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INTERNATIONAL TRADE, PRODUCTIVITY GROWTH, EDUCATION AND WAGE DIFFERENTIALS: A CASE STUDY OF TAIWAN

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International Trade, Productivity Growth, Education and Wage Differentials: A Case Study of Taiwan

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Abstract

The source of changes in the wage differential between skilled and unskilled labor has been an important subject of debate for several decades. International trade and productivity growth are two main causes that have been suggested from large country studies. Recent research proposes education as another influence. All three causes have been significantly associated with Taiwan's economic development. This paper attempts to contribute to the literature by investigating wage differentials of Taiwan, a small open economy with a paucity of study on the issue of trade and wages. An Error Correction Model (ECM) incorporating both short and long run effects is employed.

Education and international trade are found to be important arguments for raising wage differentials in Taiwan. Productivity growth has a significant influence on wage differentials in the short but not in the long run.

Keywords: Wage Differential, International Trade, Productivity Growth, Error Correction Model, Skill Adjustment Cost, Bootstrapping

JEL classification: C12; C15; C51; F10; F41; H52; J31

1. Introduction

Wage differentials between skilled and unskilled labor have been an important issue for debate for several decades. There is a large amount of research which attempts to determine its causes. Katz and Autor (1999) have developed a supply-demand-institutions (SDI) framework to assess the role of market forces (supply and demand shifts) and institutional factors in changes in the wage structure. In the discussion of market forces, they analyze skill-biased technological change, globalization, and deindustrialization in determination of wage differentials. Deardorff and Hakura (1994) conducted a selective survey of the empirical literature on trade and wages, and categorized the discussion into trade volumes, prices, and protection. The cause of technology innovation (sometimes also referred to loosely as productivity growth) was introduced when some research, for example Bound and Johnson (1992), and Lawrence and Slaughter(1993), failed to find a significant trade impact on wages. Essentially, international trade as measured by trade volume, prices, protection and globalization, and technology change, inducing deindustrialization and productivity growth, are the two main arguments. There is an ongoing debate as to whether international trade or technological change is more significant in the determination of wage differentials. Both labor economists (such as Katz and Autor (1999); Wood (1994)) and trade theorists (such as Bhagwati and Dehejia (1993); Leamer (1994)) contribute to the literature, theoretically and empirically, by proposing compelling arguments from various angles and by elaborating different methodologies. However, the more investigation one does the less conclusive it becomes. The majority of existing research focuses on developed or large countries and is based either theoretically on the Heckscher-Ohlin-Samuelson framework or is based empirically on econometric models. The econometric models use either reduced forms from relatively simple theoretical models or somewhat ad hoc forms, neither of which is sufficiently comprehensive. This paper attempts to contribute to the literature by investigating wage differentials of Taiwan, a small open economy with a paucity of study on the issue of trade and wages[1]. In addition this paper also includes

[1] The only recent work of Chen and Hsu (1998) ends with a deviated conclusion from the U.S. case as well as the simulation results in Chang (2000).

education investment, which is seldom discussed in the literature, as a factor influencing wage differentials. An Error Correction Model (ECM) incorporating both short and long run effects is employed. The legitimacy of the explanatory variables, i.e. trade, productivity growth and education, is substantiated by a more comprehensive theoretical model developed in Chang (2000) using Dynamic Intertemporal General Equilibrium (DIGE) methodology. All three proposed factors have played important roles in Taiwan's economic development. This makes Taiwan an interesting case study and the results not only suggest some policy implications for Taiwanese government, but also contribute to the literature as comparisons with the large country cases.

This paper evaluates the importance of three determinants of wage differentials in Taiwan, i.e. trade, productivity growth, and education, and concludes the three variables' performance is fairly consistent with the theoretical simulation results, i.e. international trade is responsible for the wage differential in both the short and long run; productivity growth at most raises wage differentials in the short run; an increase in government education investment decreases wage differentials in the long run and has an insignificant effect in the short run. In addition the conclusion infers that the adjustment cost of skill formation of Taiwan has been low enough to enable unskilled labor to catch up with the skill upgrade. It also sheds light on the importance of including skill adjustment cost in future research on wage differentials. Section 2 illustrates a profile of wage differentials in Taiwan. Section 3 briefly frames the theoretical model, Section 4 demonstrates the empirical test and Section 5 concludes.

2 Wage Differentials in Taiwan

The issue of wage differentials has caught the public attention in Taiwan along with the emergence of increased income inequality. This section describes wage differentials between different skill groups of Taiwan from 1978 to 1996. The monthly average wage data by education attainment is from the Manpower Utilization Survey. The real wage is the nominal wage deflated by the consumer price index (CPI) measured on the base of the price level in 1991. Conventionally, education attainment is the principal determination of skilled and unskilled labor. Practically, the chosen education level for splitting labor skills affects the results. This section presents two classification schemes[2]. First, individuals with a degree from college or above are designated as skilled labor while the remainder as unskilled labor. Second, individuals with a degree from a junior college or above are designated as skilled labor and the remainder as unskilled labor. To manipulate the raw data, which includes several categories in the group of unskilled labor[3], the weighted average monthly wage is applied with the weights as the population proportion of each category in the group. The following profile also sketches both types of wage differentials, i.e. the wage gap and wage ratio.

2.1 Degree from College or Above Designated to Skilled Labor

Figure 1 shows an increasing trend of wage gap between skilled and unskilled labor from 1978 to 1996. The differential jumps 2.57 times in 1996 relative to 1978 and follows an average annual growth rate of 5.1 percent.

An important point is that the growth rates of the unskilled wage are larger than the skilled wage in more years, especially from 1987 to 1995 (and except for 1993). This indicates a continuing shortage of unskilled labor in Taiwan since 1987. From then on, government policy on importing foreign labor has become important[4].

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[2] The reason being, in Taiwan, there is a category called "junior college". Students spend two, three, or five years to get a degree which is in a lower rank than a four year college degree. The subjects offered in junior colleges are similar to those offered in colleges. Hence, it is considered reasonable to take a look at the case of including this category in skilled labor. Katz and Murphy (1992) created a measurement of college and high school equivalents, which might not be a good alternative under the limited time series data.

[3] They are illiterate, self-educated, primary school, junior high (including junior vocational) school, senior high school, vocational school, and/or junior college.

[4] Refer to Tsay (1995) for a detailed discussion.

Figure 1 Real Average Monthly Wage of Skilled and Unskilled Labor (NT$: 100)

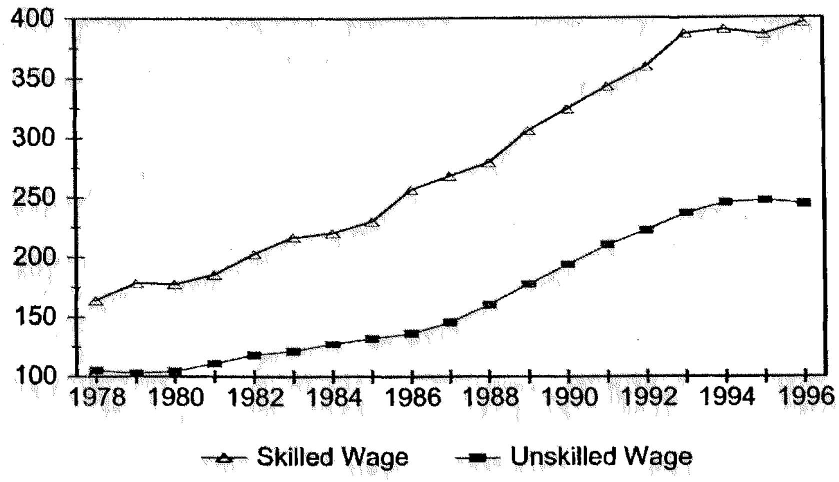
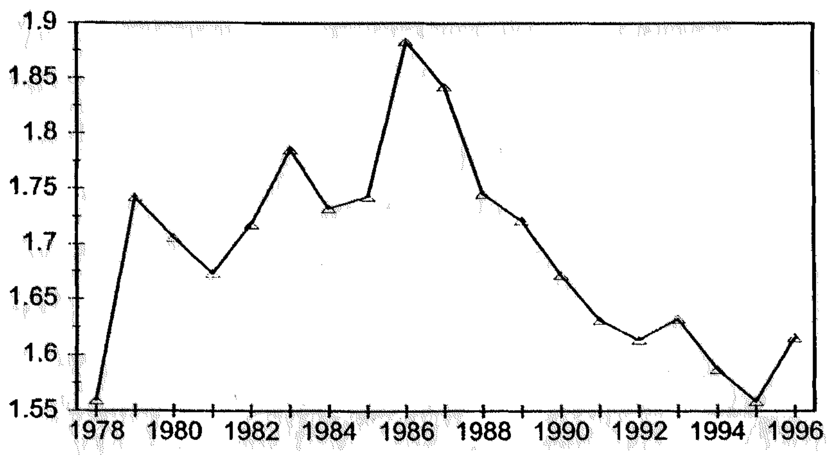


Figure 2 illustrates the variation of wage ratio of skilled to unskilled, the other definition of wage differentials. From 1978 to 1986, the wage ratio basically shows an increasing trend. From 1987 to 1995, the ratio follows a downward trend (except for 1993). This substantiates that, during this period, the unskilled wage grew more than the skilled wage. In 1995, the wage ratio drops to a similar level as in 1978.

Figure 2 Wage Ratio of Skilled to Unskilled Labor

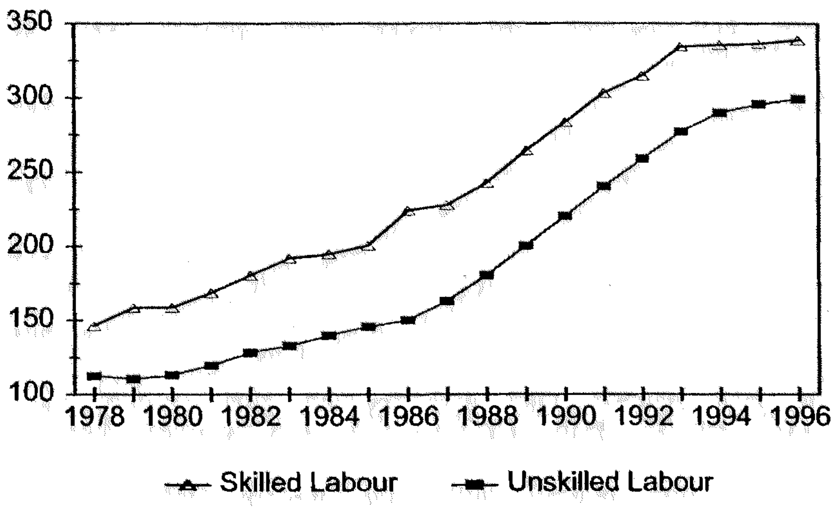


In summary, from the viewpoint of wage gap, Taiwan shows an increasing trend of wage differentials. However, in the respect of wage ratio, there is no convincing evidence of a growing wage differential after 1987.

2.2 Degree from Junior College or Above Designated to Skilled Labor

When workers with a junior college degree are included in the category of skilled labor, the wage gap shows no increasing trend. As depicted by Figure 3, it follows a fairly parallel shape.

Figure 3 Real Average Monthly Wages with Junior College in Skilled Labor (NT$: 100)



The characteristics of both the wage growth rate and the wage ratio are similar to the analysis of section 2.1 except the wage ratio presents a lower rate than that of junior college not included in the category of skilled labor[5].

In summary, both the wage gap and the wage ratio reveal that Taiwan has experienced a non-increasing wage differential if skilled labor is defined as workers with a degree from junior college or above.

[5] Obviously, this is a result from a weighted average method and from junior college with a lower wage rate.

3. Theoretical Model

A dynamic intertemporal general equilibrium (DIGE) model describes a small open economy with three types of goods[6]: exports, imports, and non-traded; three agents: firms, households, and the government; and two kinds of labor: skilled and unskilled labor. Unlike the Heckscher-Ohlin-Samuelson model, this DIGE model allows production factor endowments to vary along time by optimal choices and provides a relatively comprehensive framework. Unlike computable general equilibrium (CGE) models, this model illuminates both of the short and long run transition of those endogenous variables. It shows that a long run transition could be misleading in the short run.

3.1 Firms

Firms employ physical capital (K), skilled and unskilled labor to produce three types of goods and sell them to households for consumption, to government for education capital investment, and to themselves for physical capital investment. The capital accumulation in each sector depends on the rate of fixed capital formation J_i and the rate of depreciation δ_i,

$$(3.1) \qquad \frac{dK_i}{dt} = J_{t,i} - \delta_i \cdot K_{t,i}.$$

where i is the sector indicator, and i = 1, 2, 3.

Exports (X) based on foreign demand is a function of foreign income (Y^*) and the inverse of terms of trade as follows,

[6] Three types of goods are also characterized as skilled labor intensive, unskilled labor intensive, and capital intensive.

(3.2) $$X = \left(\frac{P_2}{P_1}\right)^{\rho} \cdot Y^*,$$

where ρ is a parameter.

3.2 Households

Households supply unskilled labor (L_u) to firms and skilled labor (L_s) to both firms and government to gain wages (W_s is the skilled wage; W_u the unskilled wage). Households also own the physical capital and earn financial dividends to finance goods consumption from firms and purchases of education from government. Leisure has an opportunity cost of not working. To maximize utility households distribute consumption optimally on both goods and leisure. The budget constraint the household faces and the skill formation under optimal choice are:

(3.3) $$\frac{dF_t}{dt} = r_t \cdot F_t + (1-\tau_t) \cdot \left(\frac{W_s}{P_2} \cdot L_{s,t} + \frac{W_u}{P_2} \cdot L_{u,t}\right) - \left[\left(\frac{P_1}{P_2}\right) \cdot C_{1,t} + C_{2,t} + \left(\frac{P_3}{P_2}\right) \cdot C_{3,t} + \left(\frac{P_{E,t}}{P_2}\right) \cdot S_{E,t}\right],$$

(3.4) $$\frac{dL_{s,t}}{dt} = J_{s,t} - \delta_s \cdot L_{s,t},$$

where $C_{i,t}$ is the consumption of goods, F_t is the financial assets, $P_{E,t}$ is the price of one unit of education, $S_{E,t}$ is the amount of education buying, $J_{s,t}$ is the fixed skill formation, and δ_s is the depreciation rate of skill.

3.3 Government

The government buys goods, i.e. good 1 ($I^G_{E,1}$), good 2 ($I^G_{E,2}$), and good 3 ($I^G_{E,3}$), from firms and transforms them into education capital ($K_{E,t}$), together with hiring skilled labor to produce education. The government also balances its budget by collecting labor income tax and selling education to households to finance its spending on education capital investment and skilled labor hiring. The role of government as an education supplier is essential. This model attempts to capture the reality of government supplying education in consideration of externalities. Total government investment on education capital is represented by $I^G_{E,t}$, which is assumed to be exogenously controlled by the government. The accumulation of education capital is followed by the total investment of government subtracting the depreciation,

(3.5) $$\frac{dK_{E,t}}{dt} = I^G_{E,t} - \delta_E \cdot K_{E,t},$$

where δ_E is the rate of depreciation and $I^G_{E,t}$ is defined as follow,

(3.6) $$I^G_{E,t} = \frac{1}{P^G_E} \cdot (P_1 \cdot I^G_{E,1} + P_2 \cdot I^G_{E,2} + P_3 \cdot I^G_{E,3}),$$

where P^G_E is the weighted price index.

To assure the model is consistent, as well as the economy is in equilibrium, the rule of demand equal to supply is applied on both sides of the goods and factors market. The full model in steady state is shown in Appendix 1.

3.4 Simulation Results

The main results from this model are that, in the long run, productivity growth and an increase in government education investment lessen wage differentials. However, in the short run, an increasing education investment is followed by a fluctuated transition in wage differentials because the adjustment process of skill formation takes time and households make optimal choices between working and leisure. Productivity growth at most raises wage differentials in the short run. An increase in trade enlarges wage differentials in both the short and long run. It is also found that if the export sector is skilled intensive, an increase in exports boosts wage differentials; if the export sector is unskilled intensive, an export expansion reduces wage differentials; if the export sector is capital intensive, an increase in exports may either boost or reduce wage differentials. This small open economy model shows that a developed country's trade with a developing country enlarges wage differentials in the developed country and reduces wage differentials in the developing country. This is consistent with the majority of results from large country cases. The result also tends to substantiate the argument that trade has a responsibility for wage differentials. From a theoretical perspective it is unclear how productivity growth raises wage differentials in the long run due to skill formation eventually catching up with the progress of technology.

4. Empirical Testing

The data is from several sources. The monthly average wage data by education attainment comes from the Manpower Utilization Survey, which is published by Directorate-General of Budget, Accounting, and Statistics (DGBAS) of the Republic of China. As mentioned in Section 2, the raw wage data has been manipulated to be a weighted average. Government investment on education uses government expenditure on education, science, and culture (EDUN) as a proxy, which provides a broad meaning of education investment and is from the CEIC Database, maintained by the EconData Pty. Ltd. The proxies for productivity growth and international trade are, respectively, the annual growth rate of industrial production (PIND) and net exports (NETX), which are drawn from various issues of Taiwan Statistical Data Book, published by the Council for Economic Planning and Development of the Republic of China. The whole dataset is shown in Appendix 2 and this time series covers 1978 to 1996. Due to it being a small sample, a Bootstrapping estimation is constructed for the robustness test. Both education expenditure and net exports are measured in millions of U.S. dollars. The wage differential is measured by the ratio ($\frac{W_s}{W_u}$) of the average monthly wage with a college or above degree (skilled labor) to that with a degree from junior college or below (unskilled labor)[7]. Based on the theoretical framework in the previous section, a long run model and an Error Correction Model are established to demonstrate both the long and short run effects of PIND, EDUN, and NETX on wage differentials.

4.1 Unit Root Tests

Table 1 reports results of the Dickey-Fuller unit root tests[8]. Although the Dickey-Fuller test is known to have a low power in testing for unit roots, especially when dealing with a small sample, it still provides suggestive results to the stationarity of time series. The

[7] The wage ratio, not wage gap, is chosen to perform testing due to its role in the simulation results. To focus on the conventional definition of college or above as skilled labor is plausible due to the systematic shift down of wage ratio if junior college is included.
[8] Phillips-Perron unit root tests end with the same results.

Dickey-Fuller test for unit root shows that, except for PIND which is I(0), the other three variables, $\frac{W_s}{W_u}$, EDUN, NETX, are I(1).

Table 1 Unit Root Tests

	W_s/W_u	PIND	EDUN	NETX	C.V. 5%[1]
CONSTANT, NO TREND[2]					
A(1)=0 T-TEST	-2.0	-5.3	-0.9	-1.5	-2.9
A(0)=A(1)=0	2.1	14.4	1.2	1.3	4.6
CONSTANT, TREND					
A(1)=0 T-TEST	-3.1	-5.2	-2.3	-1.5	-3.4
A(0)=A(1)=A(2)=0	4.0	9.8	2.5	0.9	4.7
A(1)=A(2)=0	6.0	14.1	2.7	1.1	6.3
Conclusion	**I(1)**	**I(0)**	**I(1)**	**I(1)**	

Note: 1. C.V 5% means critical value at 5% significance level.
2. The Augmented Dickey-Fuller (ADF) regression equations in Shazam use first-difference regressant with and without a time trend, where A(0) is the so-called "drift" coefficient; A(1) the coefficient of the tested variable with backward one lag; A(2) is the time trend coefficient. The null hypothesis is A(1)=0 for an existence of unit roots.

4.2 Long Run Model

Following the above tests, a long run model is proposed and estimated to examine the long run relationship[9]. The model is as follows and Table 2 shows the estimation results.

$$(1)\qquad \frac{W_s}{W_u} = \beta_0 + \beta_1 \cdot EDUN + \beta_2 \cdot NETX + \varepsilon \qquad \varepsilon \sim \text{i.i.d. } N(0, \sigma_\varepsilon^2)$$

Table 2 The Long Run Model

VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 16 DF	P-VALUE	ELASTICITY AT MEANS
EDUN	-0.11716E-02	0.2347E-03	-4.992	0.000	-0.0472
NETX	0.12433E-02	0.2588E-03	4.803	0.000	0.0433
CONSTANT	169.92	2.351	72.27	0.000	1.0038

DURBIN-WATSON = 1.6451
R-SQUARE ADJUSTED = 0.6905
LOG OF THE LIKELIHOOD FUNCTION = -55.9264

[9] Due to the small sample size and low power of Dickey-Fuller unit root test, a long run model includes PIND still being tested. The result shows PIND is an insignificant long-run factor of wage differentials, which is consistent with the simulation result.

In the long run, trade and education have a significant effect on the wage differential. If government education investment increases by 1 billion U.S. dollars, the wage ratio drops about 1.17 (0.69% of the average wage differential over the period). If net exports increase by 1 billion U.S. dollars, the wage ratio rises by around 1.24 (0.73% of the average wage differential over the period).

4.3 An Error Correction Model

The following ECM provides a case of PIND only affecting wage differential in the short run. EDUN and NETX are included in both the short and long run. In equation (2), if the term in the bracket is used, it may not satisfy the regularity condition in the sense that they are I(1) while the left hand side is I(0). Also, for parsimony of losing the degree of freedom, the bracket term is replaced by the residual from the long run model. Table 3 illustrates the results of the estimation of equation (2) after correcting for both heteroskadasticity and autocorrelation using the Shazam program.

(2) $$\Delta(\frac{W_s}{W_u})_t = \beta_0 + \beta_1 \cdot PIND_t + \beta_2 \Delta EDUN_t + \beta_3 \Delta NETX_t + \gamma \cdot [(\frac{W_s}{W_u})_{t-1} - \delta_2 \cdot EDUN_{t-1} - \delta_3 \cdot NETX_{t-1}] + \omega_t$$

$\omega_t \sim$ i.i.d. $N(0, \sigma_\omega^2)$

Table 3 An ECM without Long Run Effect of PIND and Bootstrapping Estimation

VARIABLE	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO 13 DF	P-VALUE	BOOTSTRAPPING MEANS
PIND	0.38796	0.1832	2.118	0.054	0.38517
ΔEDUN	-0.17121E-02	0.1079E-02	-1.587	0.136	-0.17298E-02
ΔNETX	0.94895E-03	0.2472E-03	3.838	0.002	0.90218E-03
RESIDUAL	-1.1900	0.1505	-7.909	0.000	-1.1851
CONSTANT	-0.90699	1.476	-0.6144	0.550	-0.84184

DURBIN-WATSON = 1.7926
R-SQUARE ADJUSTED = 0.8290
LOG OF THE LIKELIHOOD FUNCTION = -42.2032

This ECM estimation performs a fairly good match to the simulation results in Section 3. This supports these empirical results by a theoretical model. The explanation for the insignificant short-run effect of education investment is that the outcome from education investment often emerges after a certain period of time. This corresponds with the argument that skill formation takes time. In the short run, if industrial productivity growth increases by 1 percent point (e.g. from 6% to 7%), the wage ratio rises by about 0.39 (0.23% of the average wage differential over the period). If net exports increase by 1 billion U.S. dollars, the wage ratio rises by around 0.95 (0.56% of the average wage differential over the period).

Since this empirical data has a small sample size, a Bootstrapping procedure in Efron (1979) with a 2000 random re-sampling replication is demonstrated to test the robustness of the estimation, and the Bootstrapping estimation is shown in the last column of Table 3. The mean of each variable is fairly close to its estimated coefficient in the above ECM model. This supports for the validity of the estimation.

5 Conclusion

This paper describes the profile of Taiwan's wage differentials by skill level and employs the error correction model, which can perform tests in both the short and long run, to examine the effects of international trade, productivity growth, and education investment on Taiwan's wage differentials. An increasing wage gap occurs under the conventional definition of skilled labor with a degree from college or above. However, the wage gap seems fairly stable if workers with a degree of junior college are included in skilled labor. From the view of the wage ratio, Taiwan has experienced an increasing trend from 1978 to 1986 and a decreasing trend from 1987 to 1995. Any analysis about wage differentials should first clarify the definition of skilled labor as well as the wage differential itself, i.e. wage gap or wage ratio.

That education could be an important argument for the wage differential is substantiated by the empirical data. International trade is also a significant factor for the wage differential. Education investment takes time to see its outcome, therefore the empirical data shows it is an insignificant factor of changing wage differentials in the short run. In the long run, if government education investment increases by 1 billion U.S. dollars, the wage ratio drops by 0.69% due to more skilled labor ready for the economy. If net exports increase by 1 billion U.S. dollars, the wage ratio rises by around 0.56% in the short run and by 0.73% in the long run. Taiwan's exporting structure has shifted from relatively high labor intensive to relatively medium and high capital and technology intensive goods, and its import share of low labor intensive goods has gradually been replaced by high labor intensive goods. Incorporating this fact with the empirical result of international trade raising wage differentials, it seems to be consistent with the large country cases. Productivity growth has a significant influence on the wage differential in the short run, but may have a minor effect in the long run. It is because the skill supply eventually catches up with the demanded quantity as long as the adjustment cost of skill formation is affordable for labor. If industrial productivity growth increases by 1 percentage point (e.g. from 6% to 7%), the wage ratio rises by about 0.23% in the short run.

An inference that the skill adjustment cost in Taiwan is low enough to allow unskilled labor to catch up with the skill upgrade can be made for the Taiwanese economy. This paper proposes a new angle from which to probe the long-term effect of productivity growth on wage differentials by pointing out the essentiality of skill adjustment cost in the determination. Different countries face different so-called affordable skill adjustment costs. Even within a country, the skill adjustment cost may vary along with other alteration in the whole economy. This suggests it is important to take a close look at adjustment cost of skill formation for the future research on wage differentials, especially with a discussion of productivity growth.

APPENDIX 1

The Theoretical Model in Steady State

Equations
$Q_i = A_{Qi} \cdot K_i^{\alpha i} \cdot {L_{s,i}^F}^{\beta i} \cdot L_{u,i}^{1-\alpha i-\beta i}$
$J_{t,i} = \delta_i \cdot K_{t,i}$
$I_i = J_i \cdot (1 + \phi_i \delta_i / 2)$
$Q_{i,Ls} = W_s / P_i$
$Q_{i,Lu} = W_u / P_i$
$\lambda_i = 1 + \phi_i \cdot \delta_i$
$Q_{Ki} = (r + \delta_i)\lambda_i - \phi_i \cdot \delta_i^2 / 2$
$P_{2,t} \cdot M_t = P_{1,t} \cdot X_t$
$X = (P_2/P_1)^{\rho} \cdot Y^*$
$0 = r_t \cdot F_t + (1-\tau_t) \cdot [(W_s/P_2) \cdot L_{s,t} + (W_u/P_2) \cdot L_{u,t}] - [(P_1/P_2) \cdot C_{1,t} + C_{2,t} + (P_3/P_2) \cdot C_{3,t} + (P_{E,t}/P_2) \cdot S_{E,t}]$
$J_{s,t} = \delta_s \cdot L_{s,t}$
$F_t = (P_1/P_2) \cdot \lambda_{1,t} \cdot K_{1,t} + \lambda_{2,t} \cdot K_{2,t} + (P_3/P_2) \cdot \lambda_{3,t} \cdot K_{3,t}$
$I_{E,t} = J_{s,t} (1 + \Phi \cdot \delta_s / 2)$
$l_t = T - L_{s,t} - L_{u,t}$
$U_{Ci} = (P_i/P_2) \cdot \mu_1$
$U_{Lu,t} = -\mu_1 \cdot (1-\tau) \cdot W_u/P_2$
$\mu_2 = \mu_1 \cdot P_E \cdot (1 + \Phi \cdot \delta_s)/P_2$
$r_t = \theta$
$U_{Ls} = (\theta + \delta_s) \cdot \mu_2 - \mu_1 \cdot [(1-\tau) \cdot W_s + P_E \cdot (\Phi \cdot \delta_s^2)/2]/P_2$
$S_E = K_E^{\xi} \cdot L_s^{G^{1-\xi}}$
$I_E^G = \delta_E \cdot K_E$
$I_{E,t}^G = (P_1 \cdot I_{E,1}^G + P_2 \cdot I_{E,2}^G + P_3 \cdot I_{E,3}^G)/P_E^G$
$P_E^G = P_1^{\varepsilon_1} \cdot P_2^{\varepsilon_2} \cdot P_3^{\varepsilon_3}$
$P_E^G \cdot I_E^G + W_s \cdot L_s^G = \tau \cdot (W_s \cdot L_s + W_u \cdot L_u) + P_E \cdot S_E$
$Q_{1,t} - X_t = C_1 + I_{E,1}^G + I_1$
$Q_{2,t} + M_t = C_2 + I_{E,2}^G + I_2$
$Q_{3,t} = C_3 + I_{E,3}^G + I_3$

APPENDIX 2

Year	Ws/Wu[@](%)	EDUN[#](Mil.US$)	NETX(Mil.US$)	PIND(%)
1978	155.9265	1112.587	1768.2*	22.6
1979	174.1842	1303.682	462.76*	6.3
1980	170.565	1778.354	-870.35*	6.9
1981	167.3305	2148.728	786	3.5
1982	171.7611	2298.405	2325	-0.9
1983	178.5358	2416.052	4314	12.7
1984	173.2066	2657.966	6407	11.8
1985	174.2559	3014.292	8277	2.7
1986	188.3676	3695.056	14568	14
1987	184.2621	4910.535	16410	10.6
1988	174.5347	6239.96	8716	4.3
1989	172.1145	8262.083	9707	3.8
1990	167.14	9505.637	7157	-0.2
1991	163.1183	11902.34	7252	7.4
1992	161.3609	13289.74	3590	4.4
1993	163.2398	13756.25	3554	3.9
1994	158.7449	14094.6	3984	6.6
1995	155.8546	13421.76	4198	4.7
1996	161.5622	13644.89	9447	2

Data Sources:

1. [@] Directorate-General of Budget, Accounting, and Statistics (DGBAS). Various Years. *Manpower Utilization Survey*, Republic of China, Taipei.
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