing from economics, sociology, anthropology, and public policy - demonstrates a holistic research approach, capable of yielding more comprehensive and contextually relevant findings for both academic and policy-making audiences.

The findings and analytical framework of this research offer strong potential for replication and adaptation in other similarly structured regions. The econometric model developed for Vietnam's northern highlands can be recalibrated and applied to the Central Highlands, Mekong River Delta, or even cross-border ethnic communities in Laos, Cambodia, and southern China. This provides a foundation for constructing a sub-regional comparative model of ethnic-inclusive development, with potential policy implications at the ASEAN or Greater Mekong Subregion level.

Moreover, the construction of composite socio-economic indicators that reflect ethnic and gender sensitivities can enhance the monitoring and evaluation systems used by provincial governments. By institutionalizing these indicators in public governance frameworks, local authorities can track policy outcomes more accurately, promote transparency, and improve accountability in the implementation of ethnic and regional development programs.

This study opens several promising avenues for further scholarly inquiry. First, from a methodological standpoint, future research should consider dynamic panel models such as System-GMM to better control for endogeneity and capture lagged effects of social variables on economic growth. Combining econometric analysis with qualitative tools - such as in-depth interviews and focus group discussions - would also enhance the explanatory depth of causal mechanisms and offer more granular insights.

Second, the scope of analysis should be expanded beyond the provincial level to encompass household- and community-level data. Disaggregating findings by ethnic group (e.g., H'Mông, Dao, Tày, Thái) can reveal micro-level variations in economic behavior, institutional responsiveness, and policy effectiveness, thereby enabling multi-tiered and culturally nuanced policy responses.

Third, in light of Vietnam's accelerating digital transformation, future studies should examine the phenomenon of digital inequality among ethnic groups - particularly with regard to disparities in access, usage, and digital literacy. Understanding whether digital technologies serve to bridge or widen existing development gaps will be crucial for designing equitable digital governance and ensuring that ethnic minority communities are not left behind in the Fourth Industrial Revolution.

In addition to the introduction presented above, the rest of the study is organized as follows: In the next section, the study conducts an overview of the research status on the research topic, then the study conducts empirical research using econometric models. Finally, the study proposes some relevant policy recommendations.

II. LITERATURE REVIEW

The participation of women in the economy is one of the clearest indicators of the level of integration of a society into

modern development standards. According to the theoretical framework of the Cobb–Douglas production model, the total national output $Y = A.K^\alpha.L^{1-\alpha}$ depends directly on the labor factor L (see Douglas (1976)). An increase in the proportion of women in the labor force means an expansion of the size of the labor force, thereby promoting output growth under the condition that other factors remain unchanged. In addition to contributing in terms of quantity, women also create diversity in skills, especially in the fields of services, crafts, education, and health care - sectors that have the potential to spread social impact and sustainable development. From the perspective of gender economics, this is evidence of an improvement in the efficiency of labor resource allocation - which is a prerequisite for sustainable growth in the endogenous growth model. Furthermore, according to the theory of household consumption in microeconomics, when women have stable jobs and increased income, household consumption also increases, contributing to stimulating domestic demand - an important factor in the Keynesian growth cycle. In the context of the northern mountainous provinces still heavily dependent on domestic consumption and self-sufficient economic models, the increase in female labor is an important driving force for economic growth.

The study conducted by Na-Chiangmai (2018) explores the relationship between female labor force participation and economic growth, employing both the classical Solow growth model and the augmented version proposed by Mankiw, Romer, and Weil. Within these frameworks, male and female labor forces are treated as separate explanatory variables, thereby enabling a more precise estimation of their respective contributions to the steady-state level of income. Ordinary Least Squares (OLS) regression is applied to cross-sectional data from 122 countries in 2014, followed by panel data estimation spanning from 1998 to 2016, with countries grouped into five income categories according to the World Bank classification. Given that the variables in question exhibit different orders of integration, the Autoregressive Distributed Lag (ARDL) approach is utilized to assess long-run cointegration relationships. The explanatory variables include the proportion of female and male labor within the total labor force, physical capital (measured by gross capital formation as a share of GDP), human capital (proxied by secondary school enrollment rates), alongside demographic and technological parameters such as population growth, technological advancement, and depreciation rates. The OLS estimation reveals a statistically significant and positive coefficient for female labor force participation, affirming its constructive impact on per capita income, albeit with male labor showing a marginally higher coefficient. Panel data results using ARDL indicate the existence of long-run equilibrium relationships across all income groups, with error correction terms negative and significant as expected. The effect of female labor force participation is particularly pronounced in upper-middle-income countries, whereas its significance diminishes in high-income economies - underscoring the heterogeneity of developmental dynamics across income strata. Although male labor appears to exert a slightly greater influence on growth, the difference is

relatively small, suggesting that the productive potential of female labor remains underutilized. These empirical findings reinforce the notion that integrating women more fully into the labor market constitutes a vital strategy for enhancing economic performance. Nonetheless, structural barriers - such as social norms, cultural biases, and insufficient institutional support - continue to restrict women's full economic engagement. The study therefore advocates for comprehensive policy interventions aimed at improving female access to quality employment, reducing the domestic burden through expanded childcare and parental leave provisions, and addressing wage disparities. Illustratively, Japan's "Womenomics" initiative, which included tax reforms and childcare expansion, successfully raised female labor force participation to 66% while lowering unemployment. Such evidence-based policy models serve as valuable references for governments seeking to leverage female labor supply as a catalyst for sustainable economic growth.

Lahoti & Swaminathan (2013) presents a rigorous investigation into the seemingly paradoxical decline in female labor force participation amidst sustained economic expansion in India between 1983 and 2010. Utilizing state-level panel datasets and applying both static and dynamic econometric methodologies, the authors critically evaluate the empirical validity of the U-shaped hypothesis, which theorizes a non-linear association whereby female employment declines in early stages of economic development but rebounds as structural transformation and gender norms evolve. Contrary to this prevalent theoretical construct, the study finds no compelling evidence to substantiate the existence of a U-shaped curve between per capita Net State Domestic Product (NSDP) and women's labor market engagement. Initial estimates indicate an inverted U-shape; however, this pattern loses statistical significance once regional heterogeneity and time-specific factors are adequately accounted for. Through the deployment of dynamic panel models with Generalized Method of Moments (GMM) estimators, the analysis addresses endogeneity concerns and the temporal inertia of labor force participation. The results point to a weak and marginally negative relationship between economic growth and female employment, thereby challenging deterministic models of gendered labor participation embedded in mainstream development discourse. A more granular, sectoral analysis reveals that the nature of growth is pivotal: employment gains in agriculture and increases in the manufacturing sector's value-added are associated with higher female labor force participation, while growth driven by the services sector - characterized by skill intensity and gender exclusion - offers limited inclusivity. The authors argue that India's trajectory of services-led growth, bypassing a labor-absorptive industrial phase, combined with entrenched patriarchal norms and insufficient institutional support, has significantly constrained women's economic integration. This paper thus provides a sophisticated empirical critique of linear development paradigms, asserting that it is not merely the pace, but the structure and inclusiveness of economic growth, that determine women's access to and retention in the labor market.

Hazarika (2024) draws a clear distinction between cultural determinants and technical requirements linked to labor intensity in rice cultivation, while shifting analytical focus to female labor force participation in urban settings. Utilizing data from the 2001 and 2011 Indian Censuses, the study reveals a statistically robust positive correlation: the proportion of urban women engaged in the labor market at the district level is significantly higher in areas with greater agroecological suitability for rice cultivation. Furthermore, longitudinal analysis over the 2001–2011 period demonstrates a marked divergence in labor force participation growth across districts, with more pronounced increases occurring in regions possessing a comparative advantage in rice rather than wheat production. Complementing these findings, microdata drawn from the National Sample Survey on Employment and Unemployment (1999–2000) affirm a positive association between urban women's labor engagement and a district's relative agro-suitability for rice farming. However, this relationship proves statistically significant only for native women—those born in and residing within the district—suggesting that cultural norms, potentially shaped by the local agricultural ecosystem, may mediate labor market outcomes. A particularly salient insight emerges from responses of urban women primarily engaged in domestic work: this group exhibits a higher likelihood of reporting a persistent sense of obligation to remain occupied, a form of psychosocial pressure arguably rooted in localized gender norms. Notably, this reported internalized compulsion is more prevalent in districts with less favorable rice-growing conditions, and again, is confined to native women. Taken together, the empirical evidence strongly suggests that rice cultivation has come to embody a culturally embedded role, shaping gendered patterns of labor force participation in India's urban labor markets through a subtle interplay between ecological context and sociocultural expectations.

Morales, K. S. and Mery, N. (2024) investigate the rising participation and contribution of women in Chile's mining sector, a traditionally male-dominated industry undergoing gradual transformation. Their study further engages with a series of policy interventions designed to attract and retain female talent, offering a critical appraisal of institutional strategies aimed at fostering gender inclusivity within extractive industries.

In addition to the impact of labor—particularly the positive contribution of female labor to economic growth—Tian and Feng (2023) delve into the multifaceted transmission mechanisms through which internet development influences China's Green Total Factor Productivity (GTFP) during the digital transformation era. Employing dynamic Generalized Method of Moments (GMM) models, the authors rigorously examine the internal structural effects of internet expansion on GTFP. Empirical findings indicate that internet development exerts a significantly positive influence on GTFP by fostering technological advancement, optimizing industrial structure, and enhancing economies of scale. Within the same thematic scope, Abdulqadir and Asongu (2022) investigate the asymmetric effects of internet access—proxied by an internet index—on economic growth across 42 Sub-Saharan African

(SSA) countries over the period 2008–2018. Utilizing a nonlinear threshold regression model, their empirical analysis identifies a statistically significant internet threshold of 3.55%, beyond which internet access exerts a positive influence on economic growth. Additionally, the study explores the short-run linear effects of internet accessibility on economic performance. The marginal effects of internet penetration, evaluated at both the lower and upper bounds of government regulation and tariff regime intensity, are found to be positive, thereby reinforcing the conditional relevance of institutional environments in amplifying the growth-enhancing potential of digital connectivity. Moreover, Camba and Camba (2020) examine the impact of internet penetration and broadband subscriptions on economic growth across 10 ASEAN countries over the period 2000–2016. The study employs a pooled multiple regression model, the Johansen-Fisher panel cointegration test, and a Vector Error Correction Model (VECM) tailored for panel data. Empirical cointegration results reveal the existence of a long-run equilibrium relationship among internet penetration, broadband subscriptions, and economic growth. Causality tests further confirm the presence of a long-term causal linkage from both internet penetration and broadband subscriptions to economic growth. In the short run, broadband subscriptions are found to exert a positive and significant effect on economic growth within the ASEAN context. However, internet penetration does not exhibit a statistically significant short-run causal relationship with economic growth during the study period. Furthermore, Lubis and Febrianty (2018) draw upon data from the 2016 national survey conducted by the Indonesian Internet Service Providers Association (APJII), which reported the number of internet users in that year. This empirical evidence aligns with the projection by Godjali et al. (2012), which anticipated that by 2020, consumer spending on goods and services would significantly surpass expenditure on basic needs, driven by technological development that encourages engagement in online transactions. The authors' analysis reveals a positive correlation between internet user growth and the emergence of innovative business models, such as e-commerce and e-business. These models, in turn, create new employment opportunities and enable entrepreneurs to expand their market outreach via digital platforms, ultimately enhancing economic performance, increasing income levels, and fostering economic growth. The study utilizes time-series data spanning from 2001 to 2016, focusing particularly on internet users, broadband subscriptions, and internet servers, and highlights the positive effects of these variables on GDP across various lag structures.

Addressing another critical factor influencing economic growth—namely, the contribution of education through the lens of female teachers and female students—Ghosh (2019) explores the role of foreign direct investment (FDI), capital formation, and the expansion of female education in driving Japan's economic growth over the period 1971–2014, based on time-series data. The study employs the Autoregressive Distributed Lag (ARDL) model to examine the long-run causal relationships among the variables. In the context of the digital economy and the broader reform era, sustainable

economic development necessitates not only strong institutions but also careful consideration of social policy dimensions. The article investigates one such social issue—gender and economic development—by analyzing the gender-specific dynamics of capital accumulation and its contribution to economic growth. Empirical results underscore the existence of a long-term relationship among economic growth, FDI, and capital formation within a gender-differentiated framework, emphasizing the role of human capital formation across both male and female populations.

Fatima (2011) investigates the contribution of female education to GDP growth, with a particular emphasis on highlighting the critical role of women's education and its broader implications for economic development. The study underscores the significance of investing in female education and delineates its transformative potential in fostering sustainable growth. At the same time, the paper identifies several challenges to advancing female education, particularly the persistently low levels of investment in rural regions of Pakistan. Furthermore, the research explores the implications of women's participation in the labor force, recognizing it as a vital component of economic contribution. By doing so, the study identifies pathways and opportunities to strengthen women's engagement in economic development activities at large. Gebre (2020) analyzes the impact of female education on economic development in the case of Gimbo Woreda, Ethiopia. Specifically, the study examines the relationship between women's education and economic development, grounded in the premise that female education plays a pivotal role in the advancement of any nation—particularly in developing countries such as Ethiopia. The findings indicate that educated women exert a positive influence on economic development, even in contexts where girls continue to face systemic disadvantages compared to their male counterparts. Recently, Dhar and Sarker (2023) analyzed the impact of female secondary education on long-term economic growth in Bangladesh over the period 1995–2021. Employing the Autoregressive Distributed Lag (ARDL) modeling framework, the empirical findings reveal that female secondary education, along with the female labor force participation rate, exerts a positive and statistically significant influence on economic growth. The study offers robust evidence from a developing economy context, reinforcing the critical role of gender-focused human capital development in fostering sustained economic progress. An additional factor warranting consideration in its contribution to economic growth is the age at first marriage for both men and women in the studied local context. Notable research in this domain includes the work of Yount et al. (2018), which discusses Sustainable Development Goal 5 (SDG5), calling on nations to promote gender equality and empower all women and girls. SDG5 explicitly underscores the significance of women's economic empowerment, including equitable access to economic resources and full participation in economic decision-making across all levels. Crucially, the goal also stipulates that eliminating harmful practices—such as child marriage, defined as marriage before the age of 18—is a necessary precondition for achieving such empowerment. Utilizing

nationally representative data from 4,129 ever-married women aged 15–43 drawn from the Egypt Labor Market Panel Survey (ELMPS 1998–2012), the study employed cross-lagged autoregressive panel analysis to investigate whether a woman’s entry into her first marriage during adulthood (i.e., at age 18 or older, as classified in the 2006 wave) was positively associated with her long-term post-marital economic empowerment. This empowerment was operationalized through two key indicators measured in 2012: participation in market-based labor and latent household economic agency. The findings revealed a positive, albeit unadjusted, association between women’s attainment of adult marriage and their subsequent engagement in market work and economic agency within the household, suggesting that delayed marriage may serve as a catalyst for enhancing women’s economic roles over time. Maubrigades (2017) examines historical evidence on marriage patterns in Latin America and critically analyzes their potential implications for long-term economic growth. The author explores whether the European marriage pattern can serve as an analytical lens through which to understand the dynamics of women’s empowerment in the Latin American context. The paper elucidates the relationship between socioeconomic development and the age at first marriage, with a specific focus on eight Latin American countries. The age at first marriage is conceptualized as a proxy for women’s bargaining power within households and is proposed as an indicative measure of the degree of autonomy women possess in marital decision-making. The study further situates the timing of first marriage within broader developmental trajectories, including urbanization, educational attainment, and fertility trends, thereby highlighting its multifaceted impact on economic growth. Through this framework, the research offers insights into how gendered social institutions interact with macroeconomic development pathways over time.

III. EMPIRICAL ANALYSIS

Gross regional domestic product per capita (million VND), Number of female employees in acting enterprises as of annual 31 December by types of enterprise (thousand), Number of employees in acting cooperatives as of 31/12 (thousand), Number of telephone subscribers (million), Number of internet subscribers (million), Number of female teachers and schoolgirls of general schools (thousand), Average age of first marriage in general, Average age of first marriage of male, Average age of first marriage of female. Data collected in some northern mountainous provinces of Vietnam such as Bac Giang, Bac Kan, Cao Bang, Ha Giang, Hoa Binh, Lai Chau, Lang Son, Phu Tho, Thai Nguyen, Tuyen Quang, Yen Bai, Dien Bien.

Table I presents basic descriptive statistics for the ten variables used in this study, including the number of observations (Obs), mean (Mean), standard deviation (Std. Dev.), minimum (Min), and maximum (Max). The data show significant variation in the number of observations among the variables. The variable GRDPPERC has the largest number of observations (N=99), while some other variables such as Fewerworker (N=45), worker (N=50), feteacher (N=50), and

schoolg (N=50) have significantly lower numbers of observations, implying the presence of missing data that should be taken into account in subsequent analyses.

TABLE I. Data Descriptive of research variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
GRDPPERC	99	2925.944	9966.155	2.437	47461.64
Fewerworker	45	41.27467	58.57024	2.737	199.132
worker	50	5.40956	10.52757	.605	39.086
tele	92	.8238782	.5019647	.030269	2.12
inter	91	.4675026	.446111	.015862	1.906966
feteacher	50	6.8239	2.536619	3.52	13.217
schoolg	50	73.80876	39.9014	1.398	177.847
Married	69	23.49723	1.332758	20.9	25.8
Married male	69	25.5945	1.64974	22.4	28.6
Married fe	69	21.23365	1.121351	19.3	23.7

A notable feature of the dataset is the high degree of dispersion in many variables. In particular, economic and technological variables such as GRDPPERC (Std. Dev. = 9966.155), Fewerworker (Std. Dev. = 58.57024), worker (Std. Dev. = 10.52757), tele (Std. Dev. = 0.5019647), and inter (Std. Dev. = 0.446111), as well as the education variable schoolg (Std. Dev. = 39.9014), all have large standard deviations, in many cases exceeding or approaching the mean. The wide range between the minimum and maximum values of these variables further reinforces the notion of dispersion, suggesting the possibility of skewed distributions and the presence of outliers that may influence the analysis results. In contrast, the variables related to age at marriage (Married, Married_male, Married_fe) show greater stability, with relatively small standard deviations from the mean (e.g., Married: Std. Dev. = 1.332758; Married_fe: Std. Dev. = 1.121351) and narrow ranges. This suggests greater homogeneity of this characteristic across observation units. These statistical features of the data provide important background information and should be carefully considered during model building and interpretation of the research results.

Description of Gross Domestic Product per capita (million VND) by province as shown in Table II.

TABLE III. Descriptive statistics of Gross Domestic Product per capita (million VND) by province.

Province	mean	sd	min	max	N
Bac Giang	60.384	20.29964	36.17	94.261	9
Bac Kan	38.22189	7.548343	27.992	50.302	9
Cao Bang	32.64733	6.398352	23.544	41.518	9
Ha Giang	27.84633	5.333416	20.105	36.048	9
Hoa Binh	55.28322	10.15459	40.094	71.254	9
Lai Chau	45.8716	4.268757	41.134	51.92	5
Lang Son	41.84544	8.710589	31.418	56.336	9
Phu Tho	48.23475	10.52341	31.997	63.047	8
Thai Nguyen	82.74444	20.56393	51.3	112.6	9
Tuyen Quang	2.906	.3773268	2.437	3.398	5
Yen Bai	37.37992	8.543143	25.91426	50.775	9
Dien Bien	32.53322	6.193231	24.323	43.449	9
Total	2925.944	9966.155	2.437	47461.64	99

The descriptive statistics table above presents the average Gross Domestic Product per capita (million VND) in 12 mountainous provinces in the North of Vietnam, with a total of 99 observations. The presented indicators include: mean,

standard deviation, minimum, maximum and number of observations (N) for each province. The average of the entire sample is 43.53 million VND/person, with a standard deviation of 20.69, reflecting a fairly large dispersion among the provinces. The smallest value in the entire sample is 2,437 million VND (Tuyen Quang), and the highest is 112.6 million VND (Thai Nguyen). Thai Nguyen has the highest average (82,744 million VND) and also has a large fluctuation range (51.3 - 112.6 million VND), showing that this is the most developed province in terms of income in the group. Tuyen Quang has the lowest average income (VND 2,906 million) with very small fluctuations (VND 2,437 - 3,398 million), reflecting extremely low income and little fluctuation, possibly due to specific economic characteristics or different measurement units that need to be verified. Bac Giang and Hoa Binh also have quite high average incomes (VND 60,384 and VND 55,283 million), with moderate standard deviations (about 10-20), showing a more stable standard of living compared to the general level. Provinces such as Ha Giang, Cao Bang, Dien Bien have relatively low average incomes (VND 27-33 million), with narrow fluctuations, showing that this is a group of provinces that still face many economic difficulties. Yen Bai has an average of VND 37.38 million, quite close to the general average, and a lower standard deviation (8.5), showing that income distribution in the province is quite stable. The data show marked inequality in living standards among the northern mountainous provinces, suggesting the need for region-specific economic development policies.

It is possible to perform descriptive statistics on some variables in the model showing the relationship between ethnic groups such as Number of female workers in enterprises operating at 31/12 each year classified by enterprise type (thousand people) by province as in Table 3, number of female high school students (thousand people) by province as in Table IV.

Table III shows that the average number of female employees in enterprises in all 45 observations is 41.27 thousand people, with a very large standard deviation (58.57), indicating a significant difference between provinces.

TABLE III. Number of female workers in enterprises operating at 31/12 each year classified by enterprise type (thousand people) by province.

Province	mean	sd	min	max	N
Bac Giang	174.0424	26.0506	138.958	199.132	5
Bac Kan	.	.	.	.	0
Cao Bang	4.9376	.0639085	4.861	5.009	5
Ha Giang	6.307	.3003889	5.885	6.637	5
Hoa Binh	28.7452	4.280521	24.351	34.238	5
Lai Chau	2.9902	.2124175	2.737	3.218	5
Lang Son	7.4148	.1464452	7.246	7.555	5
Phu Tho	.	.	.	.	0
Thai Nguyen	113.9748	7.863978	105.889	124.522	5
Tuyen Quang	.	.	.	.	0
Yen Bai	24.5658	1.380656	23.024	25.995	5
Dien Bien	8.4942	1.031289	7.509	9.729	5
Total	41.27467	58.57024	2.737	199.132	45

The lowest value is 2,737 thousand people (Lai Chau) and the highest is 199,132 thousand people (Bac Giang), showing a large gap in female labor force between provinces. Bac

Giang leads with an average of 174.04 thousand people, ranging from 138.96 to 199.13 thousand people, showing a very large enterprise scale and female labor force, consistent with the fact that it is a strongly developed industrial province. Thai Nguyen ranks second with 113.97 thousand people, also with a relatively large fluctuation (105.89 to 124.52), reflecting the role of an industrial center (Samsung, Yen Binh industrial park, ...). Hoa Binh (28.75 thousand people) and Yen Bai (24.57 thousand people) are in the middle group, with small fluctuations, showing a stable level of female labor force in enterprises. Dien Bien, Lang Son, Ha Giang, and Cao Bang have female labor force numbers ranging from 4.9 to 9.7 thousand people, reflecting smaller enterprise sizes or lower female participation rates. Lai Chau has the lowest number of female labor force (average of only 2.99 thousand people), and the standard deviation is small (0.21), indicating little fluctuation. Bac Kan, Phu Tho, and Tuyen Quang do not have data in this sample, possibly due to lack of information or unavailable data. This variable shows a large difference in the distribution of female labor among provinces, reflecting uneven levels of enterprise development. Bac Giang and Thai Nguyen are industrial centers, with large female labor forces, while many other mountainous provinces still have very limited numbers. This may suggest future research directions on gender equality, labor distribution, and regional development policy.

TABLE IV. Number of female high school students (thousand people) by province.

Province	mean	sd	min	max	N
Bac Giang	166.7012	9.05947	154.714	177.847	5
Bac Kan	.	.	.	.	0
Cao Bang	47.5734	1.930765	45.102	49.993	5
Ha Giang	88.7708	5.402836	81.646	95.232	5
Hoa Binh	82.33	2.409605	78.685	84.819	5
Lai Chau	52.7556	1.240929	50.689	53.847	5
Lang Son	68.7508	4.36531	64.216	74.473	5
Phu Tho	.	.	.	.	0
Thai Nguyen	1.462	.0438007	1.398	1.513	5
Tuyen Quang	80.7854	4.65999	75.152	87.353	5
Yen Bai	81.2672	2.544768	77.636	84.219	5
Dien Bien	67.6912	3.306768	63.129	71.404	5
Total	73.80876	39.9014	1.398	177.847	50

Table IV shows that the mean of the entire sample is 73.81 thousand female students, with a standard deviation of 39.90, indicating a relatively large dispersion among provinces. The lowest value in the sample is 1,398 thousand people and the highest is 177.847 thousand people, reflecting the large differences in the size of the general-age population and access to female education among the provinces. Bac Giang ranks first with an average of 166.70 thousand female students, ranging from 154.71 to 177.85 thousand, reflecting a large population size and high school attendance rate among female students. This is a figure that is superior to the mean of the entire sample, and this province also has a moderate standard deviation (9.06), demonstrating relative stability during the survey period. Ha Giang, Tuyen Quang, Yen Bai, Hoa Binh and Lang Son have an average of about 67.7 to 88.8 thousand female students, indicating a medium population size and a fairly stable proportion of female students in high

school. Dien Bien, Lai Chau and Cao Bang provinces have a lower population size, or it may reflect socio-economic conditions, geographical distance, and limited access to education. Thai Nguyen has an average of only 1,462 thousand female students, with a very small fluctuation (0.044), suggesting that this may be just a sub-group of data or a coded variable and not reflect the actual total (need to re-check the variable definition or possibility of error). Bac Kan and Phu Tho do not have data in this table. The statistical table shows a significant difference in the number of female students in high school among the northern mountainous provinces. Provinces such as Bac Giang, Ha Giang, and Tuyen

Quang show high rates of female access to education, while some provinces such as Lai Chau, Cao Bang, and Dien Bien are at lower levels. This suggests the potential for further research on educational equality, female human resource development in mountainous areas, and influencing factors such as terrain, population, and local policies.

With the provincial panel data for 9 years, the steps of estimating the POLS, FEM, REM models, selecting the model, testing and editing the model to overcome the defects, finally obtaining the regression model results, the appropriate model is the adjusted RE model as shown in Table V below:

TABLE V. Estimation results.

GRDpperC	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Feworker	.3234832	.1069995	3.02	0.003	.1137681	.5331982
inter	7.294494	9.50703	0.77	0.443	-11.33894	25.92793
feteacher	-3.367413	2.442096	-1.38	0.168	-8.153833	1.419008
schoolg	-.2437218	.0540483	-4.51	0.000	-.349607	-.1377955
Married	4.659365	17.06374	0.27	0.785	-28.78495	38.10368
Married_male	-1.381899	10.86704	0.13	0.899	-19.9171	22.6809
Married_fe	.7458347	6.344718	0.12	0.906	-11.68958	13.18125
cons	-86.41795	51.10937	-1.69	0.091	-186.5905	13.75459
sigma_u	0					
sigma_e	2.3215161					
rho	0					(fraction of variance due to u _i)

IV. POLICY IMPLICATIONS

The empirical results show that the number of female employees in enterprises operating as of December 31 each year has a positive impact on the Gross Domestic Product (GDP) per capita by province. This implies that as the proportion of female employees participating in enterprises increases, the economic value created per capita in that province also tends to increase. This impact can be explained by the increasingly prominent role of women in the manufacturing and service economy, especially in small and medium-sized enterprises - where women often account for a large proportion. The increase in female employees not only expands the scale of production but also contributes to improving labor productivity thanks to the diversification of the workforce, improving the working environment and improving the efficiency of production organization. In addition, the active participation of women in the business sector also promotes household consumption, increasing spending and investment capacity in the local economy. Based on the above empirical findings, the following three policy solutions can be proposed:

Strengthening policies to encourage enterprises to employ female workers, including financial support, tax exemptions or preferential loans for enterprises with a high proportion of female workers.

Developing vocational training and skills improvement systems for women, especially in mountainous and rural provinces, to improve access to quality jobs in the enterprise sector.

Developing social security programs and supporting childcare at work, helping female workers to participate in the workforce in a stable and long-term manner, contributing to

maintaining sustainable economic growth.

Quantitative analysis shows that the number of female high school students by province has a positive relationship with GDP per capita, reflecting that provinces with a larger number of female high school students tend to have higher per capita income. This positive impact can be explained by the mediating role of education in improving the quality of female human resources. When more girls have access to and complete general education, they have more opportunities to continue their studies at higher levels, thereby contributing to increasing the proportion of skilled workers in the local economy. In addition, general education also contributes to the formation of scientific thinking, social skills, and the ability to adapt to the labor market - essential factors to promote economic growth. In particular, in mountainous provinces - where the level of economic development is low - promoting female education can create a positive shift in the labor structure and sustainable income growth in the long term. Based on the empirical results, the following three policy solutions are proposed:

Increase budget investment in general education, especially giving priority to girls in disadvantaged areas, through scholarships, support for study costs and transportation.

Implementing education promotion programs and community mobilization on gender equality in access to education, to raise social awareness of the importance of education for women. Developing policies to support the transition from general education to vocational education and university for female students, thereby expanding quality job opportunities and increasing labor productivity in the future, contributing to sustainable increase in GDP per capita.

REFERENCES

- [1] Abdulqadir, I. A. & Asongu, S. A. (2022), "The asymmetric effect of internet access on economic growth in sub-Saharan Africa", *Economic Analysis and Policy*, Vol 73, Pages 44-61, <https://doi.org/10.1016/j.eap.2021.10.014>.
- [2] Camba, A. L., & Camba Jr, A. C. (2020), "The cointegration relationship and causal link of internet penetration and broadband subscription on economic growth: Evidence from ASEAN countries", *Journal of Economics and Business*, 3(1).
- [3] Dhar, S., & Sarker, T. (2023), "The Impact of Female Secondary Education on Economic Growth in Bangladesh: An ARDL Approach."
- [4] Douglas, P. H. (1976), "The Cobb-Douglas production function once again: its history, its testing, and some new empirical values", *Journal of political economy*, 84(5), 903-915.
- [5] Fatima, G. (2011), "Female Education as a Determinant of Economic Growth: The Case Study of Pakistan", *Contemporary Issues in Education Research*, 4(11), 15-22.
- [6] Gebre, G. G. (2020), "The Role of Female Education on Economic Development: Cross Sectional Data. Education", 10(4).
- [7] Ghosh, S. (2019), "Foreign Direct Investment, Female Education, Capital Formation, and Economic Growth in Japan and South Korea", *International Economic Journal*, 33(3), 509-536. <https://doi.org/10.1080/10168737.2019.1600155>.
- [8] Hazarika, G. (2024), "The cultural role of rice cultivation in female workforce participation in India", *Journal of Economic Behavior & Organization*, Vol. 226, 106698, <https://doi.org/10.1016/j.jebo.2024.106698>.
- [9] Lahoti, R., & Swaminathan, H. (2013), "Economic growth and female labour force participation in India."
- [10] Lubis, N., & Febrianty, H. F. (2018), "Internet Influencing Economic Growth: What and How Much? A Case Study of Indonesia Using Time Series Data (2001-2016)", In *3rd International Conference of Integrated Intellectual Community (ICONIC)*.
- [11] Maubrigades, S. (2017), "Connections between women's age at marriage and social and economic development", In *Gender Inequalities and Development in Latin America During the Twentieth Century* (pp. 45-67). Routledge.
- [12] Morales, K. S. & Mery, N. (2024), "Preliminary insights into initiatives at different stages for attracting female workforce to mining in Chile", *The Extractive Industries and Society*, Volume 19, 101496, <https://doi.org/10.1016/j.exis.2024.101496>.
- [13] Na-Chiangmai, D. (2018), "Female labor force contribution to economic growth", *Chiang Mai University Journal of Economics*, 22(3), 47-62.
- [14] Tian, Y. & Feng, C. (2023), "How does internet development drive the sustainable economic growth of China?" *Evidence from internal-structural perspective of green total-factor productivity*, *Science of The Total Environment*, Volume 887, 164125, <https://doi.org/10.1016/j.scitotenv.2023.164125>.
- [15] Yount, K. M., Crandall, A., & Cheong, Y. F. (2018), "Women's age at first marriage and long-term economic empowerment in Egypt", *World development*, 102, 124-134.