

The Effect of Foreign Workers on the Native Wages in Taiwan A Dynamic Intertemporal General Equilibrium Model

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Abstract

A decade has elapsed since the Taiwanese government first allowed the entry of foreign workers in 1989. A range of problems related to foreign workers have emerged and have become current issues in Taiwan. This paper is to focus on the issue of native wages by investigating the wage differential between skilled and unskilled labor with importation of foreign workers.

The main finding is that foreign workers do affect native unskilled labor negatively by enlarging the wage differential in both the short- and long-run. However, this adverse effect is not as serious as expected in the overall wage differential. The policy strategies of increasing or decreasing the number of foreign workers have been examined. In order to prevent a further contribution of foreign workers to the wage differential, the Council of Labor Affairs should consider imposing a policy of not increasing the number of foreign workers.

JEL classification: C61; C68; D91; J31; J61; J68

1. Introduction

Taiwan legalized the importation of foreign workers in October of 1989. The two main reasons for the Taiwanese government taking this step were: first, there was a shortage of native unskilled labor. This situation impeded the continuation of the national Fourteen Major Construction Projects and the Six-year National Development Plan. Second, the unskilled wage had increased high enough to drive firms to look for cheaper workers overseas. This accelerated Taiwan's outward foreign direct investment and drained capital out of the country. The importation of foreign workers is expected to resolve the above problems, impelling the Taiwanese economy to move forward. One decade has elapsed since the first entry of foreign workers and a range of problems related to foreign workers, not only economic but also social, have emerged and have become very important public policy issues in Taiwan. Amongst those economic issues, native wages and unemployment are the two main concerns. However, there is a lack of in-depth

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research on these issues in the Taiwanese context. To make the analysis of the two issues (wages and unemployment) clear, this paper focuses on the issue of native wages by investigating the effect on the wage differential between skilled and unskilled labor of the importation of foreign workers. By taking the suggestion in Borjas (1994) into account that we do not “understand the dynamic process through which natives respond to these supply shocks and reestablish labor market equilibrium”, this paper adopts a new methodology, dynamic intertemporal general equilibrium (DIGE) modeling¹, to disclose both short- and long-run transitions followed by foreign workers’ shocks.

A large amount of research investigating the effect of immigration on native wages has been undertaken by U.S. and Australian studies. The findings are mixed. One viewpoint is that there is little evidence of an adverse wage effect of immigration (Butcher & Card 1991, Heckman et al 1998 and Addison & Worswick 2002). The other viewpoint suggests that immigration adversely affects less-skilled native wages (Lalonde & Topel 1991, Altonji & Card 1991, Kuhn & Wooton 1991, Borjas et al 1992, Borjas et al 1996 and Friedberg & Hunt 1995). The empirical studies using a spatial correlations approach have produced a confusing array of results² (Borjas 1999). Substantial efforts on the methodology innovation have been made. Altonji & Card (1991) and Schoeni (1997) use instrumental variables estimations, however, they end with very different estimates (Borjas 1999). Heckman et al (1998) and Kuhn & Wooton (1991) use a dynamic and the static general equilibrium approach respectively to look at the issues of wage inequality and native wages. Different conclusions result from their models. In contrast to these existing general equilibrium models, this paper constructs a relatively comprehensive dynamic framework in which government plays the important role of supplying education, and wages are determined by labor supply and demand. By calibrating this theoretical model with Taiwanese data, the simulation results provide empirical implications and these can be compared to existing literature from studies in other countries.

Section 2 provides the theoretical framework of the model, section 3 presents the calibration of the model, section 4 shows the simulation results and section 5 summarizes the conclusions.

2. The Model

A framework with one-good, two-labor (skilled and unskilled) and three-agent (firms, households, and government) is established as follows. The whole economy is treated as one aggregate entity. Firms produce the good by hiring physical capital, skilled labor and unskilled labor, they then sell this good to the households for consumption, to the government for education capital investment and to themselves for physical capital investment. The objective of each firm is to maximize its intertemporal profit under

¹ The model follows the general approach of the G-Cubed model (McKibbin and Wilcoxon (1999)). The endogenized skill formation and education production follow the model in Chang (1999) with the first-time application on the migration issue of Taiwan studies.

² The spatial correlation is the relationship between labor market outcomes in a locality and the extent of immigrant penetration. The sign of the relevant coefficient changes erratically over time.

constraints of capital accumulation and of investment with an adjustment cost. The ownership of firms belongs to households. Households supply unskilled labor to firms and skilled labor to both firms and the government in order to earn wages, together with the dividends from renting physical capital to firms, to finance the purchase of the good and education. Leisure is consumed by households with an opportunity cost of not working. The objective of households is to maximize utility by an optimal distribution of consumption between the good and leisure under their budget and time constraints and the choice of investment on education with an adjustment cost to upgrade their skill. The government buys the good from the firms and transforms it into education capital. This capital is combined with skilled labor hired by the government to produce education. The role of government as an education supplier is essential. This model captures the reality of government supplying education in consideration of the associated beneficial externalities. The government balances its budget by collecting labor income tax and selling education to households³. The accumulation of physical capital, skill formation, education capital and financial assets drives the dynamic evolution of the economy over time.

The role of foreign workers in this economy is characterized as follows. Foreign workers, categorized as unskilled labor, join production of the good with natives and are assumed to be homogeneous to native unskilled labor in productivity. However, they receive a lower payment than natives⁴. In consideration of the demand side of foreign workers, this model explicitly captures the foreign workers' consumption of goods⁵. By so doing, the domestic households' consumption in the utility function carries a fraction variable by which the proportion of domestics' contribution to the production of goods is measured. This fraction variable is defined as the total domestic labor force divided by the total labor force, including the foreign workers, in the economy. Therefore, before the entry of foreign workers, the fraction variable is equal to one. In each period, the numbers of domestic skilled and unskilled labor are endogenized, hence, this fraction variable is also endogenized. Foreign workers are assumed to pay the same tax rate as natives and not to join the activities in the financial markets.

Cobb-Douglas functional forms are used for goods production, education production and utility function to assist in the simulation of this empirical data calibrated model. The full model and its steady state are presented in Appendix 1.

3. Calibration of the Model

All data are from the official sources including the Directorate-General of Budget Accounting and Statistics (DGBAS), Ministry of Education (MOE), the Council of Labor Affairs (CLA) and the Council for Economic Planning and Development (CEPD). The monthly average wage data by education attainment is from the Manpower Utilization

³ To avoid unnecessary complexities, a subsidy rate on investment and a tax rate on financial dividends is assumed to be balanced out.

⁴ Foreign workers are protected under the Labor Standard Law in Taiwan and most are paid the regulated minimum wages. On average, foreign workers' wages are between 50% to 60% of natives'.

⁵ Foreign workers in Taiwan have no consumption on education.

Survey, which is published by DGBAS. The real wage is the nominal wage deflated by the consumer price index (CPI) measured with 1991 as the base year. Following the convention in the literature, workers who have a degree of college or above are designated as skilled labor and the rest are unskilled labor. To manipulate the raw data, which includes several categories in the group of unskilled labor⁶, the weighted average monthly wage is applied with the weights as the population proportion of each category in the group.

Since the restriction of importation of foreign workers in Taiwan was lifted from October 1989 and the official data of numbers of foreign workers commenced in 1991, the base year for the calibration is 1990⁷. The only exception is the shares of skilled labor and unskilled labor in the production function which are estimated by running ordinary least square (OLS) on related data from 1978 to 2000. A detailed calibration is listed in Appendix 2.

4. Simulation Results and Reality

Foreign workers are allowed to stay in Taiwan for a maximum period of two years. A one-year extension is available only once. An additional six-month extension might be granted under special circumstances for foreign workers engaged in major construction projects. For each foreign worker, the stay in Taiwan is temporary. However, from the standpoint of the Taiwanese economy, to continue recruiting new foreign workers is tantamount to a permanent stay of foreign workers. The magnitudes of shocks are the rescaled number of foreign workers based on the simulation result in the steady state. The simulation is undertaken with a permanent foreign workers shock with a zero growth rate after year 2000. Policies such as an increasing or decreasing growth rate of the importation of foreign workers can be tested and these policy implications are presented in the next section.

The simulation result of this DIGE model for Taiwan shows that the wage differential between skilled and unskilled labor increases in the short run, defined as the first period after the shock, by 1.06% and in the long run by 3.09%. This states that the importation of foreign workers worsens the relative status of native unskilled labor to skilled labor. The worsening status deteriorates in the long run if a non-decreasing number of foreign workers keeps working in Taiwan. The main transition is as follows. That foreign workers join the production of goods by receiving a lower pay motivates firms to hire more foreign workers in the future. The threat to local workers causes the unskilled wage to decrease. This encourages locals to upgrade their skills by taking education. By so doing, an increased demand for skilled labor in education sector boosts the skilled wage. An interesting phenomenon is that the importation of foreign workers motivates locals to pursue a higher education degree and brings out a more prosperous education sector.

⁶ They are illiterate, self-educated, primary school, junior high (including junior vocational) school, senior high school, vocational school, and junior college.

⁷ Foreign workers were numbered much less before 1992 than after and before 1992 all of them were working for the government major construction projects.

This simulation result shows little connection to the empirical data as illustrated in Figure 1. Before 1995, the wage differential in Taiwan followed a decreasing trend. No complaints regarding the importation of foreign workers were heard noticeably during that time. After 1995, the wage differential actually trends upward. Foreign workers have been blamed for the deterioration of the unskilled wage since then. Foreign workers do take some responsibility for the worsening status of native unskilled labor and also contribute to a better status of native skilled labor. However, their responsibility is not explicitly shown by the Taiwanese empirical data. The wage differentials from 1991 to 2000 actually decrease in comparison with that in 1990, when foreign workers began coming in. This demonstrates that foreign workers have a limited impact on the overall wage differential. The simulation result suggests the existence of another factor or factors which dominated the decreased trend before 1995. After 1995 the decreased trend reverses with a possible disappearance of this unveiled factor(s). Taiwanese public blame foreign workers for the wrong reasons.

[Insert Figure 1 Here]

5. Policy Implications

Recent disputes over the negative impact of foreign workers on native unskilled labor have urged the Government to reduce the number of foreign workers. Meanwhile, the local employers argue that foreign workers engage in those jobs in which the natives show little interest, therefore, they demand more cheaper foreign workers. Simulations with an ascending 5% and a descending 5% of numbers of foreign workers after 2000 have been done to provide policy suggestions to the Council of Labor Affairs. The results show that importing more foreign workers enlarges the wage differential more, that is, the relative status of native unskilled labor deteriorates over time. In order to prevent a further escalation of the wage differential, the Council of Labor Affairs should consider imposing a non-increasing number of foreign workers' policy. Figure 2 shows this comparison.

[Insert Figure 2 Here]

6. Conclusion

This paper constructs a dynamic intertemporal general equilibrium model and calibrates this theoretical model by Taiwanese data to investigate the impact of foreign workers on native wages.

The results show that foreign workers do affect native unskilled labor negatively by enlarging the wage differential in both the short- and long-run. In comparison with existing literature, this paper supports the view that immigration adversely affects less-skilled native wages. However, this is not explicitly shown by the Taiwanese empirical data. The simulation dynamics, with a consistent increase in the wage differential till reaching the new steady state, show little connection to the real data, especially prior to 1995. Empirical data show that 1995 is the year of a turning point for wage differentials

from a decreasing to an increasing trend. This demonstrates that the effect from foreign workers plays a small role in the overall wage differential and suggests the existence of some factor(s) by which the wage differential is dominated. A change in direction of the wage differential might be caused by a disappearance of this unveiled factor(s). This is beyond the scope of this paper. While the Taiwanese public saw the increasing trend of the wage differential after 1995 and blamed this on foreign workers, this paper would suggest their conclusion was erroneous.

A comparison of different policies with more or less foreign workers provides the principle that the recruitment of more foreign workers in the future raises a larger wage differential. Therefore, if the Taiwanese government wants to make sure the native unskilled labor not worsening further, the Council of Labor Affairs should consider a policy of not increasing the number of foreign workers. As mentioned above that the effect of foreign workers plays a small role in the overall wage differential. The main task for both of the Taiwanese government and the future research is to unveil the dominant factor(s) not captured in the model.

Figure 1. Foreign Workers and Wage Differential in Taiwan

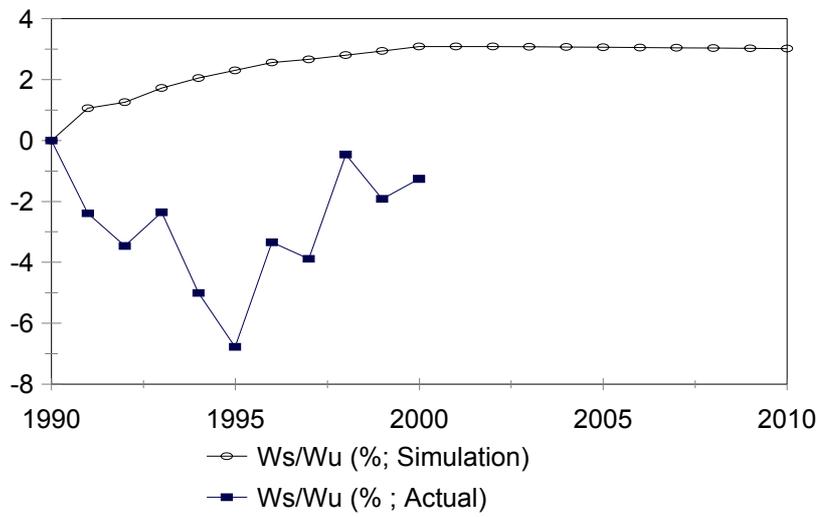
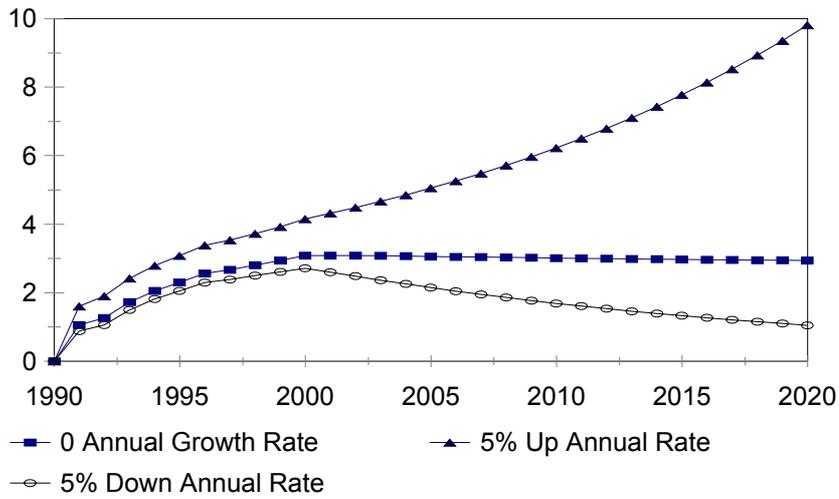


Figure 2. Policy Implications: Foreign Workers and Wage Differential in Taiwan



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Appendix 1

The Model

Firms:

$$\text{Max. } \int_0^{\infty} [Q_t - W_{s,t} \cdot L_{s,t}^F - W_{u,t} \cdot L_{u,t} - \eta \cdot W_{u,t} \cdot L_{m,t} - I_t] \cdot e^{-r \cdot t} \cdot dt$$

Subject to

$$(1) \quad \frac{dK}{dt} = J_t - \delta \cdot K_t,$$
$$(2) \quad I_t = J_t \cdot \left[1 + \frac{\phi}{2} \cdot \frac{J_t}{K_t}\right],$$
$$(3) \quad Q_t = L_{s,t}^{\alpha} \cdot (L_{u,t} + L_{m,t})^{\beta} \cdot K_t^{1-\alpha-\beta},$$

Households:

$$\text{Max. } \int_0^{\infty} U(C_t, l_t) \cdot e^{-\theta \cdot t} \cdot dt$$

Subject to

$$(4) \quad \frac{dF}{dt} = r \cdot F_t + (1 - \tau) \cdot (W_{s,t} \cdot L_{s,t} + W_{u,t} \cdot L_{u,t}) - V_t \cdot C_t - P_{E,t} \cdot S_{E,t},$$
$$(5) \quad \frac{dL_s}{dt} = J_{s,t} - \delta_s \cdot L_{s,t},$$
$$(6) \quad S_{E,t} = J_s \cdot \left(1 + \frac{\Phi}{2} \cdot \frac{J_{s,t}}{L_{s,t}}\right),$$
$$(7) \quad l_t = T - L_{s,t} - L_{u,t},$$
$$(8) \quad F_t = \lambda_t \cdot K_t,$$
$$(9) \quad U(C_t, l_t) = C_t^{\gamma} \cdot l_t^{1-\gamma},$$

Government:

$$(10) \quad S_{E,t} = f(K_{E,t}, L_{s,t}^G) = K_{E,t}^{\xi} \cdot L_{s,t}^{G \cdot 1-\xi},$$
$$(11) \quad \frac{dK_E}{dt} = I_{E,t}^G - \delta_E \cdot K_{E,t},$$
$$(12) \quad I_E^G + W_{s,t} \cdot L_{s,t}^G = \tau \cdot [W_{s,t} \cdot L_{s,t} + W_{u,t} \cdot (L_{u,t} + \eta \cdot L_m)] + P_{E,t} \cdot S_{E,t}.$$

Model in the Steady State

Equations

$$\begin{aligned}Q_t &= L_{s,t}^\alpha \cdot (L_{u,t} + L_m)^\beta \cdot K_t^{1-\alpha-\beta} \\J_t &= \delta \cdot K_t \\I &= J \cdot (1 + \delta \cdot \phi / 2) \\Q_{L_s} &= W_s / P \\Q_{L_u} &= W_u / P \\\lambda &= 1 + \phi \cdot \delta \\Q_K &= (r + \delta) \cdot \lambda - \phi \cdot \delta^2 / 2 \\0 &= r \cdot F_t + (1 - \tau) \cdot (W_{s,t} \cdot L_{s,t} + W_{u,t} \cdot L_{u,t}) - V_t \cdot C_t - P_{E,t} \cdot S_{E,t} \\V &= (L_{s,t} + L_{u,t}) / (L_{s,t} + L_{u,t} + L_m) \\J_{s,t} &= \delta_s \cdot L_{s,t} \\F_t &= \lambda_t \cdot K_t \\S_E &= J_{s,t} \cdot (1 + \Phi \cdot \delta_s / 2) \\l_t &= T - L_{s,t} - L_{u,t} \\U_C &= \mu_1 \\U_{L_u} &= -\mu_1 \cdot (1 - \tau) \cdot W_u \\\mu_2 &= \mu_1 \cdot P_E \cdot (1 + \Phi \cdot \delta_s) \\r_t &= \theta \\U_{L_s} &= (\theta + \delta_s) \cdot \mu_2 - \mu_1 \cdot [(1 - \tau) \cdot W_s + P_E \cdot \Phi \cdot \delta_s^2 / 2] \\L_{s,t} &= L_{s,t}^G + L_{s,t}^F \\S_{E,t} &= (K_{E,t}^\xi + L_{s,t}^G)^\frac{1}{\xi}, \\I_E^G &= \delta_E \cdot K_E \\I_E^G + W_{s,t} \cdot L_{s,t}^G &= \tau \cdot [W_{s,t} \cdot L_{s,t} + W_{u,t} \cdot (L_{u,t} + \eta \cdot L_m)] + P_{E,t} \cdot S_{E,t} \\Q_t &= C_t + I_E^G + I_t\end{aligned}$$

Notation:

Q: Production; L_s^F : Skilled labor hired by firms; L_s^G : Skilled labor hired by government;
 L_s : Total skilled labor; L_u : Unskilled labor; L_m : Foreign Workers; K: Capital;
J: Fixed capital formation; I: Capital investment; W_s : Skilled wage; W_u : Unskilled wage;
P: Goods price (defined as 1); F: Financial asset; C: Consumption; l : Leisure;
 S_E : Amount of education buying; J_s : Fixed skill formation; T: Time constraint;
 I_E : Household's education investment; U_Z : Marginal utility of Z; P_E : Price of education;
r: Interest rate; K_E : Education capital; I_E^G : Government education investment;
 τ : Tax rate; α, β : Input shares in goods production function; λ : Shadow price of capital;

δ : Depreciation rate of capital; ϕ : Adjustment cost parameter of capital investment;
 Φ : Skill adjustment cost parameter; μ_1 : shadow price of financial asset;
 μ_2 : shadow price of skill; η : Wage proportion of foreign workers to local unskilled wage;
 θ : Rate of time preference; ξ : Input share in education production function;
 δ_E : Depreciation rate of education capital; δ_s : Depreciation rate of skill.

Appendix 2

$$T = 8760; \quad \tau = 0.201; \quad I_E^G = 62; \quad \alpha = 0.53;$$

$$\beta = 0.26; \quad \delta = 0.2; \quad \delta_s = 0.094; \quad \delta_E = 0.2;$$

$$\phi = 0.3; \quad \theta = 0.0775; \quad \xi = 0.3061; \quad \gamma = 0.5;$$

$$\Phi = 60.5; \quad \eta = 0.52;$$

Note:

1. The shares of skilled labor (α) and unskilled labor (β) in the production function are estimated by running ordinary least square (OLS) using data from 1978-2000.
2. The depreciation rate of skill (δ_s) is estimated by using data of skilled labor of 1990 and of 1991 and graduates from university or above (J_s) in 1990.
3. The adjustment cost of skill formation is estimated by related data in 1990. The related data includes: student in tertiary education, expenditure on education, skilled labor and graduates from university or above (J_s).
4. Interest rate (θ) is the interest rate for the bank's 3-month term deposit.
6. Tax rate τ is the tax burden in Table 9-9 of Taiwan Statistical Data Book 2001.
7. Time (T) is measured by the number of hours in one year.
8. The depreciation rates of physical capitals, δ and δ_E , are based on the 5-year depreciation time frame.
9. The share of consumption goods (γ) and leisure ($1-\gamma$) are assumed equal.

Data Source:

1. Directorate-General of Budget Accounting and Statistics, R.O.C.
2. Ministry of Education, R.O.C.
3. Taiwan Statistical Data Book 2001, Council for Economic Planning and Development R.O.C.
4. Statistical Yearbook of the Republic of China 2000.
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