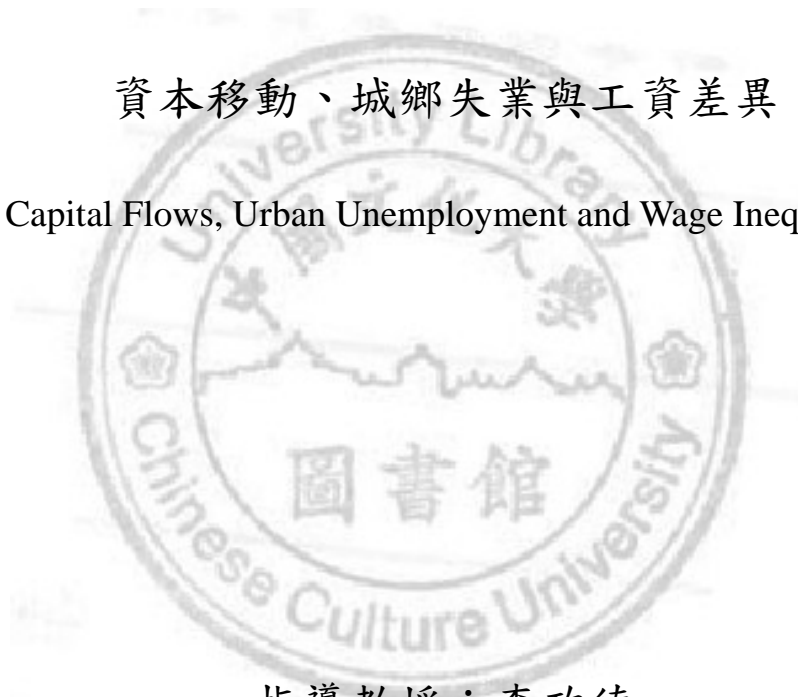


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資本移動、城鄉失業與工資差異

Capital Flows, Urban Unemployment and Wage Inequality



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論文提要內容：

自 1980 年代中期後，面對生產成本的上揚，台灣低技術勞力產業逐漸轉往低度開發國家進行投資與貿易。本文延伸 Harris-Todaro 模型，探討在垂直多國籍企業的模式下，對於母國(台灣)與地主國(低度開發國家)在工資差異及失業的影響。我們證明出母國對地主國子公司投資量愈大時，將使母國工資差異縮小。而地主國工資差異的影響則決定於財貨的要素密集度：若地主國的製造業財是資本密集財，則地主國工資差異擴大；若地主國農業財為資本密集財，則地主國工資差異減小。另一方面，垂直多國籍企業的對外投資行為將產生兩種效果進而影響母國與地主國失業的程度，分別是擴大效果 (the expansion effect) 與遷徙效果 (the migration effect)。當母國對地主國子公司投資量增加時，本文發現母國與地主國都市部門低技術勞工失業的問題皆獲得改善。最後，我們以國民所得做為衡量福利水準的依據，並證明當母國對地主國投資量愈大時，母國與地主國的福利均上升。

關鍵字：工資差異，垂直多國籍企業，城鄉失業

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ABSTRACT

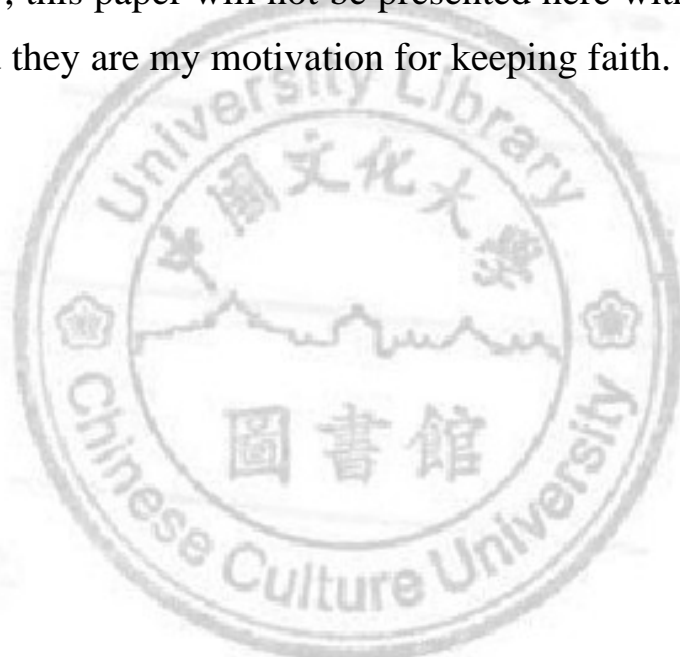
Since the mid of 1980s, Taiwan's unskilled labor industry has begun to invest in the less-developed countries (LDCs) in order to reduce the cost of production. Taking vertical multinationals (MNEs) into account, this paper extends the Harris-Todaro model to analyze the impacts of capital flows on wage inequality and urban unemployment with respect to the parent country (Taiwan) and the host country (LDCs). We show that an increase in the capital flows reduces wage inequality of the parent country; however, the effect of increasing capital flows on the host country's wage inequality depends on factor intensity. The flows of capital increase the wage inequality of parent country if the manufactured is capital-intensive, and vice versa. In addition, we find that rising capital flows affects urban unemployment from two channels. The first channel refers to the expansion effect and the other channel is the migration effect. We prove that an increase in the capital flows both lowers urban unemployment of unskilled labor in the parent and host country. Finally, welfare is defined as national income and we derive that increasing capital flows also arises welfare of the parent and host country.

Key words: wage inequality, vertical multinationals, urban unemployment

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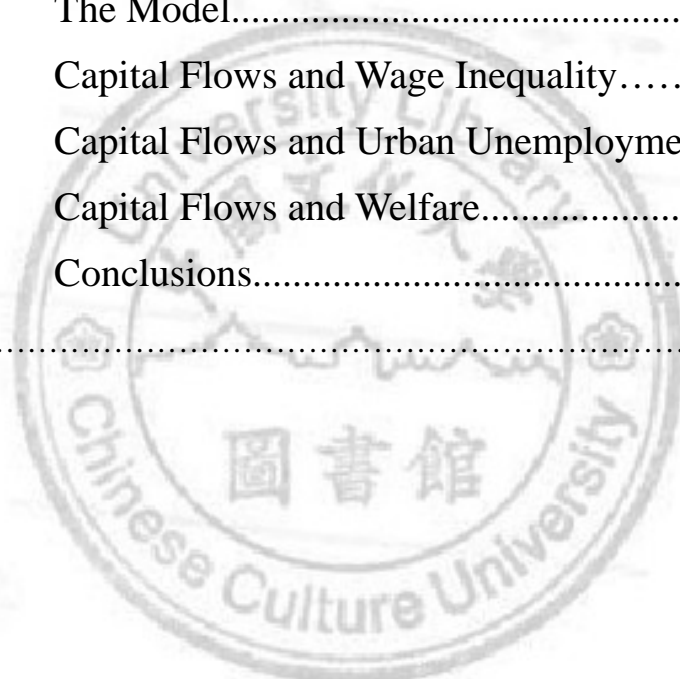
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Chapter 1 Introduction

Taiwan, was one of the “Asian Tigers” due to rapid economic growth in the 1970s. In particular, since the Taiwan government adopted the policy of an expansion of unskilled-labor-intensive exports, which not only created much employment opportunities but also raised the wage of unskilled labor (Chu, 2001). Therefore, Taiwan experienced a relative low unemployment rate and wage inequality. Since the 1980s, the emergence of globalization, has affected the world’s labor market by means of highly integration of production across national borders and booming capital flows as well as trade volumes (Marjit and Acharyya, 2003). Under this wave, Taiwan also faced new challenges that affect the structure of employment and wage.

Firstly, since the mid of 1980s, Taiwan has experienced a tremendous currency appreciation and cost of production. At the same time, China’s economic reform and the Southeast Asian countries opened their market. To take advantage of lower cost of unskilled labor, a huge number of Taiwan’s unskilled-labor-industries invest in those countries. According to the Investment Commission, Ministry of Economic Affairs, Taiwan in the period of 1991-2007, the amount of Taiwan’s outward capital investment to China (including Hong Kong) is US\$67,542 million, to Vietnam is US\$1,462 million, and to Thailand is US\$704 million.

Secondly, Taiwan has changed the pattern of trade since the late of 1980s. Corresponding to a rise of economic integration in the Southeast Asian countries, Taiwan’s exports to China has greatly in-

creased from US\$17.9 billion in 1995 to US\$74.2 billion in 2007, and Taiwan's exports to the Association of Southeast Asian Nations (ASEAN) also increased from US\$11.4 billion in 1994, to US\$18.5 billion in 2000, and to US\$36.3 billion in 2007. Specifically, mainly of those exports are intermediate goods, electronic component and equipment. Lin (1995) argues that foreign capital investment from Taiwan to Indonesia, Malaysia, Philippines and Thailand has a positive effect on exports, and Taiwan's subsidiaries in Southeast Asian countries also use intermediate goods which come from Taiwan.

Thirdly, Taiwan invests in the Southeast Asian countries in the form of vertical Multinationals (hereafter vertical MNEs) in order to utilize unskilled labor for assembly. Tsaur, Chen, and Chen (2006) find that most Taiwan's exports are unskilled-labor-intensive. As a result, a rise in exports reduces the demand for skilled labor and thus narrows Taiwan's wage inequality. Moreover, Liang and Mai (2003) argue that an increase in capital flows from Taiwan to its subsidiaries in the less-developed-countries (hereafter LDCs) and the output of intermediate goods creates an excess demand for unskilled labor.

Following this line of thinking, the purpose of this paper is to analyze the effect of capital flows from Taiwan to its subsidiaries in the LDCs on wage inequality and unemployment. Extending the Harris-Todaro model (hereafter H-T model), which involves the manufactured, intermediate and agricultural sector. We argue that Taiwan exports intermediate goods, which is unskilled-labor-intensive in Taiwan's perspective, to its subsidiaries in LDCs. This enlarges the employment opportunities and raises the wage of unskilled labor. In addition, the output of agricultural goods falls since an expansion of in-

intermediate sector and attracts unskilled labor moves in. While the output of manufactured goods produced by skilled labor declines since capital shifts to the LDCs and the intermediate sector. This decreases the wage and the demand for skilled labor. Therefore, Taiwan's wage inequality declines, and employment of unskilled labor rises.



Chapter 2 Literature Review

Since the late 1970s, economists have observed rising wage inequality and unemployment in the United States and its trading partners. Based on conventional wisdom, the Heckscher-Ohlin-Samuelson and Stolper-Samuelson theorem, predicts that the United States will export skilled-labor intensive goods to Mexico and Chile according to comparative advantage. For Mexico and Chile, their exports tend to be intensive in unskilled-labor due to abundant unskilled-labor. Consequently, growing trade will increase the relative demand for skilled-labor, but labors without skill will lose. This increases wage inequality of the United States (Sachs and Shatz, 1996; Freeman, 1995; Feenstra and Hanson, 1996). On the other hand, Mexico and Chile should experience a fall in the wage inequality by raising the relative demand for unskilled labor. However, Feenstra and Hanson (1997) examine the effect of foreign direct investment (hereafter FDI) on wage inequality. They find that the increasing FDI is positively correlated with the relative demand for skilled labor and thus wage inequality increased in Mexico. Beyer, Rojas, and Vergara (1999) argue that increasing wage inequality has been accompanied by trade liberalization. A fall in the price of unskilled-labor intensive good leads to a rise in the wage inequality in Chile. In addition, as China and India have become the world factory which attribute a decline in the price of unskilled-labor intensive good, and it can be a possible reason that cause wage inequality to rise in Latin America countries (Wood, 1997).

In the process of globalization, vertical multinationals (hereafter vertical MNEs) plays an important role in this wave. The characteris-

tic of vertical MNEs is that, the parent country produces the skilled-labor intensive intermediate good, and then ships to host country for assembly (Zhang and Markusen, 1999; Feenstra, 1998). Feenstra and Hanson (2003) argue that trade in intermediate good both raises the relative demand for skilled labor in the United States and other developing countries. Interestingly, not all developed and developing countries experienced increasing wage inequality. In East Asia, empirical evidences of Chen and Hsu (2001) and Tsaour et al. (2006) find that Taiwan reveals a declining trend in wage inequality. Taiwan, the newly industrializing economy (hereafter NIE), shows that a decrease in wage inequality by exporting unskilled-labor intensive good to the LDCs. Liang and Mai argue that the parent country, Taiwan, ships capital and intermediate good to the subsidiary in LDCs, and therefore leads to a decline in Taiwan's wage inequality.

On the other hand, rising unemployment has become an issue in the wave of globalization. Berman, Bound, and Griliches (1994), Bound and Johnson (1992) and Acemoglu (1999) show that the structure of unemployment has changed since 1980s. A shift toward skilled labor contributes to an increase in unemployment of the United States. In many Western European countries, the data reveals a relatively stagnant trend in employment (Card, Kramarz, and Lemieux, 1999).

In a pioneering work, Harris and Todaro (1970) construct a general model to capture the problem of urban unemployment and rural-urban migration in the developing countries. Recently, the H-T model has been comprehensively extended to discuss the urban unemployment in LDCs. ¹In a two-sector H-T model, Corden and

¹ The basic H-T two sector model has been intensively extended in the issues of wage

Findlay (1975) find that foreign capital inflow accentuates the urban unemployment. Assume that foreign capital inflow is a specific factor, Beladi and Yabuuchi (2001), Fung, Zeng, and Zhu (1999), Beladi and Marjit (2000) and Gupta (1994) argue that foreign capital decreases the level of urban unemployment. Since the export processing zone (hereafter EPZ) or duty-free zone (hereafter DFZ) have been adopted as an important development strategy for LDCs, several papers have explored the impact of foreign capital inflow on urban unemployment by introducing the EPZ or DFZ sector in the mobile capital H-T model. Beladi and Marjit (1992) assume that foreign capital is specific to the DFZ sector and show that an increase in foreign capital might lower aggregate employment, while Yabuuchi (1999) proves that a rise in FDI decreases the urban unemployment of the host country, if FDI is a specific factor in the DFZ. Chaudhuri (2000) argue that an expansion of the DFZ sector in terms of demand management policy leads to a fall in the urban unemployment. It is worth to note that Chaudhuri (2007) and Chaudhuri, Yabuuchi, and Mukhopadhyay (2006) indicate that the influence of foreign capital inflow on urban unemployment is ambiguous. There are two effects, the expansion effect and the migration effect, affecting urban unemployment.

Though a huge body of literatures has discussed the increasing trend of wage inequality and urban unemployment, less paper put emphasis on declining wage inequality and urban unemployment of NIE. This paper attempts to extend a two-country mobile capital H-T

inequality between skilled and unskilled as well as urban unemployment, see Basu (2000), Batra and Naqvi (1987), Beladi and Naqvi (1988), Beladi and Yabuuchi (2001), Bhagwati and Srinivasan (1974), Chao and Yu (1996) Chaudhuri (2003), Din (1996), Fields (1975), Gupta (1993), Hazari and Sgro (1991), Khan (1980), Majit and Beladi (2003), Neary (1981), Yabuuchi (1993) and Yabuuchi (2007).

model and find the impact of capital flows on wage inequality as well as unemployment. We prove that an increase in capital flows in the form of vertical MNEs decreases wage inequality of the parent country. However, the impact of capital flows on wage inequality of the host country depends on factor intensity. In addition, we show that a rise in the capital flows encourages the employment for unskilled labor of the parent and host country. Further, this paper investigates the effect of capital flows on welfare. Both the parent and host country exhibit a positive link between capital flows and welfare.

The structure of this paper is as follows. In chapter 3, we construct a two-country H-T model. Chapter 4 examines the impact of the capital flows on wage inequality. The influence of capital flows on urban unemployment is analyzed in chapter 5. Moreover, the effect of capital flows on welfare of both countries is examined in chapter 6. Chapter 7 concludes the paper.

Chapter 3 The Model

In this chapter, we construct a theoretical framework to discuss the effects of capital flows through vertical MNEs on wage inequality and urban unemployment. Consider that the world is composed of three parts: the parent country of vertical MNEs (Taiwan), the host country of vertical MNEs (LDCs), and the rest of the world (the developed countries). Assume that the parent and the host country are small open economy relative to the rest of the world. The parent country is divided into two sectors, the rural and urban sector, respectively. The rural sector employs the unskilled labor (L_X) and land (T) to produce the agricultural good (X). Note that the urban sector is subdivided into the skilled-labor-intensive sector which produces the manufactured good (Y) with the help of the skilled labor (S) and capital (K_Y). On the other hand, the unskilled labor (L_M) and capital (K_M) are required to produce the intermediate good (M) in the urban unskilled sector. Following Liang and Mai (2003), the labor who produce the intermediate good is unskilled from Taiwan's view; however, from the LDCs' perspective, they are relatively skilled than the labor who produce the subsidiary-produced good (final good) in the host country. The production functions exhibit constant returns to scale can be written as follows:

$$X = X(L_X, T), \quad (3-1a)$$

$$Y = Y(S, K_Y), \quad (3-1b)$$

$$M = M(L_M, K_M). \quad (3-1c)$$

Suppose that the land and urban skilled labor are specific to the agricultural good and manufactured good, respectively. Moreover, the unskilled labor is perfectly mobile between the rural and urban unskilled sector. To simplify the analysis, we choose the agricultural good as the numeraire. Given cost-minimization, the factor price is paid by the value of its marginal product

$$w = X_L(L_X, T), \quad (3-2a)$$

$$\tau = X_T(L_X, T), \quad (3-2b)$$

$$w_S = P_Y Y_S(S, K_Y), \quad (3-2c)$$

$$r = P_Y Y_K(S, K_Y), \quad (3-2d)$$

$$\bar{w} = P_M M_L(L_M, K_M), \quad (3-2e)$$

$$r = P_M M_K(L_M, K_M), \quad (3-2f)$$

where $P_i (i=X, Y, M)$ denotes the price of i good, τ represents the rental rate of land, and r serves as the rental rate of capital. In addition, w_S is the real wage of skilled labor, w is the real wage of rural unskilled labor, and \bar{w} is the minimum wage rate of urban unskilled labor determined exogenously by government policy. The zero-profit conditions can be obtained from (3-2a) - (3-2f),

$$C^X(w, \tau) = 1, \quad (3-3a)$$

$$C^Y(w_S, r) = P_Y, \quad (3-3b)$$

$$C^M(\bar{w}, r) = P_M, \quad (3-3c)$$

where $C^i(\cdot)$, $i=X, Y, M$ denote the unit cost function of good i .

Since \bar{w} is exogenously given, the phenomenon of unemployment may exist in the urban sector. We define L_U as the urban unemployment of unskilled labor, while $\lambda = L_U / L_M$ represents the ratio of unemployment to employment in the urban unskilled sector. The equilibrium condition of urban unskilled sector can be expressed as follows:

$$L_x + (1 + \lambda)L_M = L, \quad (3-4)$$

where L denotes the endowment of unskilled labor in the parent country. Alternatively, (2-4) can be revised as

$$C_1^x(w, \tau)X + (1 + \lambda)C_1^M(\bar{w}, r)M = L, \quad (3-5)$$

where $C_1^x(\cdot)$ and $C_1^M(\cdot)$ denote the partial derivative with respect to the first variable in the function of agricultural and intermediate good, respectively. The crucial assumption of H-T model is that unskilled labor will stop migrating between urban unskilled and rural sector when the real wage of these two sectors equalized. Thus, the migration equilibrium condition is given by as follows:

$$w = w^e = \frac{1}{1 + \lambda} \bar{w}, \quad (3-6)$$

where \bar{w} denotes the expected wage for the urban unskilled labor and $1/(1 + \lambda)$ is the probability for an unskilled rural migrant finding a job in the urban sector.

To analyze the effect of capital flows through vertical MNEs, we assume that there is only capital freely mobile from the parent to the host country; other factors are prohibited. We define K_f as the capital flows from the parent to the host country. Therefore, the full-employment conditions of the land, urban skilled labor and capital

can be described as follows:

$$C_2^X(w, \tau)X = T, \quad (3-7)$$

$$C_1^Y(w_s, r)Y = S, \quad (3-8)$$

$$C_2^Y(w_s, r)Y + C_2^M(\bar{w}, r)M = K - K_f, \quad (3-9)$$

where K is the endowment of capital. As mentioned above, $C_1^Y(\cdot)$ represents the partial derivative with respect to the first variable in the function of the manufactured good, $C_2^X(\cdot)$ serves as the partial derivative with respect to the second variable in the function of the agricultural good. In addition, $C_2^Y(\cdot)$ and $C_2^M(\cdot)$ denote the partial derivative with respect to the second variable in the function of the manufactured and intermediate good, respectively.

Now we turn to develop the subsystem for the subsidiary in the host country. All the variables for the host country are marked asterisk (*). In this paper, we follow Liang and Mai that the vertical MNEs set up the subsidiary in the DFZ for assembly. There are three sectors in the host country, including the rural, the urban skilled and the DFZ sector. Note that the skilled labor and the DFZ sector are subdivided by the urban sector. Assume that the rural sector employs the unskilled labor (L_x^*) and capital (K_x^*) to produce agricultural good (X^*), the urban skilled sector produces manufactured good (Y^*) with the help of skilled labor (S^*) and capital (K_y^*). The DFZ sector requires the unskilled labor (L_z^*) and, intermediate good (M) imported from the parent country and capital flows through vertical MNEs (K_f) to produce the subsidiary-produced good (Z^*). All production functions exhibit constant returns to scale can be revised as follows:

$$X^* = X^*(L_X^*, K_X^*), \quad (3-10a)$$

$$Y^* = Y^*(S^*, K_Y^*), \quad (3-10b)$$

$$Z^* = Z^*(L_Z^*, M, K_f). \quad (3-10c)$$

Suppose that the skilled labor is specific to the urban sector and, the unskilled labor is perfectly mobile between the rural and the DFZ sector, and the capital can move across the rural and the urban skilled sector freely; however, all factors are not allowed to move out of the host country. For the sake of analytical simplicity, we choose the price of agricultural good to be the numeraire. We denote P_Y^* and P_Z^* represent the price of manufactured and subsidiary-produced good. Here, following Gupta (1994), Chaudhuri (2000), Liang and Mai (2003) and Chaudhuri et al. (2006), we assume that the production function of subsidiary-produced good is fixed-proportion. As a result, the production function (3-10c) can be derived as follows:

$$Z^* = M = L_Z^* = K_f. \quad (3-11)$$

Given cost-minimization, we can obtain following expressions:

$$w^* = X_L^*(L_X^*, K_X^*), \quad (3-12a)$$

$$r^* = X_K^*(L_X^*, K_X^*), \quad (3-12b)$$

$$w_s^* = P_Y^* Y_S^*(S^*, K_Y^*), \quad (3-12c)$$

$$r^* = P_Y^* Y_K^*(S^*, K_Y^*), \quad (3-12d)$$

where r^* represents the rental rate of capital, w_s^* and w^* serve as the real wage with respect to the urban skilled labor and rural unskilled labor. Given perfect competition, from (3-11), and (3-12a) - (3-12d),

the zero-profit conditions are expressed as

$$C^{X^*}(w^*, \tau^*) = 1, \quad (3-13a)$$

$$C^{Y^*}(w_s^*, r^*) = P_Y^*, \quad (3-13b)$$

$$C^{Z^*}(\bar{w}^*, P_M, r) = P_Z^*, \quad (3-13c)$$

where \bar{w}^* is the minimal wage rate of urban unskilled labor, $C^i(\cdot)$, $i=X,Y,Z$ represent the unit cost function of good i^* .

Consider that urban unemployment exists in the urban unskilled sector due to the minimum wage. Denote that L_u^* represents the level of unemployment in the urban unskilled sector, and $\lambda^* = L_u^*/L_z^*$ can be shown as the ratio of unemployment to employment for urban unskilled labor. Hence, the equilibrium condition of urban unskilled sector is as follows:

$$L_x^* + (1 + \lambda)L_z^* = L, \quad (3-14)$$

where L^* represents the endowment of urban unskilled labor and (3-14) can be further revised as follows:

$$C_1^{X^*}(w^*, r^*)X^* + (1 + \lambda^*)C_1^{Z^*}(\bar{w}^*, P_M, r)Z^* = L^*, \quad (3-15)$$

where $C_1^{X^*}(\cdot)$ and $C_1^{Z^*}(\cdot)$ denote the partial derivative with respect to the first variable in the function for the agricultural and subsidiary-produced good. In the H-T model, the unskilled labor will stop migrating between the rural and urban sector when the real wage of two sectors equalized. Consequently, the migration equilibrium condition can be derived as

$$w^* = w^{e^*} = \frac{1}{1 + \lambda} \bar{w}^*, \quad (3-16)$$

where w^e represents the expected wage of urban unskilled labor, and $1/(1+\lambda^*)$ denotes the probability of finding a job for urban unskilled labor. Finally, the full-employment condition of the skilled labor and capital can be described as follows:

$$C_1^{Y^*}(w_s^*, r^*)Y^* = S^*, \quad (3-17)$$

$$C_2^{X^*}(w^*, r^*)X^* + C_2^{Y^*}(w_s^*, r^*)Y^* = K^*, \quad (3-18)$$

where K^* denotes the endowment of capital, $C_1^{Y^*}(\cdot)$ expresses the partial derivative with respect to the first variable in the function of the manufactured good. In addition, $C_2^{X^*}(\cdot)$ and $C_2^{Y^*}(\cdot)$ serve as the partial derivative with respect to the second variable in the function of the agricultural and manufactured good, respectively.

Since the subsidiary-produced good requires the capital provided solely from the parent country, P_Z^* is endogenously determined. Therefore, the system contains 17 equations, (3-3a) - (3-3c), (3-5) - (3-9), (3-11), (3-13a) - (3-13c) and (3-15) - (3-18). There are 17 endogenous variables in the model, including P_M , w , w_s , r , τ , λ , X , Y , M , P_Z^* , w^* , w_s^* , r^* , λ^* , X^* , Y^* and Z^* . Next, we are going to examine the effects of capital flows through vertical MNEs on wage inequality and unemployment with respect to the parent and the host country in the following sections.

Chapter 4 Capital Flows and Wage Inequality

Using the model we have established in chapter 2, this chapter we examine the impact of capital flows on wage inequality with respect to the parent and host country. Totally differentiating (3-11), we derive the result as

$$dZ^* = dM = dL_z^* = dK_f. \quad (4-1)$$

Next, totally differentiating (3-3a)-(3-3c) and (3-5)-(3-9), and substituting $dM = dK_f$ by (4-1), we obtain following matrix:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & -\theta_{MK} & 0 & 0 & 0 \\ 0 & -\theta_{XL} & -\theta_{XT} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -\theta_{YS} & -\theta_{YK} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & \lambda/(1+\lambda) & 0 & 0 \\ 0 & \theta_{XL}\sigma_X & -\theta_{XL}\sigma_X & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & -\theta_{YK}\sigma_Y & \theta_{YK}\sigma_Y & 0 & 0 & 1 \\ 0 & -\theta_{XT}\sigma_X\lambda_{XL} & \theta_{XT}\sigma_X\lambda_{XL} & 0 & (1+\lambda)\theta_{MK}\sigma_M\lambda_{ML} & \lambda\lambda_{ML} & \lambda_{XL} & 0 \\ 0 & 0 & 0 & \theta_{YS}\sigma_Y\lambda_{YK} & -\delta_r & 0 & 0 & \lambda_{YK} \end{bmatrix} \begin{bmatrix} \hat{P}_M \\ \hat{w} \\ \hat{\tau} \\ \hat{w}_s \\ \hat{r} \\ \hat{\lambda} \\ \hat{X} \\ \hat{Y} \end{bmatrix}$$

$$= \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -(1+\lambda)\lambda_{ML} \\ -\delta_K \end{bmatrix} \hat{K}_f, \quad (4-2)$$

where σ^i ($i=X, Y, M$) represents the elasticity of substitution for good i . θ_{ij} ($i=X, Y, M; j=T, S, L, K$) denotes the cost share of factor j of good i . λ_{ij} ($i=X, Y, M; j=L, K$) is the fraction of factor j employed of good i . Moreover, $\delta_r = \theta_{YS} \sigma_Y \lambda_{YK} + \theta_{ML} \sigma_M \lambda_{MK} > 0$, $\delta_k = \lambda_{k_f} [1 + (K_M / M)] > 0$ and $\lambda_{k_f} = K_f / (K - K_f)$ refers to the fraction of capital flows from the parent country to the host country. Let Δ be the value the determinant of matrix (4-2), we have

$$\Delta = \lambda [(\sigma_X + \lambda_{XL}) / (1 + \lambda) + \theta_{XT} \lambda_{ML}] (\sigma_Y \lambda_{YK} + \theta_{ML} \theta_{YS} \sigma_M \lambda_{MK}) > 0. \quad (4-3)$$

The following comparative static exercises can be derived by using (3-2) and (3-3),

$$\hat{P}_M / \hat{K}_f = \frac{\theta_{MK} \theta_{YS} \delta_k \lambda}{\Delta(1 + \lambda)} [\sigma_X \lambda_{XL} + (1 + \lambda) \theta_{XT} \lambda_{ML}] > 0, \quad (4-4)$$

(4-4) shows that the relationship between capital flows and the price of intermediate good is positive. It indicates that increasing capital flows from the parent country to the host country raises the demand for intermediate good, and thus leads to a rise in the price of intermediate good.

$$\hat{X} / \hat{K}_f = \frac{-\theta_{XL} \sigma_X \lambda \lambda_{ML}}{\Delta} (\theta_{YS} \sigma_M \delta_k + \sigma_Y \lambda_{YK}) < 0. \quad (4-5a)$$

$$\hat{Y} / \hat{K}_f = \frac{-\theta_{YK} \sigma_Y \delta_k \lambda}{\Delta(1 + \lambda)} [\theta_{XT} (1 + \lambda) \lambda_{ML} + \sigma_X \lambda_{XL}] < 0. \quad (4-5b)$$

(4-5a) and (4-5b) show that the increasing capital flows from the parent country to the host country lowers the output of agricultural and manufactured good. The result can be explained as follows. An increase in capital flows raises the demand for the intermediate good. At the same time, it attracts that unskilled labor and capital move from

the agricultural sector and the manufactured sector into the intermediate sector, respectively. As a consequence, an increase in capital flows reduces the output of agricultural and manufactured good.

The impact of capital flows on factor price in the parent country can be derive as

$$\hat{\tau} / \hat{K}_f = \frac{-\theta_{XL} \lambda \lambda_{ML}}{\Delta} [\theta_{YS} \sigma_M (\theta_{MK} \delta_K + \theta_{ML} \lambda_{MK}) + \sigma_Y \lambda_{YK}] < 0, \quad (4-6a)$$

$$\hat{r} / \hat{K}_f = \frac{\theta_{YS} \delta_K \lambda}{\Delta(1+\lambda)} [\sigma_X \lambda_{XL} + \theta_{XT} (1+\lambda) \lambda_{ML}] > 0, \quad (4-6b)$$

$$\hat{w}_s / \hat{K}_f = \frac{-\theta_{YK} \delta_K \lambda}{\Delta(1+\lambda)} [\sigma_X \lambda_{XL} + (1+\lambda) \theta_{XT} \lambda \lambda_{ML}] < 0, \quad (4-6c)$$

$$\hat{w} / \hat{K}_f = \frac{\theta_{XT} \lambda \lambda_{ML}}{\Delta} [\theta_{YS} \sigma_M (\theta_{MK} \delta_K + \theta_{ML} \lambda_{MK}) + \sigma_Y \lambda_{YK}] > 0. \quad (4-6d)$$

(4-6a) states that the link between increasing capital flows and the rental rate of land is negative. From (4-5a), we show that increasing capital flows lowers the output of agricultural good and therefore the rental rate land decreases. (4-6b) demonstrates a positive link between rising capital flows and the rental rate of capital. Since an increase in capital flows from the parent country to the host country reduces the supply of the parent country, the rental rate of capital increases. (4-6c) shows that the effect of capital flows on the real wage of skilled labor is negative. A decrease in the output of manufactured good leads to a fall in the derived demand for skilled labor, then the real wage of skilled labor goes down. On the other hand, the real wage of unskilled labor rises since unskilled labor moves from the agricultural sector to the intermediate sector.

It is noteworthy that (4-6c) and (4-6d) state that increasing capital flows lowers real wage of skilled labor and increases real wage of unskilled labor. Therefore, wage inequality declines. We derive following proposition which is identical with the conclusion of Liang and Mai (2003).

Proposition 1. An increase in capital flows through vertical MNEs decreases wage inequality of the parent country.

Now we examine how capital flows through vertical MNEs affects wage inequality of the host country. Totally differentiating (3-13a) - (3-13c) and (3-15) - (3-18), and replacing $dZ^* = dK_f$ by (4-1), it yields following matrix:

$$\begin{bmatrix}
 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
 0 & -\theta_{XL}^* & 0 & -\theta_{XK}^* & 0 & 0 & 0 & 0 \\
 0 & 0 & -\theta_{YS}^* & -\theta_{YK}^* & 0 & 0 & 0 & 0 \\
 0 & 0 & -\theta_{YK}^* \sigma_Y^* & \theta_{YK}^* \sigma_Y^* & 0 & 0 & 1 & 0 \\
 0 & -\theta_{XK}^* \sigma_X^* \lambda_{XL}^* & 0 & \theta_{XK}^* \sigma_X^* \lambda_{XL}^* & \lambda^* \lambda_{ZL}^* & \lambda_{XL}^* & 0 & 0 \\
 0 & \theta_{XL}^* \sigma_X^* \lambda_{XK}^* & \theta_{YS}^* \sigma_Y^* \lambda_{YK}^* & -\delta_r^* & 0 & \lambda_{XK}^* & \lambda_{YK}^* & 0 \\
 0 & 1 & 0 & 0 & \lambda^* / (1 + \lambda^*) & 0 & 0 & 0
 \end{bmatrix}
 \begin{bmatrix}
 \hat{P}_Z^* \\
 \hat{w}^* \\
 \hat{w}_S^* \\
 \hat{r}^* \\
 \hat{\lambda}^* \\
 \hat{X}^* \\
 \hat{Y}^*
 \end{bmatrix}
 =
 \begin{bmatrix}
 (\theta_{ZM}^* \hat{P}_M / \hat{K}_f + \theta_{ZK}^* \hat{r} / \hat{K}_f) \\
 0 \\
 0 \\
 0 \\
 -(1 + \lambda^*) \lambda_{ZL}^* \\
 0 \\
 0
 \end{bmatrix}
 \hat{K}_f
 \quad (4-7)$$

Again, σ_i^* ($i=X, Y$) represents the elasticity of substitution of good i ;

θ_{ij}^* ($i = X^*, Y^*, Z^*$; $j = S^*, L^*, K^*, K_f, M$) denotes the cost share of factor j in good i ; λ_{ij}^* ($i = X^*, Y^*, Z^*$; $j = L^*, K^*$) is the fraction of factor j employed of good i . Besides, $\delta_r^* = \theta_{XL}^* \sigma_X^* \lambda_{XK}^* + \theta_{YS}^* \sigma_Y^* \lambda_{YK}^* > 0$. Let Δ^* be the value of determinant of the left side of (4-7), we have

$$\begin{aligned} \Delta^* = & \lambda^* \{ \lambda_{XL}^* [1/(1 + \lambda^*)] (\theta_{YS}^* \sigma_X^* \lambda_{XK}^* + \theta_{XL}^* \sigma_Y^* \lambda_{YK}^*) \\ & + \theta_{XK}^* \theta_{YS}^* \lambda_{ZL}^* \lambda_{XK}^* \} > 0. \end{aligned} \quad (4-8)$$

Using Cramer's rule, we have following expressions.

$$\begin{aligned} \hat{P}_Z^* / \hat{K}_f = & \frac{-(\theta_{ZM}^* \hat{P}_M / \hat{K}_f + \theta_{ZK}^* \hat{r} / \hat{K}_f)}{\Delta^*} \{ \lambda^* [\theta_{XK}^* \theta_{YS}^* \lambda_{XK}^* \lambda_{ZL}^* \\ & + \lambda_{XL}^* (1/1 + \lambda^*) (\theta_{YS}^* \sigma_X^* \lambda_{XK}^* + \theta_{XL}^* \sigma_Y^* \lambda_{YK}^*)] \} < 0, \end{aligned} \quad (4-9)$$

(4-9) shows that the effect of increasing capital flows on the price of subsidiary-produced good is negative. Since the product function of the subsidiary-produced good is fixed proportions, an increase in capital flows from the parent country to the host country will increase the output of subsidiary-produced good. Therefore, the price of subsidiary-produced good falls.

$$\hat{X}^* / \hat{K}_f = \frac{-\theta_{XL}^* \lambda^* \lambda_{ZL}^*}{\Delta^*} (\theta_{YS}^* \sigma_X^* \lambda_{XK}^* + \sigma_Y^* \lambda_{YK}^*) < 0, \quad (4-10a)$$

$$\hat{Y}^* / \hat{K}_f = \frac{\theta_{XL}^* \theta_{YK}^* \sigma_Y^* \lambda^* \lambda_{XK}^* \lambda_{ZL}^*}{\Delta^*} > 0. \quad (4-10b)$$

From (4-10a) and (4-10b), we have shown that increasing capital flows lowers the output of agricultural good and raises the output of manufactured good. An increase in the capital flows from the parent country to the host country leads to a rise in the output of subsidiary-produced good, and thus increases the derived demand for un-

skilled labor in the DFZ sector. Hence, a movement of unskilled labor from the rural sector to the DFZ sector decreases the output of agricultural good. Meanwhile, a decline in the output of agricultural good will contribute to a shift of capital from the agricultural sector to the manufactured sector. As a result, the output of manufactured good rises.

$$\hat{r}^* / \hat{K}_f = \frac{-\theta_{XL}^* \theta_{YS}^* \lambda^* \lambda_{XK}^* \lambda_{ZL}^*}{\Delta^*} < 0, \quad (4-11a)$$

$$\hat{w}_s^* / \hat{K}_f = \frac{\theta_{XL}^* \theta_{YK}^* \lambda^* \lambda_{XK}^* \lambda_{ZL}^*}{\Delta^*} > 0, \quad (4-11b)$$

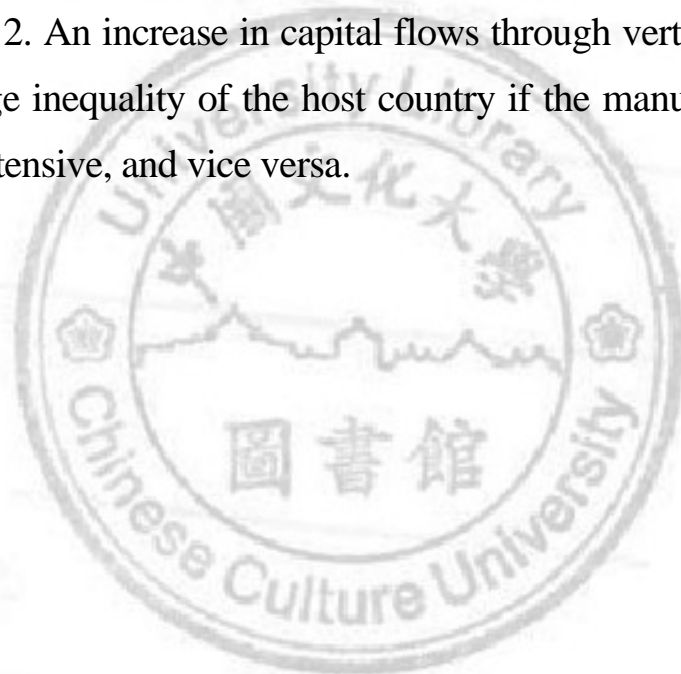
$$\hat{w}^* / \hat{K}_f = \frac{\theta_{XK}^* \theta_{YS}^* \lambda^* \lambda_{XK}^* \lambda_{ZL}^*}{\Delta^*} > 0, \quad (4-11c)$$

$$(\hat{w}_s^* - \hat{w}^*) / \hat{K}_f = \frac{(\theta_{XL}^* \theta_{YK}^* - \theta_{XK}^* \theta_{YS}^*)}{\Delta^*} \lambda^* \lambda_{XK}^* \lambda_{ZL}^*, \quad (4-11d)$$

(4-11a) - (4-11c) express the effect of increasing capital flows on factor price in the host country. The economic intuition is clearly described as following statements. A rise in the output of subsidiary-produced good due to increasing capital flows from the parent country to the host country, and thus raises the derived demand for unskilled labor in the DFZ sector. It results in a movement of unskilled labor from the agricultural sector to the DFZ sector and leads to a decline in the supply of unskilled labor of the agricultural sector. Hence, the real wage of unskilled labor in the agricultural sector increases. On the other hand, as we have proved above, the output of manufactured good rises. This increases the derived demand for skilled labor and leads to an increase in the real wage of skilled labor. However, a rise

in the real wage skilled and unskilled labor tends to decrease profit. The rental rate of capital must fall in order to satisfy the zero-profit condition. Further, (4-11d) state that the impact of increasing capital flows on wage inequality depends on factor intensity of the manufactured and agricultural good. Here, we also find the same conclusion as Liang and Mai. Wage inequality rises if the manufactured good is capital-intensive; on the contrary, wage inequality falls if the agricultural good is capital-intensive. This leads to following proposition:

Proposition 2. An increase in capital flows through vertical MNEs increases wage inequality of the host country if the manufactured good is capital-intensive, and vice versa.



Chapter 5 Capital Flows and Urban Unemployment

This chapter examines the impact of capital flows through vertical MNEs on urban unemployment. Using (4-2) and (4-3), we derive the relationship between capital flows and urban unemployment of the parent country,

$$\hat{\lambda} / \hat{K}_f = \frac{-(1 + \lambda)\theta_{XT}\lambda_{ML}}{\Delta} [\theta_{YS}\sigma_M(\theta_{MK}\delta_K + \theta_{ML}\lambda_{MK}) + \sigma_Y\lambda_{YK}] < 0. \quad (5-1)$$

Since $1/(1 + \lambda)$ represents the employment rate of urban unskilled labor, (4-1) shows that a rise in the capital flows increases the employment rate, or decreases the unemployment rate, of the urban unskilled sector. The impact of capital flows on urban unemployment through two channels. First, the expansion effect creates new jobs for unskilled labor of the urban sector by means of an expansion of the intermediate good sector. Thus, this channel tends to reduce the urban unemployment. The second channel is the migration effect which tends to raise the urban unemployment. A migration of unskilled labor from the agricultural sector to the intermediate sector leads to a rise in the urban unemployment. The net effect depends on the relative strength of the two channels, while (5-1) shows that the capital flows tends to favor the employment of urban unskilled labor in the parent country. The proposition 3 can be described as following statement:

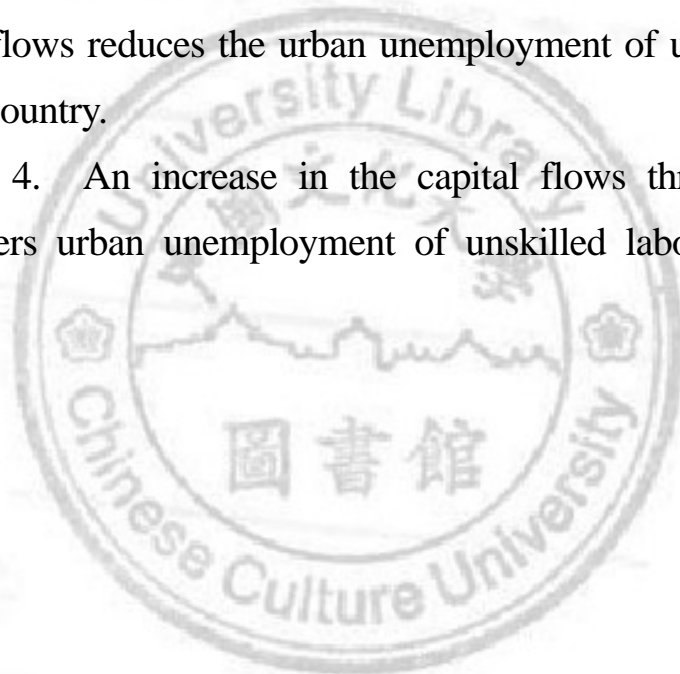
Proposition 3. An increase in the capital flows through vertical MNEs lowers urban unemployment of unskilled labor in the parent country.

Next, by the use of (4-7) and (4-8), we derive the negative link between increasing capital flows and urban unemployment of the host country,

$$\hat{\lambda}^* / \hat{K}_f = \frac{-(1 + \lambda^*)}{\Delta^*} \theta_{xK}^* \theta_{yS}^* \lambda_{xK}^* \lambda_{zL}^* < 0. \quad (5-2)$$

As mentioned above, we have shown that the influence of capital flows on urban unemployment was determined by the relative strength of expansion effect and migration effect. (5-2) expresses that a rise in the capital flows reduces the urban unemployment of unskilled labor in the host country.

Proposition 4. An increase in the capital flows through vertical MNEs lowers urban unemployment of unskilled labor in the host country.



Chapter 6 Capital Flows and Welfare

The welfare implication of increasing capital flows through vertical MNEs will be examined with respect to the parent and host country. The welfare is defined as national income, I , which comes from the sum of factor payments. Hence,

$$I = w_s S + wL + \tau T + rK, \quad (6-1)$$

$$I^* = w_s^* S^* + w^* L^* + r^* K^*. \quad (6-2)$$

By totally differentiating (6-1) and (6-2), we get

$$\begin{aligned} dI/dK_f &= (P_M M / \Delta K_f) \{ \theta_{YL} \theta_{MK} \lambda \delta_K [\sigma_X \lambda_{XL} (1/1 + \lambda) + \theta_{XT} \lambda_{ML}] \\ &+ (1 + \lambda) \theta_{XT} \theta_{ML} \lambda \lambda_{ML} [\theta_{YS} \sigma_M (\theta_{MK} \delta_K + \theta_{ML} \lambda_{ML}) + \sigma_Y \lambda_{YK}] \} > 0, \end{aligned} \quad (6-3)$$

and

$$dI^*/dK_f = (1/\Delta^* K_f) \{ (1 + \lambda^*) \theta_{XK}^* \theta_{YS}^* \theta_{ZL}^* \lambda^* \lambda_{XK}^* \lambda_{ZL}^* P_Z^* Z^* \} > 0. \quad (6-4)$$

From (6-3) and (6-4), we show that increasing capital flows through vertical MNEs raises national income of the parent country and host country. The economic intuitive is interpreted as follows. As mentioned above, we have proved that increasing capital flows raises the real wage of unskilled labor and the rental rate of capital. On the contrary, the real wage of skilled labor and rental rate of land decline. Meanwhile, the parent country is capital-intensive relative to the host country, the parent country benefits the national income from rising the rental rate of capital and the real wage of unskilled labor exceed the losses from the falling rental rate of land and real wage of skilled labor. As a result, the welfare of the parent country increases. On the other hand, increasing capital flows lead to a rise in the real wage of

skilled and unskilled labor of the host country. However, the rental rate of capital falls. The welfare of host country improves since the host country is unskilled-labor-abundant than the parent country, and thus gains the national income from increasing labor income outweigh the losses from falling the rental rate of capital. The following proposition is immediate.

Proposition 5. An increase in the capital flows through vertical MNEs improves the welfare of both nations if the parent country is capital-intensive relative to the host country.

Liang and Mai (2003) show that a rise in the capital flows increase the national income of both countries. However, Beladi and Marjit (1992) show that the impact of foreign capital inflow on welfare depends on factor intensity. An inflow of foreign capital will reduce welfare if the DFZ sector is unskilled-labor-intensive relative to other sectors in the economy. In addition, Yabuuchi (1999) argues that FDI inflow has no effect on welfare. This happens because increasing FDI inflow is absorbed from urban unemployment labors and there is no change in the level of output. Hence, the welfare of the host country unchanged.

Chapter 7 Conclusions

From 1966 to 1976, Taiwan enjoyed relative low unemployment and wage inequality due to adopting a policy of an expansion of unskilled-labor-intensive exports. During this period, the demand for unskilled labor rose faster than skilled labor (Chu, 2001). Nonetheless, since 1980, NIE had started to face an upward trend of cost of labor and land. In addition, after the economic reform, China provided a huge amount of cheaper unskilled labor and became as the world factory. Specifically, China also received 70% of FDI from NIE (Gao, 2005). The production structure and economic environment of developing Asia countries has changed. For example, the Barbie Doll case, Taiwan produced raw materials and then assembled. But it has now migrated to LDCs for lower cost of labor, such as China and Indonesia. Another example is the information technology industry. In order to reduce the cost of production, the capital and intermediate goods were obtained from the parent country of Taiwan, and then it would be shipped to LDCs for assembly (Tung, 2006).

In this paper we extend H-T model to examine the impact of capital flows through vertical MNEs from the parent to host country on wage inequality, urban unemployment and national income. We have derived following results. An increasing capital flows through vertical MNEs lowers wage inequality of the parent country. However, the wage inequality of the host country depends on factor intensity; that is, the wage inequality of the host country rises if the manufactured good is capital-intensive. If the agricultural good is capital-intensive, the host country's wage inequality declines. On the other

hand, the impact of capital flows affects urban unemployment from two channels. We find that the level of urban unemployment is determined by the relative strength of the expansion effect and the migration effect. Further, we show that an increase in capital flows reduces the urban unemployment of Taiwan and LDCs. Moreover, increasing capital flows through vertical MNEs improves welfare for both countries.



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