

# PLS Modelling on Determinants of Low Pay in Taiwan?

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**Abstract:** As an export-oriented economy, the fruits of Taiwan's economical growth do not seem to reflect higher wage levels. What determinants account for low pay (wage levels) in Taiwan? This study proposed a partial least squares (PLS) model on wage determinants, testing ten hypotheses derived from with macro-level monthly data during the period of 2000/01-2014/06. The results found that there are seven paths regarding Taiwan's wage levels. Exports and trade is the key and direct determinant of average regular wage levels and average working hours; the number of college or university graduates is an important one regarding average first regular wage levels in Taiwan. The results provide insight for schools, enterprises and government authorities.

**Key-Words:** - wage levels, determinants, partial least square (PLS), Taiwan, low pay

## 1 Introduction

Recently, the low average monthly wage of NTD 22,000 (the so-called 22 K; equivalent to USD 730) for local college graduates in their first jobs has been hotly debated in Taiwan. In 2013, real monthly earnings averaged NTD 44,739 (about USD 1,483), lower than the average of NTD 44,798 in 1998, despite economic growth of over 2%. Taiwan's real wages remain at the same level they were 16 years ago. The average monthly wage of employees in Taiwan's industry and services sector was USD 1,533.9 in 2013— a 9 % increase since the financial crisis of 2008. Yet the growth rate is less than half of that in Hong Kong, Singapore and South Korea, according to the Organization for Economic Co-operation and Development's (OECD's) data as cited by local Chinese media including the *Economic Daily News*.

Moreover, the number of foreign workers and dispatch workers is increasing. Dispatch workers are not entitled to the same benefits, bonuses, annual leave or opportunities for promotion as full-time employees and may never be able to afford a home. Minimum wages are used widely in developing countries to protect vulnerable workers, reduce wage inequality, and lift the working poor out of poverty. Finding a wage level that is considered fair, given workers' needs and the cost of living— while not harming employment or a country's global

competitiveness— is a challenge for policymakers. It is worth mentioning that when the government first proposed increasing the minimum wage to NTD 20,000, it faced stiff opposition from local companies. In South Korea, the minimum wage registered at USD 744 per month in 2007, and since then it has grown at an annual rate of between 5% and 8% to the current level of USD 1,114, representing a 49.7% increase. South Korea's current minimum wage is 66% higher than Taiwan's. Its enterprises remain competitive on the global stage.

Members of dozens of trade unions, labor rights groups and student groups took to the streets of Taipei on Labor Day despite constant rain, protesting against low pay and the use of dispatched temporary workers. The protesters said they were opposed to trade liberalization, privatization of state enterprises and bank mergers. The government's push for trade liberalization may be good for corporations but not necessarily for workers, as it could result in more exploitative practices.

New Taipei mayor Eric Chu pointed out that the minimum wage is just one component of Taiwan's overall wage problem. Even when the minimum wage is increased 1.2% to NTD 19,273 per month in July, it will not be high enough for people to live on. The real problem is wealth distribution, which is determined by whether or not employers are willing to share profits with workers.

Quanta Computer chairman Barry Lam said that Taiwan's low average wage level shows that the country's overall competitiveness is not strong enough. Only if an enterprise has innovative values can it earn profits for its employees and shareholders, and the low wage level is a reflection of weak competitiveness. Terry Gou, chairman of Hon Hai Precision Industry, attributed the low-pay phenomenon to college graduates now doing jobs that do not require a college education—a problem is linked to an educational imbalance in the job market and flaws in the country's education system.

Various papers have studied wage inequality or wage determinant from different perspectives. Literature addressing the effect on wages of change in the education composition of the labor force are as follows: Katz & Murphy (1992) regarding for the U.S.[28]; Robbins and Gindling (1999) for Costa Rica [39], Choi (1996) for Korea [9], and Robbins & Zveglic (1996) and Gindling & Sun (2002) for Taiwan [20, 40]. The results of Zamfir, Matei & Lungu (2013) show a negative effect of the education-job mismatch on wages in most of the countries [46].

The experience of East Asian countries between the 1960s and 1970s is consistent with the view of the conventional theory that a greater openness to international trade tends to reduce the skilled-unskilled wage gap in developing countries [3, 23, 27, 45]. However, the research of Abdi (2007) and Munch & Skaksen (2008) [1, 33] did not find any significant role for trade liberalization on the relative wage levels or an export wage premium for the most highly educated workers. In addition to trade liberalization, other empirical studies show other factors affecting increasing wage inequality. They include international outsourcing, increase in the relative price of skill-intensive goods, entry of overpopulated and less-developed countries like China and India into the international market, etc. [7, 8, 30, 31].

Many scholars have investigated the effects of major institutional arrangements on labor market outcomes [22, 36]. Unemployment is not due to wage inflexibility, but involves the presence of all the market imperfections that have also been increasingly linked to the presence of institutional rigidity springing from a variety of sources, such as unemployment benefits, job security legislation, labor taxes, employment protection legislation, welfare state entitlements and others. Oglöblin & Brock (2005) suggested that imperfect information and job search costs led Russia' workers to accept wages below the level they could potentially earn and in this sense left them "underpaid"[35]. The

paper focused on wage determinants including gender from a transitional economic perspective, but not involve education or trade factors, etc.

The challenge for policymakers is to find that wage levels that are considered fair given workers' needs and the cost of living, but that do not harm employment levels or a country's global competitiveness (Gindling & Terrel, 2010)[19]. According to Pauw (2012)[36], the minimum wages policy is not an effective anti-poverty tool in South Africa given poor targeting and adverse price effects.

Low pay, dispatch work, higher education policy and the minimum wages policy have become hot topics in Taiwan. In general, the relationship among higher education, open trade, wages, foreign labor policy and wage levels/working hour have been analyzed using diverse methods within many countries, but with no consistent conclusions. What about Taiwan? Does open education policy matter for wage as the abovementioned studies expected? If there is an effect, how large is it? If not, what determinants matter? The issue not only affects wage levels, but also production, trade, higher education and foreign labor policy along with other factors. The issue deserves further attention from labor groups, the industry, academia and government authorities.

This study proposes a partial least squares (PLS) path model for wage determinants. The integrated model includes factors related to education, exports, economic growth, and price index as determinants. Hypotheses regarding the effects of the determinants on Taiwan' exports are developed and tested. Using monthly data from the *Taiwan Economic Journal* (TEJ) for the years 2000/01-2014/062, this study found that there are seven paths regarding Taiwan's wage levels. Exports and trade is the key and direct determinant of average regular wage levels and average working hours; the number of college or university graduates is an important determinant of average first regular wage levels in Taiwan. The remainder of the paper is organized as follows. Section 2 describes hypothesis development; Section 3 describes the methodology, and Section 4 presents the result and discussions. The conclusion is in Section 5.

## 2 Hypothesis

According to literature reviews, the determinants on wages are include trade and macro-economic environment, higher education, foreign labor, labor unions, etc. Thus, the following hypotheses are proposed.

Katz & Murphy (1992), Wood (1995), and Borjas & Ramey (1994) [5, 28, 45] claimed that

trade has a negative effect on income distribution. Some studies found a small but positive association between trade and wage inequality in developing countries [13, 21]. Abdi (2007)[1] did not find any significant role for trade liberalization on the relative wage levels. Hering & Poncet (2009)[25] indicate that export performance is one of the channels through which market access might influence wages. Egger, Egger & Kreickemeier (2013)[15] find that openness to international trade has quantitatively important effects, leading to higher wage inequality and lower aggregate employment in five European economies. Considering that Taiwan is an export-oriented economy, the following hypotheses are proposed:

*H<sub>1-1</sub>: The volume of exports & trade is positively related to Taiwan's average first wage levels.*

*H<sub>1-2</sub>: The volume of exports & trade is positively related to Taiwan's average regular wage levels.*

*H<sub>1-3</sub>: The volume of exports & trade is positively related to Taiwan's minimum wage levels.*

*H<sub>1-4</sub>: The volume of exports & trade is positively related to Taiwan's average working hours.*

Higher education or longer working experience may determine higher productivity. Findlay & Kierzkowski (1983)[16] indicated that education can be used to produce skilled labors, who usually have higher wages than unskilled ones. However, Katz & Murphy (1992), Choi (1996), Robbins & Gindling (1999), and Gindling & Sun (2002) [9, 19, 28, 39] emphasize the negative effect on wages of change in the education composition of the labor force. Robbins & Zveglic (1996) provided evidence that decisions by education planners in the 1980s to increase the number of students enrolled in universities and junior colleges led to a fall in the wages of workers with higher education relative to the wages of workers without higher education. Munch & Skaksen (2008), Klein, Moser & Urban (2013)[29,33] also find no evidence for an export wage premium for the most highly educated workers. According to the principle of economics, labor supply increases may lead to a fall in the wage levels or a rise in working hours when new workers enter the workplace. In the long run, higher education or longer working experience may determine higher productivity and wages. Thus, the following hypotheses are proposed:

*H<sub>2-1</sub>: The number of college or university graduates is negative related to Taiwan's average first wage levels.*

*H<sub>2-2</sub>: The number of college or university graduates is positive related to Taiwan's average regular wage levels.*

*H<sub>2-3</sub>: The number of college or university graduates is positive related to Taiwan's minimum wage levels.*

*H<sub>2-4</sub>: The number of college or university graduates is negative related to Taiwan's average work hours.*

According to Taylor (1993) and Beyer, et al (1999)[3, 41], the more of a country's economic growth increase, the higher the subsequent wage levels. Wage inertia introduces a process of wage adjustment that drives the transitional dynamics of wages and modifies the time path of the other variables in the economy, including the GDP growth rate [14, 38]. Thus, the following hypotheses are proposed:

*H<sub>3-1</sub>: The macro economical variation is positively related to Taiwan's average first wage levels.*

*H<sub>3-2</sub>: The macro economical variation is positively related to Taiwan's average regular wage levels.*

*H<sub>3-3</sub>: The macro economical variation is positively related to Taiwan's minimum wage levels.*

*H<sub>3-4</sub>: The macro economical variation is positively related to Taiwan's average work hours*

Since 1989, due to the shortage of internal labor force infrastructure, the government allowed foreign laborers into Taiwan. Since then, the scope broadened and the number of foreign laborers was climbed. This policy pitted local labors against foreign ones. Chiang (2006)[10] found that leading in foreign labors had negative but not significant impact on domestic labor's wage levels; however, it stifled the the employment opportunity for domestic basic labors, and increased the rate of unemployment. Chassamboulli & Palivos (2013) [6] found that skilled native workers, who complemented immigrants in production gained in terms of both wages and employment. The effects on unskilled native workers competing with immigrants, on the other hand, were ambiguous and depended first on the presence of a statutory minimum wage and second on the way that this minimum wage is determined. In general, the working content and wage levels of domestic unskilled workers (university graduates) are different from foreign laborers. However, the 22K policy of the first wage seems positive in contrast to minimum wages for the foreign laborers in Taiwan. At the same time, as the number of workers

increases, the wage levels and working hours also increase. Thus, the following hypotheses are proposed:

H<sub>4.1</sub>: The number of foreign laborers is positive related to Taiwan's average first wage levels.

H<sub>4.2</sub>: The number of foreign laborers is positive related to Taiwan's average regular wage levels.

H<sub>4.3</sub>: The number of foreign laborers is positive related to Taiwan's minimum wage levels.

H<sub>4.4</sub>: The number of foreign laborers is positive related to Taiwan's average work hours.

Wage inertia implies that current wages depend on past wages [4, 34]. A labor union is an organization of workers who have united together to achieve common goals such as protecting the integrity of its trade, achieving higher pay and benefits such as health care and retirement, increasing the number of employees an employer assigns to complete the work, safety standards, and better working conditions. However, if labor union adopts over-fighting regarding wages, this may lead to damage on the two sides. Thus, the following hypotheses are proposed:

H<sub>5.1</sub>: The number of labor unions members is positive related to Taiwan's average first wage levels.

H<sub>5.2</sub>: The number of labor unions members is positive related to Taiwan's average regular wage levels.

H<sub>5.3</sub>: The number of labor unions members is positive related to Taiwan's minimum wage levels.

H<sub>5.4</sub>: The number of labor unions members is negative related to Taiwan's average work hours.

Except for the causality on determinants of wages and working hours, there is some relationship between the above five determinants. In an export-oriented economy, the volume of exports and trade increase may lead to economic growth, production and consumption increase. Then, the demand for higher education and foreign labor also increase. When the idea of working rights rises, the number of labor unions and their members also increases. Thus, the following hypotheses are proposed:

H<sub>6</sub>: The volume of exports & trade is positively related to the macro economical variation.

H<sub>7</sub>: The macro economical variation the macro economical variation the number of college or university graduates.

H<sub>8</sub>: The volume of exports & trade is positively related to the macro economical variation.

H<sub>9</sub>: The volume of exports & trade is positively related to the number of foreign laborers.

H<sub>9</sub>: The number of foreign laborers is positive related to the number of labor unions.

H<sub>10</sub>: The number of college or university graduates is positive related to the number of labor unions.

The conceptual framework of the proposed model is shown in Fig.1. Table 1 shows the definition of manifest and latent variables.

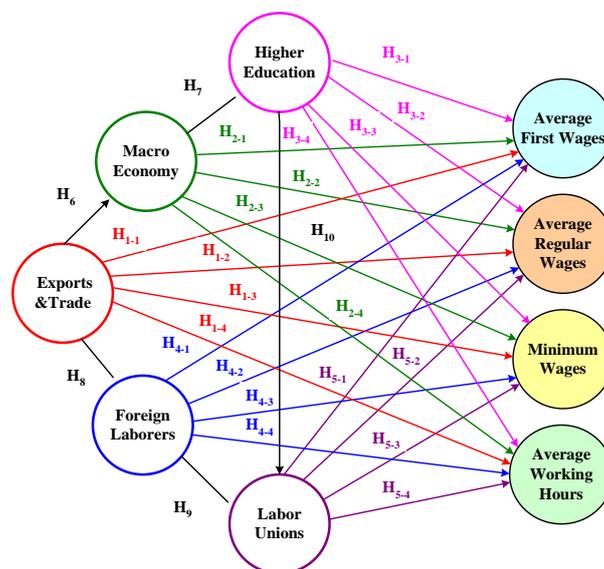


Fig.1. Conceptual framework

### 3 Methodology

PLS path modeling and linear structural relations (LISREL) are two major structural equation modeling (SEM) approaches to modeling relationships between latent variables (Tenenhaus, Pagès, Ambroisine & Guinot, 2004). Unlike LISREL, with its assumption of homogeneity in the observed population, PLS path modeling is more suitable for real world applications, and is particularly more advantageous with complex models [26].

More importantly, PLS path modeling is better suited for analyzing exploratory models with no rigorous theory grounding, because it requires minimal assumptions about the statistical distributions of data sets. Moreover, it can work with smaller sample sizes' causal relationships, small samples (minimum sample size is 30), missing values, or display of co-linearity [44]. Such a general and flexible framework also enriches data analysis methods with non-parametric validation procedures (such as bootstrap, jackknife, and blindfolding) for estimated parameters; the framework fits indices for different blocks that are more classical in a modeling approach than in data

analysis [18]. PLS gained popularity in chemometric research, and later in industrial applications, e.g. computer information and management, marketing, and social sciences [11, 12, 32].

A PLS path model is composed of two models: (1) a measurement (outer) model relating the manifest variables (MVs) to their own latent

variables (LVs) and (2) a structural (inner) model relating some endogenous LVs to other LVs. The measurement model is also called the outer model (MVs→LVs) and the structural model called the inner model (LVs→LVs). Arrows show the assumed causal relations.

Table 1. The definition of manifest variables and latent variables

LVs	MVs	Definition
L <sub>1</sub> E&T		The volume of exports & trade
	M <sub>11</sub> Trade	The volume of trade
	M <sub>12</sub> Exports	The volume of export order
	M <sub>13</sub> EOPO	The ratio of export order over production overseas
L <sub>2</sub> MAE		The macro economical variation
	M <sub>21</sub> GDP	Gross domestic product (GDP)
	M <sub>22</sub> CPI	Consumer Price Index (CPI)
	M <sub>23</sub> LPIM	Labor productivity indexes of manufacturing (LPIM)
L <sub>3</sub> HED		The number of college or university graduates
	M <sub>31</sub> College	The number of college graduates
	M <sub>32</sub> University	The number of university graduates
	M <sub>33</sub> C&U	The number of college and university graduates
L <sub>4</sub> FL		The number of foreign laborers
	M <sub>41</sub> FLM	The number of foreign laborers in manufacturing
	M <sub>42</sub> FLS	The number of foreign laborers in social service
	M <sub>43</sub> FLT	Total number of foreign laborers
L <sub>5</sub> LU		The number of labor unions members
	M <sub>51</sub> LUI	The number of industry unions members
	M <sub>52</sub> LUV	The number of vocational associations members
	M <sub>53</sub> LUT	The total number of labor unions members
L <sub>6</sub> AFRW		Average first regular wages
	M <sub>61</sub> AFWC	Average first regular wages of college graduates
	M <sub>62</sub> AFWU	Average first regular wages of university graduates
	M <sub>63</sub> AFWT	Average first regular wages of college and university graduates
L <sub>7</sub> ARW		Average regular wages
	M <sub>71</sub> ARWM	Average regular wages of manufacturing industry
	M <sub>72</sub> ARWS	Average regular wages of service industry
	M <sub>73</sub> ARWT	Average regular wages of total industry
L <sub>8</sub> MW		Minimum wages
	M <sub>81</sub> MWM	Minimum wages-monthly
	M <sub>82</sub> MWH	Minimum wages-hour
L <sub>9</sub> AHR		Average regular working hours
	M <sub>91</sub> AHRN	Average regular normal working hours
	M <sub>92</sub> AHRO	Average regular overtime working hours
	M <sub>93</sub> AHRT	Average regular total working hours

## 4 Result and Discussion

### 4.1 Descriptive statistics

All the data were collected from the database assembled by the Ministry of Labor and the *Taiwan Economic Journal* (TEJ), a for-profit organization in Taiwan, during the period of 2000/01-2014/06. SmartPLS 2.0 software, developed by Hansmann & Ringle (2005)[24], was used to estimate the model. Based on a review of previous studies, we initially chose more than 40 commonly used variables.

Regarding variables having a low correlation with FDI and employment service, if the statistical significance did not reach the required level and their weights were less than 0.4, they were then deleted, such as economic growth rate, prime rate, technical certification *number*, vocational training *number*, etc. Then, 26 MVs and 9 LVs were included in the model. Table 2 presents the descriptive statistics for these variables.

### 4.2 Result

(1) AVE, CR, and  $R^2$

In general, we anticipated that composite reliability (CR) should be greater than 0.7 and average variance extracted (AVE) greater than 0.5 [17]. Table 3 shows all of the CR and AVE values reach the threshold level for significance, suggesting that all the variables in the model are reliable and that each construct has high convergent validity.  $R^2$  for almost LVs of the model is above 0.7, and the average  $R^2$  of the model is 0.8. Overall, all the measures indicate that each construct has good reliability and validity and thus high explanatory power.

Table 3. AVE, CR and  $R^2$

	AVE	CR	$R^2$
L <sub>1</sub> E&T	0.950	0.983	
L <sub>2</sub> MAE	0.947	0.982	0.900
L <sub>3</sub> HED	0.979	0.993	0.930
L <sub>4</sub> FL	0.901	0.965	0.704
L <sub>5</sub> LU	0.979	0.993	0.956
L <sub>6</sub> AFRW	0.969	0.990	0.710
L <sub>7</sub> ARW	0.945	0.981	0.938

L <sub>8</sub> MW	0.985	0.992	0.910
L <sub>9</sub> AWH	0.734	0.889	0.516

(2) The structural model

The path coefficients and their significance levels for the structural model, measured by the bootstrap re-sampling technique (1,000 runs), are shown in Table 4. The result also shows that the variations of E&T, HED, LU and FL matter on AWH; MAE, HED and FL matter on AFRW; FL and E&T matter on ARW; FL matters on MW. Above all, E&T and HED have strong impact on AWH.

(3) The measurement model

The results of applying the bootstrap re-sampling technique to the measurement model are shown in Table 5. All the T Statistics ( $t$  values) for the weights exceed 1.96, indicating that the measurement model is significant and thus confirmed by the data.

Table 4. Path coefficients (mean, standard deviation,  $t$ )

The structure model	Mean	STDEV	$t$	The structure model	Mean	STDEV	$t$
L <sub>3</sub> HED → L <sub>9</sub> AWH	-2.718	1.009	2.693 *	L <sub>4</sub> FL → L <sub>7</sub> ARW	0.745	0.191	3.896 *
L <sub>3</sub> HED → L <sub>6</sub> AFRW	-1.715	0.800	2.143 *	L <sub>4</sub> FL → L <sub>5</sub> LU	0.319	0.082	3.911 *
L <sub>3</sub> HED → L <sub>7</sub> ARW	0.377	0.496	0.762	L <sub>4</sub> FL → L <sub>8</sub> MW	0.528	0.196	2.698 *
L <sub>3</sub> HED → L <sub>5</sub> LU	0.682	0.080	8.491 *	L <sub>5</sub> LU → L <sub>9</sub> AWH	1.655	1.068	1.550
L <sub>3</sub> HED → L <sub>8</sub> MW	0.007	0.371	0.019	L <sub>5</sub> LU → L <sub>6</sub> AFRW	0.118	0.688	0.171
L <sub>1</sub> E&T → L <sub>9</sub> AWH	2.763	0.882	3.133 *	L <sub>5</sub> LU → L <sub>7</sub> ARW	-0.418	0.342	1.223
L <sub>1</sub> E&T → L <sub>6</sub> AFRW	-0.469	0.618	0.758	L <sub>5</sub> LU → L <sub>8</sub> MW	0.317	0.467	0.680
L <sub>1</sub> E&T → L <sub>7</sub> ARW	0.588	0.264	2.224 *	L <sub>2</sub> MAE → L <sub>9</sub> AWH	-2.335	1.681	1.389
L <sub>1</sub> E&T → L <sub>4</sub> FL	0.839	0.030	27.609 *	L <sub>2</sub> MAE → L <sub>6</sub> AFRW	0.507	0.879	0.577
L <sub>1</sub> E&T → L <sub>2</sub> MAE	0.949	0.018	51.375 *	L <sub>2</sub> MAE → L <sub>7</sub> ARW	-0.285	0.429	0.664
L <sub>1</sub> E&T → L <sub>8</sub> MW	-0.036	0.388	0.093	L <sub>2</sub> MAE → L <sub>3</sub> HED	0.964	0.013	74.367 *
L <sub>4</sub> FL → L <sub>9</sub> AWH	0.512	0.603	0.849	L <sub>2</sub> MAE → L <sub>8</sub> MW	0.153	0.579	0.264
L <sub>4</sub> FL → L <sub>6</sub> AFRW	1.063	0.365	2.909 *				

\*: significance of T Statistics ( $t$ )

Table 5. Weights of the measurement model (mean, standard deviation, T statistics)

The measurement model	Mean	STDEV	$t$	The measurement model	Mean	STDEV	$t$
M <sub>11</sub> Trade ← M <sub>1</sub> E&T	0.333	0.006	58.312 *	M <sub>52</sub> LUV ← M <sub>5</sub> LU	0.329	0.002	135.657 *
M <sub>12</sub> Export ← M <sub>1</sub> E&T	0.354	0.007	49.064 *	M <sub>53</sub> LUT ← M <sub>5</sub> LU	0.350	0.005	64.933 *
M <sub>13</sub> EOPO ← M <sub>1</sub> E&T	0.339	0.008	43.607 *	M <sub>61</sub> AFRWC ← M <sub>6</sub> AFRW	0.343	0.016	20.833 *
M <sub>21</sub> GDP ← M <sub>2</sub> MAE	0.337	0.007	49.616 *	M <sub>62</sub> AFRWU ← M <sub>6</sub> AFRW	0.332	0.010	33.040 *
M <sub>22</sub> CPI ← M <sub>2</sub> MAE	0.346	0.006	56.050 *	M <sub>63</sub> AFRWT ← M <sub>6</sub> AFRW	0.340	0.009	36.099 *
M <sub>23</sub> LPI ← M <sub>2</sub> MAE	0.345	0.006	54.523 *	M <sub>71</sub> ARWM ← M <sub>7</sub> ARW	0.345	0.007	51.602 *
M <sub>31</sub> HEDC ← M <sub>3</sub> HED	0.326	0.003	121.785 *	M <sub>72</sub> ARWS ← M <sub>7</sub> ARW	0.329	0.006	54.938 *
M <sub>32</sub> HEDU ← M <sub>3</sub> HED	0.342	0.003	116.130 *	M <sub>73</sub> ARWT ← M <sub>7</sub> ARW	0.354	0.008	46.398 *

M <sub>33</sub> HEDT ← M <sub>3</sub> HED	0.342	0.003	117.543 *	M <sub>81</sub> BWM ← M <sub>8</sub> MW	0.514	0.004	117.192 *
M <sub>43</sub> FLT ← M <sub>4</sub> FL	0.360	0.013	28.356 *	M <sub>82</sub> MWH ← M <sub>8</sub> MW	0.493	0.003	141.767 *
M <sub>41</sub> FLM ← M <sub>4</sub> FL	0.297	0.019	15.564 *	M <sub>91</sub> AWHN ← M <sub>9</sub> AWH	0.405	0.090	4.528 *
M <sub>42</sub> FLS ← M <sub>4</sub> FL	0.396	0.023	17.275 *	M <sub>92</sub> AWHO ← M <sub>9</sub> AWH	0.514	0.175	2.947 *
M <sub>51</sub> LUI ← M <sub>5</sub> LU	0.332	0.002	133.647 *	M <sub>93</sub> AWHT ← M <sub>9</sub> AWH	0.422	0.070	6.012 *

\*: significance of T Statistics (t)

Table 6. The aggregate results for the model

The structural model	Hypothesis	Significance	Conclusion
L <sub>1</sub> E&T → L <sub>6</sub> AFRW	H <sub>1-1</sub>	p > 0.05	Not support
L <sub>1</sub> E&T → L <sub>7</sub> ARW	H <sub>1-2</sub>	p < 0.05	Support
L <sub>1</sub> E&T → L <sub>8</sub> MW	H <sub>1-3</sub>	p > 0.05	Not support
L <sub>1</sub> E&T → L <sub>9</sub> AWH	H <sub>1-4</sub>	p < 0.05	Support
L <sub>2</sub> MAE → L <sub>6</sub> AFRW	H <sub>2-1</sub>	p > 0.05	Not support
L <sub>2</sub> MAE → L <sub>7</sub> ARW	H <sub>2-2</sub>	p > 0.05	Not support
L <sub>2</sub> MAE → L <sub>8</sub> MW	H <sub>2-3</sub>	p > 0.05	Not support
L <sub>2</sub> MAE → L <sub>9</sub> AWH	H <sub>2-4</sub>	p > 0.05	Not support
L <sub>3</sub> HED → L <sub>6</sub> AFRW	H <sub>3-1</sub>	p < 0.05	Support
L <sub>3</sub> HED → L <sub>7</sub> ARW	H <sub>3-2</sub>	p > 0.05	Not support
L <sub>3</sub> HED → L <sub>8</sub> MW	H <sub>3-3</sub>	p > 0.05	Not support
L <sub>3</sub> HED → L <sub>9</sub> AWH	H <sub>3-4</sub>	p < 0.05	Support
L <sub>4</sub> FL → L <sub>6</sub> AFRW	H <sub>4-1</sub>	p < 0.05	Support
L <sub>4</sub> FL → L <sub>7</sub> ARW	H <sub>4-2</sub>	p < 0.05	Support
L <sub>4</sub> FL → L <sub>8</sub> MW	H <sub>4-3</sub>	p < 0.05	Support
L <sub>4</sub> FL → L <sub>9</sub> AWH	H <sub>4-4</sub>	p > 0.05	Not support
L <sub>5</sub> LU → L <sub>6</sub> AFRW	H <sub>5-1</sub>	p > 0.05	Not support
L <sub>5</sub> LU → L <sub>7</sub> ARW	H <sub>5-2</sub>	p > 0.05	Not support
L <sub>5</sub> LU → L <sub>8</sub> MW	H <sub>5-3</sub>	p > 0.05	Not support
L <sub>5</sub> LU → L <sub>9</sub> AWH	H <sub>5-4</sub>	p > 0.05	Not support
L <sub>1</sub> E&T → L <sub>2</sub> MAE	H <sub>6</sub>	p < 0.05	Support
L <sub>2</sub> MAE → L <sub>3</sub> HED	H <sub>7</sub>	p < 0.05	Support
L <sub>1</sub> E&T → L <sub>4</sub> FL	H <sub>8</sub>	p < 0.05	Support
L <sub>4</sub> FL → L <sub>5</sub> LU	H <sub>9</sub>	p < 0.05	Support
L <sub>3</sub> HED → L <sub>5</sub> LU	H <sub>10</sub>	p < 0.05	Support

(4) Discussion

A summary of the aggregate results for the model is presented in Table 6. In Table 6, the hypotheses consistent with expectations are as follows: H<sub>1-2</sub>, H<sub>1-4</sub>, H<sub>3-1</sub>, H<sub>3-4</sub>, H<sub>4-1</sub>, H<sub>4-2</sub>, H<sub>4-3</sub>, H<sub>4-4</sub>, H<sub>6</sub>, H<sub>7</sub>, H<sub>8</sub>, H<sub>9</sub> and H<sub>10</sub>. The study supports the result of 12 hypotheses. If the non significant hypotheses are deleted, the final path flow is re-plotted as Fig.2. Some indications are worth discussing, as follows.

We found that E&T is the key and direct determinant on ARW and AWH in Taiwan. MAE, HED, FL and LU are the indirect determinants. There are two direct path effects: (1) E&T → ARW (path effect: 0.588); (2) E&T → AWH (path effect: 2.763). Direct path 2 is the most powerful, indicating that the volume of trade and export is the key factor affecting average working hour in Taiwan.

In addition to the direct effect, there are five indirect path effects: (1) path 1: E&T → MAE → HED → AFRW; (2) T&E → MAE → HED → AWH (3) E&T → FL → ARW; (4) E&T → FL → AFRW; (5) E&T → FL → MW. The individual mediation effect is as follows. From the following data, indirect path 2 (E&T → MAE → HED → AWH, path effect: 2.544) is the most powerful one. The result matches the above direct path 2, indicating that trade and export plays a stimulator role on wage levels in Taiwan. That is, the volume of exports and trade increases leading to macro economical growth. Then the number of students entering college or university increase, and the number of graduates increases. This is analogous to the “Need Hierarchy Theory” proposed by Maslow (1954). When the labor supply increases, average first regular wage levels falls.

Direct effect:

- (1) path 1 = 0.588
- (2) path 2 = 2.763
- Indirect effect:
- (1) path 1 =  $0.949 \times 0.964 \times (-1.715) = -1.569$
- (2) path 2 =  $0.949 \times 0.964 \times (-2.781) = -2.544$
- (3) path 3 =  $0.839 \times 1.063 = 0.892$
- (4) path 4 =  $0.839 \times 0.745 = 0.625$
- (5) path 5 =  $0.839 \times 0.528 = 0.443$
- Total effect
- (1) AFRW =  $-1.569 + 0.892 = -0.677$
- (2) ARW =  $0.588 + 0.625 = 1.213$
- (3) MW = 0.443
- (4) AWH =  $2.763 - 2.544 = 0.219$

As for the total effect, ARW ranks the first (path effect: 1.213), and AFRW is the second (path effect: 0.677). This indicates that the volume of trade and export, and the number of foreign laborers are the two key and powerful determinants affecting average regular wage levels. The volume of exports and trade, the number of college or university graduates, and the number of foreign laborers are the three determinants affecting average first regular wage levels in Taiwan. When comparing the determinants on ARW and AFRW, it is found that “the number of college or university graduates” is indeed an important determinant affecting average regular wage levels in Taiwan.

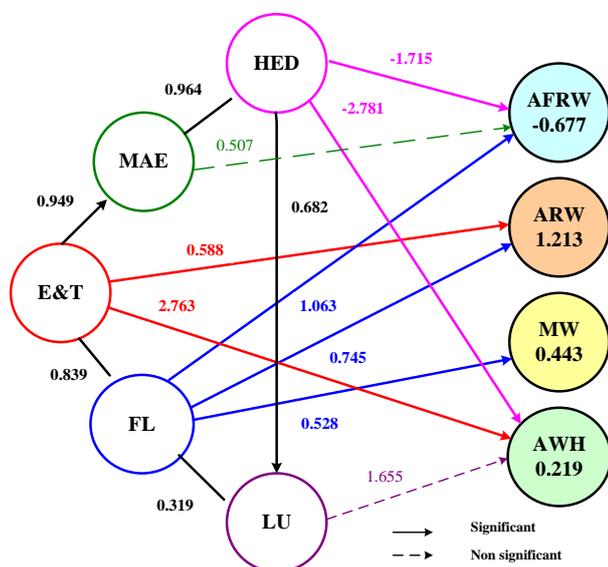


Fig.2. Final result of the PLS path model

### 5 Conclusion

In this study, we propose a PLS path model of Taiwan’s exports by using monthly data during 2000/01-2014/06. The average  $R^2$  of the model is 0.7, lending it strong support. The result found that among five determinants, exports and trade is the direct determinant affecting average regular wage

levels and average working hours in Taiwan. Macro economical variations, the number of college or university graduates, the number of foreign laborers, and the number of labor unions members are the indirect determinants.

According to the total effect of the seven paths (two direct and five indirect), the result indicates that exports and trade plays a stimulator role on wage levels. The volume of exports and trade, and the number of foreign laborers are the two key and powerful determinants affecting ARW (average regular wage level); the volume of trade and export, the number of college or university graduates, and the number of foreign laborers are the three determinants affecting AFRW (average first regular wage level) in Taiwan. By comparing the determinants on ARW and AFRW, it is found that “the number of college or university graduates” is indeed an important factor affecting average first regular wage level in Taiwan. The result confirm the demand-supply principle of economics— that labor supply increases may lead to a fall in the wage levels when the college or university graduates enter the workplace.

Finally, the study focuses on macro perspective. This approach contributes to the literature by providing an aggregate, comprehensive, and scientific framework for wage determinants modelling in Taiwan. Further research is encouraged to apply the proposed PLS model from micro perspective, such as more different departments of graduates, laborers from different countries, or specific industries of Taiwan, so as to better understand the determinants on wage levels and to facilitate the development of propositions that are generalizable.

### References:

- [1] Abdi, T. (2007). Trade liberalization, technology, relative factor supplies and the relative wage: Evidence from the south. *Applied Economics*, 39, 2451-2463.
- [2] Beladi, H., Chaudhuri, S. & Yabuuchi, S. (2008). Can international factor mobility reduce wage inequality in a dual economy? *Review of International Economics*, 16 (5), 893-903.
- [3] Beyer, H., Rojas, P. & Vergara, R. (1999). Trade liberalization and wage inequality. *Journal of Development Economics*, 59, 103-123.
- [4] Blanchard, O. & Katz, L. (1997). What do we know and we do not know about the natural rate of unemployment. *Journal of Economic Perspectives*, 11, 51-73.

- [5] Borjas & Ramey (1994). Time series evidence on sources of trends in wage inequality. *American Economic Review*, 84, 11-16.
- [6] Chassamboulli, A. & Palivos, T. (2013). The impact of immigration on the employment and wages of native workers. *Journal of Macroeconomics*, 38, 19-34.
- [7] Chaudhuri, S. (2008). Wage inequality in a dual economy and international mobility of factors: do factor intensities always matter? *Economic Modelling*, 25, 1155-1164.
- [8] Chaudhuri, S. & Yabuuchi, S. (2007). Economic liberalization and wage inequality in the presence of labor market imperfection. *International Review of Economics and Finance*, 16, 592-603.
- [9] Choi, K. (1996). The impact of shifts in supply of college graduates: repercussion of educational reform in Korea. *Economics of Education Review*, 15 (1), 1-9.
- [10] Chiang, F. (2006). The impact of leading in foreign labors on unemployment, career selection, wage of domestic labor. *Taiwan Economic Forecast and Policy*, 69-111.
- [11] Chiang, Y. H. (2013). Using a combined AHP and PLS path modeling on blog site evaluation in Taiwan. *Computers in Human Behavior*, 29(4), 1325-1333.
- [12] Chiang, Y.H. (2016). Enroll an EMI Course Offered by NSTs or not? Perspective of Undergrates in Taiwan. *WSEAS Transactions on Business and Economic*, 13, 311-320.
- [13] Cragg, M. & Epelbaum, M. (1996). Why has wage dispersion grown in Mexico? Is it the incidence of reforms or the growing demand for skills? *Journal of Development Economics*, 51 (1), 99-116.
- [14] Danthine, J. P. & Kurmann, A. (2004). Fair wages in a new Keynesian model of the business cycle. *Review of Economic Dynamics*, 7, 107-142.
- [15] Egger, H., Egger, P. & Kreickemeier, U. (2013). Trade, wages, and profits. *European Economic Review*, 64, 332-350.
- [16] Findlay, R. & Kierzkowski, H. (1983). International trade and human capital: a simple general equilibrium model. *Journal of Political Economy*, 91 (6), 957-978.
- [17] Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39-50.
- [18] Fornell, C. & Bookstein, F. L. (1982). Two structural equation model: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, 19, 440-452.
- [19] Gindling, T. H. & Sun, W. (2002). Higher education planning and the wages of workers with higher education in Taiwan. *Economics of Education Review*, 21, 153-169.
- [20] Gindling, T. H. & Terrel, K. (2010). Minimum wages, globalization, and poverty in Honduras. *World Development*, 38(6), 908-918.
- [21] Goldberg, P. K. & Pavcnik, N. (2005). Trade, wages, and the political economy of trade protection: evidence from the Colombian trade reforms. *Journal of International Economics*, 66 (1), 75-105.
- [22] Guerrazzi, M. & Meccheri, N. (2012). From wage rigidity to labour market institution rigidity: A turning-point in explaining unemployment? *The Journal of Socio-Economics*, 41, 189-197.
- [23] Gupta, M. R. & Dutta, P. B. (2010). Skilled-unskilled wage inequality: A general equilibrium analysis. *Research in Economics*, 64, 247-263.
- [24] Hansmann, K. W. & Ringle, C. M. (2005). SmartPLS website, powered by [phpBB](#) © 2001, 2005 phpBB Group.
- [25] Hering, L. & Poncet, S. (2009). The impact of economic geography on wages: Disentangling the channels of influence. *China Economic Review*, 20, 1-14.
- [26] Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: a review of four recent studies. *Strategy Management Journal*, 20, 195-204.
- [27] Isgut, A. (2001). What's different about exporters? Evidence from Colombian manufacturing. *Journal of Development Studies*, 37 (5), 57-82.
- [28] Katz, L. & Murphy, K. (1992). Changing relative wages, 1963-1987: supply and demand factors. *Quarterly Journal of Economics*, 107, 35-78.
- [29] Klein, M. W., Moser, C. & Urban, D. M. (2013). Exporting, skills and wage inequality. *Labour Economics*, 25 76-85.
- [30] Marjit, S. (2003). Economic reform and informal wage-a general equilibrium analysis. *Journal of Development Economics*, 72, 371-378.
- [31] Marjit, S. & Kar, S. (2005). Emigration and wage inequality. *Economics Letters*, 88, 141-145.
- [32] Matlzer, K. & Renzl, B. (2007). The relationship between interpersonal trust, employee satisfaction, and employee loyalty.

*Total Quality Management & Business Excellence*, 17 (10), 1261-1271.

- [33] Munch, J. R. & Skaksen, J. R. (2008). Human capital and wages in exporting firms. *Journal of International Economics*, 75, 363-372.
- [34] Montuenga-Gomez, V. & Ramos-Parreno, J. M. (2005). Reconciling the wage curve and the Phillips curve. *Journal of Economic Surveys*, 19, 735-765.
- [35] Ogloblin, C. & Brock, G. (2005). Wage determination in urban Russia: Underpayment and the gender differential. *Economic Systems*, 29, 325-343.
- [36] Pauw, K. (2012). Minimum wages and household poverty: General equilibrium macro-micro simulations for South Africa. *World Development*, 40 (4), 771-783.
- [37] Pissarides, C. A. (2001). Employment protection. *Labour Economics*, 8, 131-159.
- [38] Raurich, X. & Sorolla, V. (2014). Growth, unemployment and wage inertia. *Journal of Macroeconomics*, 40, 42-59.
- [39] Robbins, D. & Gindling, T. H. (1999). Trade liberalization and the relative wages for more-skilled workers in Costa Rica. *Review of Development Economics*, 3 (2), 140-154.
- [40] Robbins, D. & Zveglich, J. (1996). Trade liberalization and wage structure in Taiwan: 1978-1992. mimeo, Harvard University.
- [41] Taylor, J. (1993). The use of the new macroeconometric for policy formulation. *American Economic Review*, 83 (2), 300-305.
- [42] Tenenhaus, M., Pagès, J., Ambroisine, L. & Guinot, C. (2004). PLS methodology to study relationships between hedonic judgments and product characteristics, *Food Quality and Preference*, 16 (4), 315-325.
- [43] Vinzi, V. E., Wynne, Chin. W., Henseler, J. & Wang, H. (2008). *Handbook of partial least squares: Concepts, methods and applications in marketing and related fields*. Series: Springer Handbooks of Computational Statistics. New York: Springer-Verlag.
- [44] Wixom, B. H. & Watson, H. J. (2001). An empirical investigation of the factors affecting data warehousing success. *MIS Quarterly*, 25 (1), 17-41.
- [45] Wood, A. (1998). Globalisation and the rise in labor market inequalities. *The Economic Journal*, 108, 1463-1482.
- [46] Zamfir, A-M, Matei, M. M. & Lungu, E. O. (2013). Influence of education-job mismatch on wages among higher education graduates. *Procedia - Social and Behavioral Sciences*, 89, 293-297.