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## Education, Industry 4.0 and Earnings: Evidence from Provincial-Level Data of Vietnam\*

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### Abstract

This paper aims to analyze factors influencing earnings of workers in Vietnam using provincial-level data from 2016 to 2018. We show the important determinants of earnings of workers of more than 15 years old including working hour, labor force, life expectancy, education, regulation measured by Provincial Competitiveness Index (PCI) and especially Industry 4.0, our major depart from literature proxies by government expenditure on science and technology, number of phone lines, and number of internet users. Working hours are a typical measurement of quantity of labor supplied. Labor force represents market size from the supply side. Life expectancy measures the health of laborers, a physical quality measure of workers. PCI stands for institutional status of the locality. Two most important factors of our interest are education, representing qualification of workers, and Industry 4.0, reflecting the new working environment of workers. By estimating a robust standard error fixed-effect model, we have evidence that all factors are significant in explaining earnings of Vietnamese workers. Education and IR4.0 play an important role in earnings of workers of Vietnam. Results also provide an estimation of Vietnam's labor supply in the context of Industry 4.0. In addition, findings contribute to explain the income discrepancy among Vietnamese provinces.

**Keywords:** Education, Industry 4.0, Income Discrepancy, Labor Supply, Vietnam

**JEL Classification Code:** I24, I26, O32, J22, J31

### 1. Introduction

In the period from 2002 to 2018, Vietnam's economy has improved significantly. Simultaneously, people's lives

and the quality of life have been increasingly improved, and people have enjoyed many services with increasing quality. The structure of income distribution varies quite a bit. However, the year 2016 took place in the context of an extremely gloomy world economy with events such as the migration crisis and the UK deciding to leave the EU. Meanwhile, in Vietnam, in addition to suffering from annual natural disasters such as severe and damaging cold in the Northern provinces, the drought in the Central Highlands, the South Central, floods in the Central provinces, we also encounter serious marine environmental incidents in the Central provinces, saline intrusion in the Mekong Delta, causing severe impacts on production and life of people.

Vietnam's economy may develop, but not equally. In other words, there is still a great discrepancy among Vietnamese provinces. For example, the average income of workers among different provinces in Vietnam varies. Easily seen, on the one hand, the average income per month of workers in Hanoi, Ho Chi Minh City and other provinces in the South East is among the highest in Vietnam. On the other hand, the average income per month of workers in the Mekong Delta River is among the lowest in Vietnam.

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Human resources have been developed and deeply impacted by Industry 4.0. The objective of the research is to figure out the factors that cause income discrepancy among provinces in Vietnam. Some basic factors such as working hours, labor force, life expectancy, education, provincial competitiveness index (PCI) and especially Industry 4.0 measures are incorporated in the estimation.

The research objects focus on the average income per month of workers at 15 years old and above by province, the average working hour per week of workers at 15 years old and above by province, labor force at 15 years of age and above by province, life expectancy at birth by province and the ratio of labor force at 15 years old and above having technical profession by province (which stands for education) and Provincial Competitiveness Index (PCI) (which stands for regulations). Industry 4.0 is proxied by provincial expenditures on science and technology, number of phone registration and number of Internet registration.

## 2. Literature Review

Regarding provincial discrepancy of income, there have been a lot of researches on this matter conducted in big countries such as China, Canada and the USA. Most of the researchers have found the economic causes that lead to the discrepancy (Guanghua, 2004; Morrill, 2000; Takahiro, 2003). Weeks and Yudong (2003) examine the tendency toward income convergence among China's main provinces during the two periods: the pre-reform period 1953–1977 and the reform period 1978–1997 using the framework of the Solow growth model. The panel data method accounts for not only the province-specific initial technology level, but also the heterogeneity of the technological progress rate between the fast-growing coastal and interior provinces. Estimation problems of weak instruments and endogeneity are addressed by the use of a system-generalized method of moments (GMM) estimator. The main empirical finding is that there is a system-wide income divergence during the reform period because the coastal provinces do not share a common technology progress rate with the interior provinces.

Pedronia and Yudong (2006) use non-stationary panel techniques to provide empirical support for the fact that the long-run tendency since the reforms has been for provincial-level incomes to continue to diverge. More importantly, they show that this divergence cannot be attributed to the presence of separate, regional convergence clubs divided among common geographic subgroups such as the coastal versus interior provinces. Furthermore, they also show that the divergence cannot be attributed to differences in the degree of preferential open-door policies. Rather, they find that the divergence is pervasive both nationally and within these various regional and political subgroupings. They argue that these results point to other causes for regional

income divergence and also carry potentially important implications for other regions of the world.

Khan and Riskin (2005) show some decline in income inequality in both rural and urban China since 1995. However, the overall Gini ratio for China remained unchanged due to a rise in the urban–rural income gap. The reduction in rural inequality stemmed mainly from a fall in both inter-provincial inequality and inequality within most of the provinces, as well as from a further improvement in the distribution of wage income and farm income and a reduction in the repressiveness of net taxes. The reduction in urban inequality came from a fall in inter-provincial inequality and better distribution of imputed rental income and net taxes. The results raise questions about whether recent more equity-oriented policies, such as the “great western development strategy,” began to reduce some dimensions of overall income inequality. For the first time, a special survey was implemented to furnish data on migrants living in towns and cities. Incorporating the migrants into the urban population raises urban inequality and reduces the urban–rural gap somewhat, but leaves the latter still very high by international standards.

Fleisher and Jian (1997) postulate that inferior factor productivity in China's non-coastal provinces is a principal reason for their lower economic growth despite high investment rates relative to coastal provinces. Using the residual from a fixed-effect Solow growth model for the years 1978–93, they find that the total factor productivity (TFP) is roughly twice as high in the coastal provinces. They estimate that one variable subject to direct policy control, investment in higher education, helps explain the productivity gap and exhibits a very high rate of return, greater in non-coastal provinces. They estimate that investment in infrastructure has a moderate rate of return that is higher in coastal provinces, although investment in infrastructure may be necessary to attract and retain university graduates in the interior.

Rui and Zheng (2009) select several commonly used income indicators, inequality indices and concepts to measure China's inter-provincial inequality and compare the results. The result is that China's inter-provincial inequality is very sensitive to different measurements. These sensitivity analyses help us to understand the ongoing debates on China's regional income inequality. They also conduct a cross-country comparison to illustrate the broad ranking of China's regional inequality in the world and the result is that China's regional inequality appears not to be as high as usually perceived, despite approaching an alarming level.

Beckstead and et al. (2005) use Canadian statistics to describe per capita employment income disparities across provinces and across the urban-rural continuum, from larger to small cities and between cities and rural areas. The paper's first objective is to compare the degree of income disparities across provinces to income disparities across the urban-rural

continuum. Its second objective is to determine the extent to which provincial disparities can be tied to the urban-rural composition of provinces. The paper also seeks to determine whether urban-rural disparities in per capita employment income stem from poorer labor market conditions in smaller cities and rural areas compared to large cities.

Galizia (2013), after constructing a dataset on Indian provincial GDP per capita between 1875 and 1911, examines it for levels and trends of provincial income inequality. Cross-sectional dispersion of income was initially high, but declined over time. In terms of levels, internal Indian inequality compared well with a number of European states. Testing for unconditional beta-convergence, he found a tendency for provinces to converge to their steady state at a rate of 0.6 percent; 6.7 percent when controlling for province and year fixed-effects. These results indicate that the likely forces of convergence (mainly driven by transport and communication infrastructure advances) trumped forces of divergence (heterogeneity in social and geographical characteristics). He made no formal attempts to uncover the true drivers of provincial dynamics. Future research would do well to test the dynamic effects of observable provincial geographical and political characteristics on growth.

In addition to research into large countries such as China, the USA, Canada, India, there are still some more researches conducted in smaller developing and developed countries with less population. For example, Hiroshi (2007) examines regional income disparity in Indonesia for the 28 years to 2005. It first shows that the inter-provincial distribution of income differs greatly depending on whether oil and gas income is included or not. It then investigates inter-provincial income disparity in Indonesian provinces using the distribution approach, which employs the Markov transition matrix to capture transition dynamics and produce corresponding ergodic distributions. This analysis suggests that if oil and gas income is included and the distribution approach is used, there is some evidence of increasing regional disparity. If oil and gas income is excluded, the distribution becomes bimodal, this also suggests increasing regional disparity. Furthermore, if population growth in rich regions is relatively slow and past dynamics hold, inter-regional disparities could increase in the future.

To summarize, researchers have also used many different methods to assess the factors accounting for the provincial discrepancy of income in one country. For quantitative methods, commonly used methods are Solow growth model, Markov transition matrix and sensitivity analysis with variables such as income, tax, net tax and Gini coefficient. In this research, we would like to apply an earnings regression model to analyze the factors accounting for the provincial discrepancy of income in Vietnam from 2016 to 2018. The paper is organized as follows. Part 3 introduces the econometric model and data. Part 4 provides main findings

of the research. Conclusions and recommendations are in part 5.

### 3. Econometric Model

#### 3.1. Model specification

Firstly, the model refers to Jacob Mincer's model of earnings (1974), which specifies as:

$$\ln [w(s, x)] = \alpha_0 + \rho_s + \beta_0 x + \beta_1 x^2 + \varepsilon$$

where  $w(s, x)$  is wage at schooling level  $s$  and work experience  $x$ ,  $\rho_s$  is the rate of return to schooling (assumed to be the same for all schooling levels) and  $\varepsilon$  is a mean zero residual with  $E(\varepsilon|s, x) = 0$ .

The Mincer earnings function is a single-equation model that explains wage income as a function of schooling and experience, named after Jacob Mincer. The equation has been examined on many datasets and Thomas Lemieux argues it is "one of the most widely used models in empirical economics". Typically, the logarithm of earnings is modeled as the sum of years of education and a quadratic function of years of potential experience.

Tong (2015) examined labor income in Vietnam's service sector and showed factors that affect labor income in this sector using Vietnam Household Living Standards survey 2012 of the General Statistics Office (GSO). He used the Quantile Regression Model to identify the differences in distribution of income on each percentile. The research findings show that number of years on school, experiences, average of working time, male, urban percentiles, leaders, high level labor, mid-level labor, technical labor, Southeast region, Red River Delta region have positive effect on labor income, while state-ownership, North Central region and Central Coast region have negative impact on labor income.

Bonekamp and Sure (2015) investigated consequences of Industry 4.0 on Human Labour and Work Organisation. Their findings indicate that Industry 4.0 would lead to a substantial decrease in standardized low-skill and an increase in high-skill activities, embracing planning, control and IT-related tasks. This result hints a good testable relation between Industry 4.0 and workers earnings that has not been done in the literature especially for Vietnam. Our analysis fills in this important gap of the literature.

Based on the above literature, in this paper, our main determinants of average income per week are specified as working hour, labor force, life expectancy, education, PCI and Industry 4.0 proxies.

The research focuses on the average income per month of workers at 15 years old and above by province, the average working hour per week of workers at 15 years old

and above by province, labor force at 15 years of age and above by province, life expectancy at birth by province and the ratio of labor force at 15 years old and above having technical profession by province (which stands for education), Provincial Competitiveness Index (PCI) (which stands for regulations) and Industry 4.0 proxied by (i) budget expenditure on science and research, (ii) number of internet registration and (iii) number of phone line registration.

We finally have the overall model as below:

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \beta_2 x_{it2} + \beta_3 x_{it3} + \dots + \beta_k x_{itk} + a_i + u_{it}$$

where  $X_{itk}$  is the explanatory variables, whose values change over unit and time;  $a_i$  is the unobserved variable that only changes over unit, does not change over time. Here it is the province of Vietnam;  $u_{it}$  is the error term changing both over unit and time, representing the factors not included in the model.

### 3.2. Variables

We define variables of the model as in the following table:

#### +) Average income per week of workers

The average income per month of workers is income from employment including salaries or wages, bonuses and allowance (overtime, hazardous work, etc.) of all jobs (GSO, 2018).

#### +) Labor force at 15 years of age and above

The labor force, or currently active population, comprises all persons who fulfill the requirements for inclusion among the employed (civilian employment plus the armed forces)

or the unemployed. The employed are defined as those who work for pay or profit for at least one hour a week, or who have a job, but are temporarily not at work due to illness, leave or industrial action. The armed forces cover personnel from the metropolitan territory drawn from the total available labor force who served in the armed forces during the period under consideration, whether stationed in the metropolitan territory or elsewhere. The unemployed are defined as people without work, but actively seeking employment and currently available to start work. This indicator is seasonally adjusted and it is measured in persons.

Labor force (currently active population) is all persons above a specified age who were employed or unemployed during a short reference period (e.g. one week, one day). Labor force contains the employed and the unemployed.

The labor force (the sum of employed plus unemployed) is so defined as to be conceptually equivalent to the pool of labor available for the production of economic goods and services as defined for the System of National Accounts (SNA) measures of economic output.

Labor force is all people who are full 15 years of age or older, within the reference period, may do anything (not prohibited by law) from 1 hour or more to create products or provide services for purpose to create income for yourself and your family (GSO, 2018).

Labor force includes people who did not work during the research week, but who are currently in a job and remain closely attached to the job or are still being paid wages or wages during non-employment or are likely to return to work after no more than 1 month.

**Table 1:** List of variables

Variables	Meaning	Unit
Average Income per week	Average income per month of workers at 15 years old and above by province	Thousand VND
Average Working Hours	Average working hour per week of workers at 15 years old and above by province	Hour
Life Expectancy	Ratio of labour force at 15 years old and above having technical profession by province	Percent
Labour Force	Labour force at 15 years of age and above by province	Thousand people
Ratio of Labour Force having Technical Profession	Provincial Competitiveness Index	Unit
Provincial Competitiveness Index	Life expectancy at birth by province	Years
Budget Expenditure on Science and Technology	Government expenditure on science and technology	Million dong
Telephone Registration	Number of phone line registration	Unit
Internet Registration	Number of internet registration	Unit

The following specific cases are within labor force:

- People working to receive salaries, wages or profits, but participating in training, training or skill-raising activities due to the requirements of the unit's work;
- Apprentices and interns (including practicing doctors) working and receiving salaries and wages;
- People working in their own households or economic establishments to produce goods, products and services;
- People who work for wages, salaries or profits, but those salaries, wages and profits may not be paid directly to them, but are accrued to their family income. These include people working in business units organized by a family member living in the same household or other households and who perform the tasks and duties of a paid job organized by a family member living in the same household or different household.

Vietnam is a country with a large population, a relatively young population pyramid and it is in a period of "golden population structure" with the most abundant human resources ever. By the end of 2017, Vietnam's population reached 96.02 million people, of which female accounted for 48.94%. Population growth in recent years has led to an increase in the labor force. In general, each year Vietnam has about 1 million people entering the working age; this is an important competitive advantage of Vietnam in attracting foreign investment, contributing to socio-economic development. By 2018, the country still has more than 20.5 million workers working in the fields of agriculture, forestry and fisheries. This is the region with the lowest labor productivity.

Considering the labor force structure by gender, the percentage of male labor is more than female with over 50% of the labor being male. However, this difference is not significant and shows that female workers account for a large number. The unemployment rate of female workers is quite high compared to male workers due to health limitations, conflicts between childbirth and employment, and the chance of finding a suitable job after birth is low.

Currently, the labor force is still the most concentrated in the Red River Delta region (accounting for over 22%), followed by the North Central Coast, Central Coast (over 21%) and the Mekong River Delta. These are areas with large land areas, concentrated in many big cities, urban areas and industrial parks, which are favorable for production and business, thus attracting a large number of laborers concentrated in these areas. The low proportion areas are those with narrow land areas, hilly areas, few urban areas and industrial zones, which do not attract many laborers here.

The structure of the labor force by urban and rural areas also has large disparities. In general, the labor force in our country is mainly concentrated in rural areas, accounting for nearly 70%. This number tends to decrease over the years, but remains high. The country has about 17 million rural youth aged 15-30, accounting for 70% of the youth

and 60% of the rural labor. However, 80% of these people have not yet received professional training. This feature is a major obstacle for rural workers in finding jobs. By 2017, Vietnam's working-age population was over 72.04 million people (accounting for about 75% of the country's total population), of which the labor force participation rate was 75.5% with 54.4 million people. Compared to 2010 (the labor force participation rate was 75%), the labor force as of 2017 increased both in percentage and absolute quantity.

#### **+) Average working hour of workers**

The average working hours are calculated as the total number of hours worked over the year divided by the average number of people in employment. Estimates of the hours actually worked are also based on household labor force surveys in most countries, while the rest use establishment surveys, administrative sources or a combination of sources. They include regular work hours of full-time and part-time workers, over-time (paid and unpaid), hours worked in additional jobs and time not worked because of public holidays, annual paid leave, time spent on illness and maternity leave, strikes and labor disputes, bad weather, economic conditions and several other minor reasons (OECD, 2008). Average working hour per week of workers is the average amount of time workers spent working in a week. It includes working overtime, but does not include working with payment (GSO, 2018).

#### **+) Ratio of labour force at 15 years old and above having technical profession**

Pham (2012) selects the survey subjects to be salaried workers in the Mekong Delta region, using descriptive statistical methods of the variables in the model and his estimated results show that education is an important determinant of personal income, thereby confirming the benefits of education for learners in a market economy.

Borjas (2013) states that a person's salary depends on his age. The salary is relatively low for young employees, which increases as they mature and accumulates human capital, and can then be slightly reduced for older employees, who present a person's relationship and years of schooling by "Curriculum salary by education", which shows that the salaries of businesses are willing to pay correspondingly for each educational level, showing the relationship between salary and the number of years of schooling (Mincer, 1974; Borjas, 2013). Normally, employees work in the same industry, the income of employees also depends on their expertise (type of work) and work experience.

According to 2016 Labour Force Survey Report of GSO, labor force having technical profession includes:

- Vocational training: Those who have graduated (usually have been granted a diploma or certificate) at elementary vocational schools, vocational colleges or vocational colleges;

- Professional Intermediate: are those who have graduated (usually have a degree) of professional intermediate level;
- College: A person who has graduated from college (usually has a college degree);
- University: A person who has graduated from university (usually granted a bachelor’s degree);
- Postgraduate: These are people who have graduated (usually had an academic degree) with masters, Ph.D.

#### +) Provincial Competitiveness Index (PCI)

At the global level, institution factor was demonstrated as playing significant role in determining national income in Asia’s developing countries (Ngo and Nguyen, 2020). Likewise, there is no exception for country level. The PCI stands for Provincial Competitiveness Index, which assesses the quality of economic management, degree of convenience and friendliness of the business environment and the administration’s efforts of provincial governments in Vietnam, thereby measuring the quality of institution factor of each province.

Until the latest methodology update in 2017, PCI index consists of 10 component indexes, covering the main fields of economic management of the provinces and cities concerned to the development of the business.

A province that is considered as performing well on PCI is the one that has: (1) low entry costs for business start-ups; (2) easy access to land and security of business premises; (3) a transparent business environment and equitable business information; (4) minimal informal charges; (5) limited time requirements for bureaucratic procedures and inspections; (6) minimal crowding out of private activity from policy biases toward state, foreign, or connected firms; (7) proactive and creative provincial leadership in solving problems for enterprises; (8) developed and high-quality business support services; (9) sound labor training policies; and (10) fair and effective legal procedures for dispute resolution and maintaining law and order.

#### +) Industry 4.0

As we know, Industry 4.0 is characterized by the level of automation that we have achieved, where machines can often largely govern themselves, in many ways by using Internet technologies, or “the Internet of Things.” Other features of Industry 4.0 include the use of cloud technology and the importance of big data.

At the provincial level, basing upon data availability in Vietnam, the level of readiness can be measured by (i) budget expenditure on science and research, (ii) number of Internet registration and (iii) number of phone line registration.

### 3.3. Data

Data are taken from the General Statistical Office (GSO). We have 63 observations standing for 63 provinces in Vietnam in three years (2016, 2017 and 2018). We describe the data to give a general view of the collected data sets. This explains some of the errors encountered when running the model due to a data error. Summary statistics of variables are as follows:

Before running the regression model, we consider the correlation between variables. The mean VIF is 1.41, which is smaller than 10. It means the model is not multi-collinear. Each of the variables has quite small VIF. All of them are smaller than 2 and positive. Therefore, all of these variables have a positive relationship with AIM.

## 4. Main findings

### 4.1. Estimation results

Model selection has been done with the assistance of Lagrange test and Hausmann tests. The fixed effect model fits data the most. Robustness tests are well expected due

**Table 2:** Data Statistical Description

Variable	Observation	Mean	Standard Deviation	Min	Max
Monthly Average Income	189	5029.593	783.188	3527	7745
Average Working Hours	189	44.461	2.698	36.5	50.6
Life Expectancy	189	73.254	1.89	70.1	76.2
Labour Force	189	871.022	696.422	228.8	4469
Ratio of Labour Force having Technical Profession	189	20.62	6.954	12.2	46.8
Provincial Competitiveness Index	189	61.539	3.335	52.99	70.69
Expenditure on Science and Technology	189	370.608	1738.36	4	23138
Telephone Registration	189	1337.997	1820.432	20.9	15854.8
Internet Registration	177	625.305	1373.129	16.2	10390.8

to small n and t. In fact, all we have evidence to reject the hypothesis of heterogeneity, serial autocorrelation as well as cross correlation. However, to ensure the robustness of the estimates, we choose the robust standard error FE model. The estimation results are as follows:

## 4.2. Findings

Regression results provide important findings.

Firstly, the average working hour per week of workers at 15 years old and above has a positive effect on the average income per month of workers at 15 years old and above. It means in provinces where people work for a large amount of time, their income may be higher than other provinces. It can be proved from the data that Bac Ninh and Binh Duong are two provinces with a large number of workers and factories.

They work by shift and often work overtime to earn more money. Instead, Ca Mau, where people earn their living on agriculture mainly, has the lowest average working hour per week of workers at 15 years old and above.

Secondly, the ratio of the labor force at 15 years old and above having technical profession has a positive effect on the average income per month of workers at 15 years old and above. It means in provinces where people have higher education and training for work, their income may be higher than other provinces. For example, Hanoi and Ho Chi Minh City are two areas that have the highest ratio of labor force at 15 years old and above having technical profession, which means the quality of labor force here is very high, making workers more marketable to the business. Therefore, the average income per month of workers at 15 years old and above of the two above areas are among the highest in Vietnam.

**Table 3:** Fixed effect model results

	Dependent variable: Monthly Average Income of the province			
	(1)	(2)	(3)	(4)
Average Working Hours	62.415**	59.325**	42.667*	44.455**
	(26.206)	(25.984)	(24.131)	(22.576)
Life Expectancy	117.228**	126.868***	103.827**	104.004**
	(45.148)	(41.132)	(42.715)	(42.588)
Labour Force	6.755***	6.861***	6.981***	6.836***
	(1.513)	(1.543)	(1.527)	(1.475)
Ratio of Labour Force having Technical Profession	1987.409***	1811.412***	1517.082**	1383.324**
	(556.112)	(584.242)	(606.205)	(636.422)
Provincial Competiveness Index	31.811*	29.035*	29.089*	32.155*
	(17.781)	(17.262)	(17.158)	(18.089)
Ln(Expenditure on Science and Technology)		89.456**	74.452*	71.851*
		(40.517)	(40.563)	(40.462)
Ln (Internet Registration)			181.456**	180.808**
			(84.895)	(84.313)
Ln (Telephone Registration)				68.348**
				40.101
_cons	-153589.370***	-141119.730***	-119485.440***	-110274.740**
	(39435.253)	(41419.615)	(42884.041)	(45067.420)
Ob	189	189	177	177
R <sup>2</sup>	0.751	0.757	0.765	0.769

Notes: standard error in parentheses, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

Thirdly, life expectancy at birth has a positive effect on the average income per month of workers at 15 years old and above. It means in provinces where people are able to live longer due to their higher standard of life and enough healthcare service taken, they tend to earn higher than people in other provinces. Data of provinces in the South East such as Ho Chi Minh City, Binh Phuoc, Tay Ninh, Binh Duong, Dong Nai, Ba Ria - Vung Tau can prove my point. The result was also found in most research conducted in Asian developing countries using province level data (Ahn, 1997; Blejer & Guerrero, 1990; Do et al., 2020; Suhendra et al., 2020).

Fourthly, the labor force at 15 years of age and above has a positive effect on the average income per month of workers at 15 years old and above. It means in provinces where there are a large number of workers, their income tends to be higher than that of other provinces. This conclusion may be suitable for Ho Chi Minh City, Binh Duong and Dong Nai with the high development of manufacturers and businesses.

Fifthly, Provincial Competitiveness Index has a positive effect on the average income per month of workers at 15 years old and above. It means in provinces where there are many policies passed and more the administration's efforts of provincial governments to support businesses and living people and the leaders care more for their people, the quality of economic management, is higher, degree of convenience and friendliness of the business environment is higher, the development of the private sector is more promoted, people's income is higher than that of other provinces.

Sixth, all three proxies of Industry 4.0 have a positive effect on the average income per month of workers at 15 years old and above. We have evidence that in the province that spends more on science and technology, or the province that has more phone line or Internet registration, people's income is higher than that of other provinces.

To summarize, whether the average income per month of workers at 15 years old and above is high or low is based on the factors accounting for it.

### 4.3. Implications for Vietnam

In order to raise provincial income in Vietnam and reduce the provincial discrepancy of income in Vietnam, we suggest some solutions:

Firstly, the Vietnamese labor market should continue to be developed in the direction of modernization and market. The framework of laws, institutions and labor market policies should soon be strengthened. Governments should pay attention to supporting labor migration from rural to urban areas, industrial zones and border labor; support for job creation for young people, people with disabilities, ethnic minorities, poor rural women, piloting order contracts with employment service centers and other related organizations and units such as: Vietnam Chamber of Commerce and Industry (VCCI),

Central Youth Union, Vietnam Women's Union, Vietnam Farmers Union ... to support employment creation activities.

Secondly, capacity building, propaganda, inspection, monitoring and evaluation of the project implementation, including: strengthening training, training, fostering capacity building for state management officials on job; coordinating with relevant units to develop a program framework and organizing training and training for a team of job service consultants; informing and propaganda on the mass media on labor and employment, especially for rural workers, migrant workers and specific employees.

Thirdly, governments should create opportunities to expanding labor demand, gradually solving labor supply-demand imbalance with economic development solutions, encouraging investment through economic development planning, raising and maintaining position and arranging competitiveness indexes, having incentive policies on conditions for enterprises with high technologies, technologies and spearhead economic branches, expanding and improving the quality of business incubators, creating a rich labor demand market, creating many new working places.

Fourthly, governments should cooperate with private sectors to develop more comprehensive labor market information, with emphasis on:

- Collecting a relatively complete and systematic system of labor supply and demand and developing and organizing the implementation of the Project on labour market information development in the 2016-2020 period. There are solutions to collect labor supply information from localities (from aggregated population groups to the whole city) to provide complete data on labor supply parameters and addresses of each working labor force wishing to participate in labor and new sources of labor. This system may collect labor demand information from businesses, business associations and employers' representative organizations;
- Processing, analyzing, synthesizing, transmitting, providing and reporting labor market information, on the basis of database, which is scientifically processed, effectively serve as a basis for making forecasts;
- Forming a well-forecasted department at the Service Centre with the task of specializing in short and medium-term forecasts on the labor market to provide information to businesses and training institutions;
- Organizing professional fostering for staff directly involved in labor market information activities in localities and establishments; establish an effective organizational system and information gathering and processing process.
- Fifthly, businesses should define training objectives; improve the quality of labor supply to meet the needs of society;

- Improve and always adjust the planning of vocational training network;
- Organize training for priority subjects and encourage training for the labor force in areas with high labor demand and are expected to develop in accordance with the orientation of the economy;
- Through the system of job counseling services for employees to identify goals for improving the quality of labor force, improving competitiveness in the labor force market for quality and efficiency, increasing income and reproduce labor power;
- Actively implement a training channel in accordance with the forecast of labor demand.

Sixthly, businesses should plan an employment service network, building an effective employment service system, meeting information processing, supply and demand connection, consulting and forecasting labor market information; expanding and improving the efficiency of job exchanges periodically, proceeding to organize weekly transactions and good resolution of unemployment insurance, focusing on criteria of retraining and bringing workers back to the labor market quickly and connecting trained people to enter the labor market.

Seventhly, businesses should investigate and capture labor market information in the informal economic sector in order to have management solutions and appropriate policies, giving priority to auxiliary industries for the main economic sector in consciousness of sustainable development. When an employee works for a unit (especially high-tech jobs) fully trained, good labor productivity is raised by another unit to attract such worker. Therefore, there are strict rules and regulations, except for good reason for family rationalization, but these two units must be far away from a certain distance and cannot go to work every day.

Eighthly, businesses create friendly and safe working environment for employees. Investing in equipment, repairing and supplementing facilities, strengthening occupational safety and sanitation will make employees feel secure and eager to work; avoid the fact that employees are not really comfortable at work, because they are under the strict management of direct managers, they do not have the opportunity to create and develop ideas.

Ninthly, building flexible and fair wage policy. Completing the salary policy, especially the organization of salaries, building payroll scales, building labor norms in enterprises of all economic sectors, in order to implement the principle of labor distribution according to each person's contribution. Studying and regulating preferential policies for high-level workers and those with real talents, motivating workers to devote their capacity and intelligence to the cause of industrialization, modernization and economic integration internationally.

Finally, but very importantly, provinces that are more ready for Industry 4.0 or that is better prepared for Industry 4.0 provide higher living standards for their workers. It is a great need for provincial regulators to invest in making the province the most ready for Industry 4.0 possible.

Businesses need to be transparent about how to calculate wages to ensure the active participation of workers and trade unions: Many businesses pay privately so there is a complicated way for employees to calculate their salaries. But the employee has the right to know how his salary is calculated. Therefore, businesses need to understand and comply with the provisions of the law, need to pay attention to issues such as the State minimum wage, salary, probationary salary, seasonal salary, salary during pregnancy, sickness, job off; In addition, businesses need to solicit their opinions to know the pros and cons of the current salary payment mechanism and the issues that need to be overcome.

## 5. Conclusions

In conclusion, this paper estimates earning equations to explain the income discrepancy among Vietnamese provinces. We have quantified impacts of factors influencing income of Vietnamese laborers at provincial level. Our results lead to policy implications that could reduce provincial discrepancy in Vietnam. Firstly, the issue of income discrepancy needs to be addressed and should be targeted at poverty reduction as the center of the strategy to reduce inequality. It is necessary to constantly promote and improve the effectiveness of poverty reduction policies; improve the quality of training. Secondly, there is an appropriate health policy to ensure that all people have access to minimum health services, with special attention to the poorest population groups, often concentrated in mountainous, remote and isolated areas, ethnic minorities. Thirdly, in the current market economy, it is necessary to ensure a fair, healthy and transparent competitive environment among individuals and organizations. Policies should be specific, clear, detailed and accessible guidelines so that individuals and organizations can grasp and implement regulations in accordance with specific conditions. Fourthly, governments need to continue to promote the development of science and technology, increase investment in education and health, adopt important policies and attract talents, on the one hand in order to improve living standards and public awareness about the result of inequality, on the other hand, is to create quality resources for sustainable economic growth. Finally, but very importantly, provinces that are more ready for Industry 4.0 or that is better prepared for Industry 4.0 provide higher living standards for their workers. It is a great need for provincial regulators to invest in making the province the most ready for Industry 4.0 possible. The paper

can be extended in several ways. One can consider income inequality in Vietnamese provinces by taking into account the Gini coefficient (Guanghua, 2004). Accumulating data from a smaller unit such as districts if data are available is another good research using Theil decomposing method.

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