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Abstract

One trend happening in East Asia is that the previous booming economies, notably Japan, Taiwan and Hong Kong, has lost momentum of high economic growth. For example, many people in Hong Kong have been frustrated with their situations. One observation is that many Hong Kong people are not happy with the interaction between mainland China and Hong Kong. This paper develops a simple 2-country, 2-good and 2-factor general equilibrium model between a small and a large economy. It shows that when a large economy experiences technological advance and upgrades its labor force, the small economy may be worse off compared with the pre-development of the large economy. This model shows that the higher technological development and human capital growth of a large but previously backward economy may lead to lower welfare of a smaller economy. It may partly explain the recent problems in Hong Kong, as well as Taiwan and Japan.

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Unequal Technological Advance, Reverse Comparative Advantage and Welfare Reduction

Introduction

Hong Kong has enjoyed faster economic growth in the early years of the open policy in Mainland China, especially in 1980s and 1990s. Hong Kong did gain from industrial restructuring by specializing in services and importing manufacturing goods from Mainland China. However, in recent years, many Hong Kong people do not like the close interaction with Mainland China. Hong Kong people's real average income has not been improved over the past 20 years. In 1996, the real median household income (in 2009 dollars) was HK$18,770 while in 2015, the number was $19,952, an increase of merely 6.3% in 20 years. Using the data of economically active households, the real median income increased from HK$20,647 to HK$24,233, or 17.4%, less than 1% per year. The median monthly income in the same period increased from HK$10,428 to HK$12,116, an increase of 16.2%, less than 1% per year too (Census and Statistics Department, 2017).

Many surveys found that the Hong Kong people in general were pessimistic towards the future development in Hong Kong. The pessimistic views were more serious among the young people (for example, *Ming Pao*, 2016). In a rating of 1 to 10 with 1 the worst and 10 the best, the most pessimistic view is "reducing unequal income distribution" (a score of 3.56) while the most optimistic is "family economy" (a score of 5.56). The scores given by the respondents between 18-29tended to be lower. Another report found that the young people (aged 15-34) thought they were less competitive compared with the older generation (*The Hong Kong Federation of Youth Groups*, 2010). 69.4% denied the view that the competitiveness of the youngsters nowadays is superior to the older generation. The Hong Kong young people are facing lower income even though they have higher education (e.g. *Bauhinia Foundation Research Centre*, 2014). Income increase was barely higher than inflation rate while the housing price was rocketing. Occupation choices are limited and higher income posts decreased. 41.6% of young people worked in "Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services Sectors".

There have also been comments on the fading comparative advantages of existing Hong Kong production (for example, *Apple Daily*, 2014; *China News*, 2015; Dingeldey and Wa, 2015; *Inmediahk*, 2014; *Ming Pao*, 2015). Take Dingeldey and Wa (2015) as

an example, they listed a series of problems in Hong Kong: i) Gini coefficient has climbed from 0.518 in 1996 to 0.537 in 2014 while housing prices were severely unaffordable. ii) The Economist's "Crony Capitalism Index" which measured the extent of business tycoons' wealth profiting from a close relationship with government officials put Hong Kong at the top in 2014. iii) Hong Kong has been commented to be the worst place to invest in Chinese IPOs, with transactions recording lower than average returns and a higher chance of losses compared with the Shanghai or New York exchanges. iv) Hong Kong was losing its advantage as the premier offshore renminbi centre. For example, offshore renminbi payments of the centres outside Hong Kong had a share increasing from 17 per cent in 2013 to 25 per cent 2015. v) as the ports in mainland had caught up fast, Hong Kong port's importance for handling direct cargo intended for southern China fell from 76 percent in 2001 to 39 per cent in 2011. vi) Hong Kong's prime office market was ranked by CBRE Research the most expensive in Asia, more than double Shanghai's. vii) Hong Kong has tried to develop advantages in new products in recent years, such as Science Park and "Six industries". However, the results were disappointed and the employment was limited. Li et al. (2014) also found that even Hong Kong's financial service, the strongest product regarded by many people, have fading comparative advantage.

Contrasting with the fading comparative advantages of Hong Kong's existing production and difficulty in developing new industries, Mainland China has accumulated strengths in human capital and high technology. For example, graduates of higher education has increased from 1.14 million in 2001 to 7.49 million in 2015 (Chinese Education Online, 2014). In 2003, 17% of the suitable aged young people could get higher education. In 2014, the number was 37.5%. Due to the lower birth rate and increasing university students, the percentage is expected to increase to over 50%. China's technology has also improved very fast. For example, in 2000, China only involved 9.4% of high-tech manufacturing exports of Asia. In 2014, the ratio greatly increased to 47.3%. Among China's manufacturing exports, in 2000, 41% was low-tech products and 22.4% was high-tech products; in 2014, the ratio changed to 28% and 30.6% (*Asian Development Bank*, 2015).

Partly based on the recent development of Mainland China and Hong Kong, this paper tried to develop a simple model to explain the possibility that a small economy may really be worse off if a large trading partner has improved its human resources and successfully achieves technological advance.

Literature Reviews

Changing comparative advantages is not a new topic. Deardorff (2013) applied Solow Model and Ramsey Model to show that under certain situations, comparative advantages may be reversed. Empirically, there are also studies on changing comparative advantages. For example, Wolff (2003) studied the U.S. trade between 1947-1996 and found that though the exports of the U.S. had been more skill-intensive, relative advantages of capital-intensive products in imports have changed. Carolanet al. (1998) used the trade data between the U.S. and eight Asian countries and found that most Asian countries did have changing comparative advantages with increasing importance of higher human resources and technology. Kiyota (2013) found that Japan has increasingly exported less skill-intensive products while imported more skill-intensive products. Weiss (2010) confirmed other studies that China did experience rapid shift of export patterns.

Model

This is a simple 2-country, 2-good and 2-factor model. The two countries are Economy H, a small economy, and Economy F, a large economy; the two goods are Good X and Good Y; the two factors are unskilled labor, L_u and skilled labor, L_s. A general equilibrium model is based on the assumption of perfect competition, full employment and law of one price is applied to trade. Initially Economy F has lower skill level. Over time, Economy F upgrades its human resources and achieves technological advance in its importing industry. The model compares the welfare of Economy H under different situations.

Closed Economy of the Small Economy, Economy H

At first, suppose the Small Economy, Economy H, is in autarky state. In the Small economy, there are L people, all are identical with the following utility function of individual i:

$$U_i = x_i^{1/2} y_i^{1/2} \quad (1)$$

i=1,…,L.

Suppose there is no saving and all income comes from the wages. The income constraint is:

$$w_i = P_x x_i + P_y y_i \quad (2)$$

w_i is wage of individual i; P_x is price of Good X and P_y is price of Good Y.

The production of Good X and Good Y are as below

$$X^H = L_u^x + L_s^x$$

$$Y^H = L_s^y$$

X^H and Y^H are quantity of Good X and Good Y produced in Economy H; L_u^x is quantity of unskilled workers hired in Industry X while L_s^x is quantity of skilled workers hired in Industry X; L_s^y is quantity of skilled workers hired in Industry Y. The production functions refers to the fact that Good X can be produced with either unskilled or skilled workers while Good Y can only be produced by skilled workers. Suppose in Economy H, all people are skilled workers, i.e.:

$$X^H = L_s^x \quad (3)$$

$$Y^H = L_s^y \quad (4)$$

From zero profit condition:

$$P_x X^H = w_i L_s^x \quad (5)$$

$$P_y Y^H = w_i L_s^y \quad (6)$$

Substituting (3) and (4) into (5) and (6) respectively, we have

$$P_x = P_y = w_i \quad (7)$$

Dividing (5) by (6),

$$\frac{Y^H}{X^H} = \frac{P_x^2}{P_y^2}$$

From (7), we have:

$$Y^H = X^H \quad (8)$$

From the full employment condition:

$$L = L_s^x + L_s^y \quad (9)$$

Substituting (3), (4) and (8) into (9),

$$L_s^x = L_s^y = \frac{L}{2} \quad (10)$$

From the constrained utility maximization, maximizing (1) subject to (2):

$$Max \;\; U_i = x_i^{1/2} y_i^{1/2} \;\; \text{subject to} \;\; w_i = P_x x_i + P_y y_i$$

We have

$$\frac{y_i}{x_i} = \frac{P_x}{P_y} \quad (11)$$

As $Ly_i = Y^H$ and $Lx_i = X^H$, dividing (10) by L:

$$x_i = y_i = \frac{1}{2}$$

Thus the utility of an individual i under a closed economy is:

$$U_i = \frac{1}{16} \quad (12)$$

Trading between a Small Economy and a Large Economy

Suppose a large developing economy, Economy F, trades with Economy H. All individuals in Economy F have the same utility functions as Economy H. The technology

of production is also the same. The differences are that the population size is double in Economy F: 2L; and all people are unskilled workers. The utility of an individual in Economy F is:

$$U_j = x_j^{1/2} \mathrm{y}_j^{1/2} \quad (13)$$

j=1,…,2L.

The income constraint is:

$$w_j = P_x^F x_j + P_y^F y_j \quad (14)$$

W_j is wage of individual j; P_x^F is price of Good X in Economy F and P_y^F is price of Good Y in Economy F.

As all workers are unskilled, only Good X is produced:

$$X^F = L_u^x \quad (15)$$

L_u^x is quantity of unskilled workers in Economy F and L_u^x=2L. From zero profit condition:

$$P_x^F X^F = w_j L_u^x \quad (16)$$

Because the technologies are the same for both industries X and Y, and Economy F specializes in Good X, Economy H specializes in Good Y. Trading is balance between the two economies:

$$P_x X_E^F = P_y Y_E^H \quad (17)$$

X_E^F is the amount of Good X exported from Economy F to Economy H and Y_E^H is the amount of Good Y exported from Economy H to Economy F. From law of one price, $P_x^H = P_x^F = P_x$, $P_y^H = P_y^F = P_y$.

Multiplying (11) by L, the result of the constrained utility maximization of Economy H, we have:

$$\frac{Y_C^H}{X_C^H} = \frac{P_x}{P_y} \quad (18)$$

X_C^H is the total consumption of Good X in Economy H and Y_C^H is the total consumption of Good Y in Economy H:

$$X_C^H = X_E^F \quad (19)$$

$$Y_C^H = L - Y_E^H \quad (20)$$

From (17) and (18),

$$\frac{P_x}{P_y} = \frac{Y_C^H}{X_C^H} = \frac{Y_E^H}{X_E^F} \quad (21)$$

Substituting (19) and (20) into (21), we have:

$$\frac{Y_E^H}{X_E^F} = \frac{L - Y_E^H}{X_E^F}$$

And thus

$$Y_E^H = \frac{L}{2} \quad (22)$$

From the constrained utility maximization of Economy F, i.e. maximizing (13) subject to (14), we have:

$$\frac{y_j}{x_j} = \frac{P_x}{P_y} \quad (23)$$

Multiplying (23) by 2L,

$$\frac{Y_C^F}{X_C^F} = \frac{P_x}{P_y} \quad (24)$$

X_C^F is the total consumption of Good X in Economy F and Y_C^F is the total consumption of Good Y in Economy F:

$$X_C^F = 2L - X_E^F (25)$$

$$Y_C^F = Y_E^H (26)$$

From (17) and (24)

$$\frac{P_x}{P_y} = \frac{Y_C^F}{X_C^F} = \frac{Y_E^H}{X_E^F} \ (27)$$

Substituting (25) and (26) into (27)

$$\frac{Y_E^H}{X_E^F} = \frac{Y_E^H}{2L - X_E^F}$$

And thus

$$X_E^F = L \ (28)$$

Substituting (22) into (20) and (28) into (19),

$$X_C^H = L \ (29)$$

$$Y_C^H = \frac{L}{2} \ (30)$$

Dividing (29) and (30) by L and substituting into (1), the utility of an individual i in Economy H under trading becomes:

$$U_i = \frac{1}{4} \ (31)$$

which is larger than the utility under closed economy (12). Economy H gains from international trade.

Technological Advance and Human Resources Upgrade in Economy F

Suppose Economy F has experienced leapfrogging developing such that all people are upgraded to skilled workers and productivity is advanced in Industry Y. That is, the total labor in Economy F becomes:

$$2L = L_s^F \ (32)$$

L_s^F is skilled workers in Economy F. Suppose the productivity increase in Good Y be less than double, then the productions of Good X and good Y are:

$$X^F = L_s^{xF} \quad (33)$$

$$Y^F = bL_s^{yF}, 1<b<2 \quad (34)$$

$L_s^{xF} + L_s^{yF} = L_s^F = 2L$. Following the technological advance of Economy F in Good Y and all labor force are upgraded to skilled workers, Economy F produces both Good X and Good Y, while Economy H changes to specialize in producing Good X:

$$X^H = L_s^{xH} \quad (35)$$

$L_s^{xH} = L$.

Through trade and law of one price, the balance of trade becomes:

$$P_x X_E^H = P_y Y_E^F \quad (36)$$

From the constrained utility maximization of Economy F, (24) still holds:

$$\frac{Y_C^F}{X_C^F} = \frac{P_x}{P_y} \quad (24)$$

From zero-profit conditions,

$$P_x X^F = w_j L_s^{xF} \quad (37)$$
$$P_y Y^F = w_j L_s^{yF} \quad (38)$$

Substituting (33) into (37) and (34) into (38),

$$P_x = w_j \quad (39)$$
$$P_y b = w_j \quad (40)$$

Dividing (39) by (40), we have:

$$\frac{P_x}{P_y} = b \quad (41)$$

Let X_C^F and Y_C^F be total consumption of Good X and Good Y in Economy F:

$$X_C^F = L_s^{xF} + X_E^H \quad (42)$$

$$Y_C^F = bL_s^{yF} - Y_E^F \quad (43)$$

Substituting (41) into (24), we have:

$$Y_C^F = bX_C^F \quad (44)$$

Substituting (41) into (36), we have:

$$Y_E^F = bX_E^H \quad (45)$$

Substituting (32), (44) and (45) into (43) and combining (42) and (44), we have:

$$X_E^H = L - \ L_s^{xF} \quad (46)$$

Putting (46) in (42)

$$X_C^F = L \quad (47)$$

Combining (44) and (47),

$$Y_C^F = bL \quad (48)$$

For Economy H, (11) still holds from the constrained utility maximization:

$$\frac{y_i}{x_i} = \frac{P_x}{P_y} \quad (11)$$

Substituting (41) into (11) and multiplying x_i and y_i by L, we have

$$\frac{Y_C^H}{X_C^H} = \frac{P_x}{P_y} = b \quad (49)$$

The total consumption of Good Y in Economy H:

$$X_C^H = X^H - X_E^H \quad (50)$$

$$Y_C^H = Y_E^F \quad (51)$$

Using the fact that $X^H = L$ (from (35)) and substituting (50) and (51) into (49):

$$b = \frac{Y_E^F}{L - X_E^H} \quad (52)$$

Substituting (45) into (52), we have:

$$X_E^H = \frac{L}{2} \quad (53)$$

Substituting (53) into (52) and using (45),

$$X_C^H = \frac{L}{2} \quad (54)$$

$$Y_C^H = \frac{bL}{2} \quad (55)$$

Dividing (54) and (55) by L and substituting into the utility function (1), the utility of an individual i in Economy H becomes:

$$U_i = \frac{b^{1/2}}{16} < \frac{1}{4} \quad (56)$$

As $1<b<2$, $b^{1/2}<4$ and thus the utility is smaller than the value (31) before the technological advance in Economy F!

Bigger Technological Advance in Economy F

Next suppose the technological advance in Economy F further improves the productivity in Industry Y:

$$Y^F = bL_s^{yF}, \; b \geq 2 \quad (57)$$

Due to the huge advantage in Industry Y, the advantage can compensate the lower quantity in Industry X. Through trading with Economy H, Economy F specializes in producing Good Y and then L_s^{yF} = 2L. The total consumption becomes:

$$X_C^F = X_E^H \quad (58)$$

$$Y_C^F = bL_s^{yF} - Y_E^F \quad (59)$$

Substituting zero-profit condition (38) into (57):

$$w_j = bP_y \quad (60)$$

Substituting (60) into the income constraint (14) and multiplying all terms by 2L, we have:

$$\frac{P_x}{P_y} = \frac{2bL - Y_C^F}{X_C^F} \quad (61)$$

Combining the utility maximization result (24) and (61),

$$Y_C^F = bL \quad (62)$$

Substituting (62) into (59),

$$Y_E^F = bL \quad (63)$$

In Economy H, zero-profit condition is:

$$P_x X^H = w_i L$$

and thus:

$$P_x = w_i \quad (64)$$

Substituting (64) into the income constraint (2) and multiplying all terms by L:

$$\frac{P_x}{P_y} = \frac{Y_C^H}{L - X_C^H} \quad (65)$$

Combing the utility maximization result (18) and (65),

$$X_C^H = \frac{L}{2} \quad (66)$$

Substituting (66) into (50)

$$X_E^H = \frac{L}{2} \quad (67)$$

Substituting (63) and (67) into the balance of trade (36):

$$\frac{P_x}{P_y} = 2b$$

Substituting (63) into the total consumption of Good Y (51):

$$Y_C^H = bL \quad (68)$$

Dividing (66) and (68) by L and substituting into the utility function (1):

$$U_i = \frac{b^{1/2}}{4} > \frac{1}{4} \quad (69)$$

As b≥2, the utility is higher than the value (31) before technological advance in Economy F.

Concluding Remarks

A simple 2-economy, 2-good and 2-factor general equilibrium model is applied to study the effects of technological advance and upgrading human resources in a foreign large economy on the small home economy. The result shows that when the large economy has moderate technological advance, the small economy is worse off comparing with the situation that the large economy is more backward. The reason is mainly due to the situation that the large economy does not have complete specialization. The relative prices of the two goods are dominated by the local prices of the large economy.

It leads to less amount of goods left for the small economy. The relative higher price in the good of specialization cannot compensate for the lower quantity of the products consumed.

This model can partly explain why the people in more advanced small economy worry about the trading with the large economy when the large economy is undergoing fast development. One example is that some Hong Kong people feel uncomfortable with the interaction with Mainland China in recent years. Even though Hong Kong did enjoy high economic gains during the open policy of Mainland China in 1980s and 1990s, many Hong Kong people are not very happy with the economic integration with Mainland China. Many Hong Kong people are feeling losing advantages. The faster human resources upgrading and faster technological advances in Mainland China may explain the problems.

But the future may not be so dark for the small economy. The model shows that when the technological advance is bigger, the small economy will have larger gains comparing with the situation of a backward large economy. The main reason is that the larger advantage of a good allows the large economy to specialize on one product and the overall larger outputs are able to provide more goods to the small economy. If we apply the case to Hong Kong and Mainland China, Hong Kong will be able to gain from continuing technological advantage in Mainland China.

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