Macroeconomic Adjustment of Hong Kong in Response to Economic Slowdown in the U.S., China's Accession to WTO and Devaluation of RMB

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1. **Introduction – Motivation of This Paper**
2. **Stylized Facts about the Hong Kong Economy**
3. **A Static Macroeconomic Model of Hong Kong**
4. **Static Macroeconomic Equilibrium of Hong Kong**
5. **Stability Analysis of the Steady State of Hong Kong**
6. **A Dynamic Model with Rational Expectations**
7. **Concluding Remarks – Further Research**

1. Introduction – Motivation of the Paper

- There is widespread belief of an economic slowdown in the U.S.
- The Japanese economy has been in recession for a number of years.
- Speculations about the possible devaluation of the Chinese RMB.
- China's imminent accession to the WTO.
- Deflation in China.
- Greater integration of the Hong Kong economy with that of the Mainland.
- Introducing more of the highly educated persons of expertise from the Mainland to work in Hong Kong.

How might these factors affect Hong Kong from a macroeconomic perspective? Particularly the price level, wage rate and capital inflow to Hong Kong?

Lack of a concise but analytically useful macroeconomic model for Hong Kong based on some stylized facts about the Hong Kong economy.

2. Stylized Facts about the Hong Kong Economy

- Free capital flow into and out of Hong Kong.
- Interest rate of Hong Kong is determined by monetary policies of the U.S.
- The Hong Kong dollar is pegged to the U.S. dollar since October 1983.
- The tertiary sector is a very important part of the Hong Kong economy.
- Prices respond rapidly to changing conditions of demand and supply.
- Relatively flexible wage adjustment.
- Large amount of foreign exchange reserves in Hong Kong.
- Trade with the Mainland and the U.S. accounts for a very large fraction (over 50%) of the total trade of Hong Kong. Furthermore, "outward processing" accounts for a significant part of the trade between Hong Kong and the Mainland.
- Property price plays a very important role in the economic life of Hong Kong.
- There is strict foreign exchange control in China.
- Exchange rate of the Chinese RMB is managed within a narrow band around 8.27 RMB against the US dollar.
- Large foreign exchange reserves in China.

3. A Static Macroeconomic Model of Hong Kong

Aggregate Demand for Goods and Services

The real aggregate demand

$$y_1 = A_1 + NX_1$$

$$A_1 = g_1 + by_1 - dr_1$$

$$NX_1 = NX_{12} + NX_{13}$$

$$NX_{12} = t_{12} + n_{12}y_2 - n_{21}y_1 + \alpha_1 q_{12}$$

$$NX_{13} = t_{13} + n_{13}y_3 - n_{31}y_1 + \alpha_2 q_{13}$$

$$q_{12} = e_{12} - p_1 + p_2$$

$$q_{13} = e_{13} - p_1 + p_3$$

e_{12} is the nominal exchange rate between HK$ and RMB
e_{13} is the nominal exchange rate between HK$ and US$

Without loss of generality, by choosing the price unit appropriately, we can normalize the price level in the U.S. so that $P_3 = 1$ and $p_3 = 0$. Also denote $e_{13} = e_1$ and $e_{23} = e_2$

$$q_{13} = e_1 - p_1$$

$$q_{12} = e_{12} - p_1 + p_2 = e_{13} - e_{23} + p_2 - p_1 = (e_1 - p_1) - (e_2 - p_2)$$

Thus,

$$y_1 = \frac{1}{1-b+n_1}[g_1 + t_1 - dr_1 + (\alpha_1 + \alpha_2)(e_1 - p_1) - \alpha_1(e_2 - p_2) + n_{12}y_2 + n_{13}y_3]$$

Aggregate demand is

$$y_1^d = f_1 - \lambda r_1 + \gamma(e_1 - p_1) - \delta(e_2 - p_2) + \eta_{12}y_2 + \eta_{13}y_3$$

Real Interest Rate with Adaptive Expectations

$$r_1 = i_1 - [({}^{+1}_{+0}p_1^e) - p_1]$$

$$({}^{+1}_{+0}p_1^e) = ({}^{+0}_{-1}p_1^e) + m[p_1 - ({}^{+0}_{-1}p_1^e)] = mp_1 + (1-m)({}^{+0}_{-1}p_1^e)$$

where $0 < m < 1$. The *ex ante* real interest rate

$$r_1 = i_1 - (1-m)[({}^{+1}_{+0}p_1^e) - p_1]$$

Nominal Interest Rate

$$i_1 = i_3 + E\left(\frac{de_1}{dt}\right)$$

$E\left(\frac{de_1}{dt}\right) = 0$, and

$$i_1 = i_3$$

Aggregate Supply of Goods and Services

Cobb-Douglas aggregate production function, with a constant level of capital stock (without loss of generality, it is normalized to 1).

$$Y_1 = A_1 L_1^{1-a}$$

In log

$$y_1 = \hat{a}_1 + (1-\boldsymbol{a})l_1$$

Competitive economy

$$w_1 - p_1 = \ln(1-\boldsymbol{a}) + \hat{a}_1 - \boldsymbol{a}l_1$$

The aggregate supply

$$y_1^s = a_1 + \boldsymbol{b}(p_1 - w_1)$$

where a_1 represents the total factor productivity of Hong Kong.

Aggregate Demand for Labor

$$l_1^d = \frac{1}{\alpha}(p_1 - w_1) + \frac{1}{\alpha}[\ln(1-\alpha) + \hat{a}_1]$$

Aggregate Supply of Labor

$$l_1^s = \hat{l}_1 + \theta(w_1 - p_1)$$

Balance of Payments

Current account balance

$$CA_1 = t_1 + (\alpha_1 + \alpha_2)(e_1 - p_1) - \alpha_1(e_2 - p_2) + \eta_{12}y_2 + \eta_{13}y_3 - \eta_1 y_1$$

Capital account balance

$$KA_1 = \kappa_1 + \kappa\left[i_1 - i_3 - E\left(\frac{de_1}{dt}\right)\right]$$

Change of the official settlement balance

$$\partial f_1 = \partial(CA_1) + \partial(KA_1)$$

4. Static Macroeconomic Equilibrium of Hong Kong

Goods and Services Market Equilibrium

$$y_1^d = f - \lambda i_3 + \gamma e_1 - \omega p_1 - \delta(e_2 - p_2) + \eta_{12}y_2 + \eta_{13}y_3$$

where $f = f_1 + \lambda(1-\mu)(_{-1}^{+0}p_1^e)$, and $\omega = \lambda - \lambda\mu + \gamma > 0$.

$$y_1^s = a_1 + \beta(p_1 - w_1)$$

A tâtonnement process of price level adjustment

$$\frac{dp_1}{dt} = \tau(y_1^d - y_1^s)$$

$$p_1^* = \frac{\beta}{\omega+\beta} w_1^* + \frac{1}{\omega+\beta}[f - \lambda i_3 + \gamma e_1 - \delta(e_2 - p_2) + \eta_{12} y_2 + \eta_{13} y_3 - a_1]$$

Labor Market Equilibrium

$$l_1^d = \frac{1}{\alpha}(p_1 - w_1) + \frac{1}{\alpha}[\ln(1-\alpha) + \hat{a}_1]$$

$$l_1^s = \hat{l}_1 + \theta(w_1 - p_1)$$

A tâtonnement process of nominal wage rate adjustment

$$\frac{dw_1}{dt} = \sigma(l_1^d - l_1^s)$$

$$w_1^* - p_1^* = -\frac{\alpha}{1+\alpha\theta}\bar{l}_1 + \frac{\alpha}{1+\alpha\theta}a_1$$

Proposition 1:

The steady state of the economy is reached when both $\frac{dp_1}{dt} = 0$ *and* $\frac{dw_1}{dt} = 0$. *At the steady state, the price level, nominal wage rate, real wage rate, employment level, and output are*

$$p_1^* = \frac{1}{\omega}[f - \lambda i_3 + \gamma e_1 - \delta(e_2 - p_2) + \eta_{12} y_2 + \eta_{13} y_3] - \frac{\beta}{\omega}\cdot\frac{\alpha}{1+\alpha\theta}\bar{l}_1 - \frac{\alpha}{\omega}\cdot\frac{1+\theta}{1+\alpha\theta}a_1$$

$$w_1^* = \frac{1}{\omega}[f - \lambda i_3 + \gamma e_1 - \delta(e_2 - p_2) + \eta_{12} y_2 + \eta_{13} y_3] - \frac{\alpha(\omega+\beta)}{\omega(1+\alpha\theta)}\bar{l}_1 + \frac{\alpha(\omega-\theta-1)}{\omega(1+\alpha\theta)}a_1$$

$$w_1^* - p_1^* = \frac{\alpha}{1+\alpha\theta}a_1 - \frac{\alpha}{1+\alpha\theta}\bar{l}_1$$

$$l_1^* = \frac{\alpha\theta}{1+\alpha\theta}a_1 + \frac{1}{1+\alpha\theta}\bar{l}_1 + \ln(1-\alpha)$$

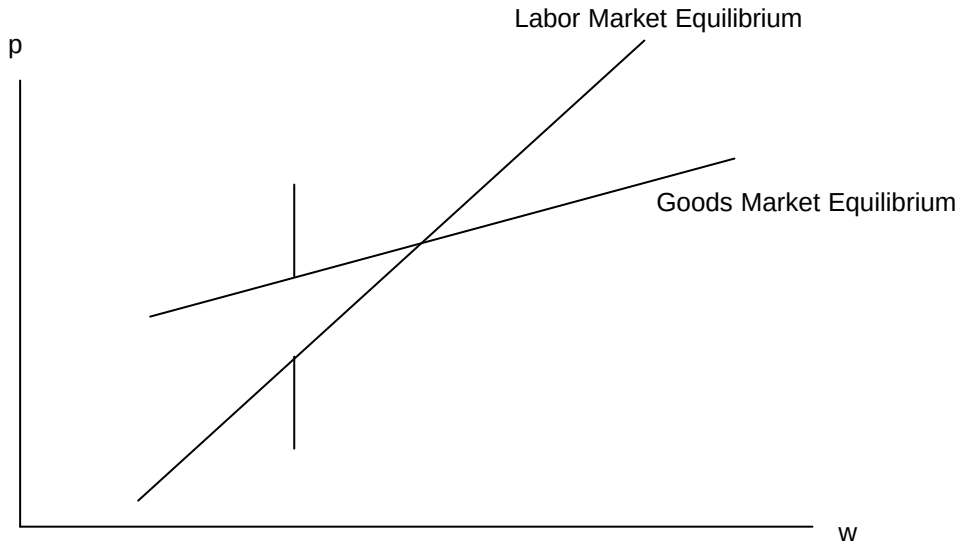
$$y_1^* = \frac{\alpha(1+\theta)}{1+\alpha\theta}a_1 + \frac{\beta\alpha}{1+\alpha\theta}\bar{l}_1$$

while the steady state value of the nominal money balance is

$$m_1^* = p_1^* + y_1^* - hi_3$$

$$m_1^* = \frac{1}{w}[f - li_3 + ge_1 - d(e_2 - p_2) + h_{12}y_2 + h_{13}y_3] + \frac{a(w + wq - b)}{w(1+aq)}\bar{l}_1 + \frac{a(bw - 1 - q)}{w(1+aq)}a_1 - hi_3$$

A Graph for Comparative Static Analysis



Money Supply and the Balance of Payments

Under the current linked exchange rate arrangement in Hong Kong, increase of the supply of U.S. dollar due to a surplus of the official settlement balance will put upward pressure on the Hong Kong dollar in the market. Whenever there is a deviation of the market exchange rate from 7.8 Hong Kong dollars per U.S. dollar, the three note-issuing banks (HSBC, BOC, Standard Chartered) will arbitrage away the profit opportunity. For example, if the market exchange rate becomes 7.7 HK$/US$, by acquiring 1 US$ with 7.7 HK$s and exchange for 1 US$ of the Certificate of Indebtedness at HKMA, one of the three banks can issue 7.8 HK$s of banknotes and therefore obtain a profit of 0.1 HK$. This inevitably results in the sale of Hong Kong dollars (and buy back of U.S. dollars) by the HKMA and thus an increase of the monetary base. If we assume the money multiplier (the ratio of total nominal balance, say M1, to the base money) is equal to y, then

$$\partial m_1 - y - p_1 = \partial f_1$$

Capital Inflow to Hong Kong

One of the important implications of the linked exchange rate system in Hong Kong is that the money supply of Hong Kong is endogenous, changing to guarantee that the nominal exchange rate remains fixed at the pre-determined parity rate. Meanwhile, the quantity equation of money should also hold true for Hong Kong. In addition, change of the monetary base must be equal to the change of the sum of the balance on the current account and the balance on the capital account. From the previous discussion, we have

$$\partial(KA_1) = \partial m_1 - \gamma - p_1 - \partial(CA_1)$$

Proposition 2:

There will be capital inflow to Hong Kong, ceteris paribus, if,

a) y_3 *increases, and* $p_1 < n_{13}\Omega - \gamma$ *;*

b) y_2 *increases, and* $p_1 < n_{12}\Omega - \gamma$ *;*

c) p_2 *increases, and* $p_1 < \alpha_1\Omega - \gamma$ *;*

d) e_1 *increases, and* $p_1 < (\alpha_1 + \alpha_2)\Omega - \gamma$ *;*

e) e_2 *increases, and* $p_1 < -\alpha_1\Omega - \gamma$ *;*

f) a_1 *increases, and* $p_1 < \frac{\alpha}{\omega(1+\alpha\theta)}[\beta\omega + (1+\theta)(n_1\omega - 1)] - \gamma$ *;*

g) $\bar{l}_1$ *increases, and* $p_1 < \frac{\alpha}{\omega(1+\alpha\theta)}[\omega(1+\theta) + \beta(n_1\omega\alpha - 1)] - \gamma$ *;*

h) i_3 *increases, and* $p_1 < -\frac{\lambda}{\omega} - h - \gamma$ *.*

Where $\Omega = \frac{1-\omega(1-b+n_1)}{\omega(1-b+n_1)} = \frac{1+dm-d-\alpha_1-\alpha_2}{\alpha_1+\alpha_2+d-dm}$.

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5. Stability Analysis of the Steady State of Hong Kong

$$\begin{cases} \dfrac{dw_1}{dt} = -\dfrac{\sigma(1+\alpha\theta)}{\alpha}(w_1 - w_1^*) + \dfrac{\sigma(1+\alpha\theta)}{\alpha}(p_1 - p_1^*) \\ \dfrac{dp_1}{dt} = \tau\beta(w_1 - w_1^*) - \tau(\omega+\beta)(p_1 - p_1^*) \end{cases}$$

The characteristic equation is

$$\det(A - xI) = \det\begin{bmatrix} a_{11} - x & a_{12} \\ a_{21} & a_{22} - x \end{bmatrix} = x^2 - tr(A)x + \det(A) = 0$$

$$tr(A) = a_{11} + a_{22} = -\frac{\sigma(1+\alpha\theta)}{\alpha} - \tau(\omega+\beta) < 0$$

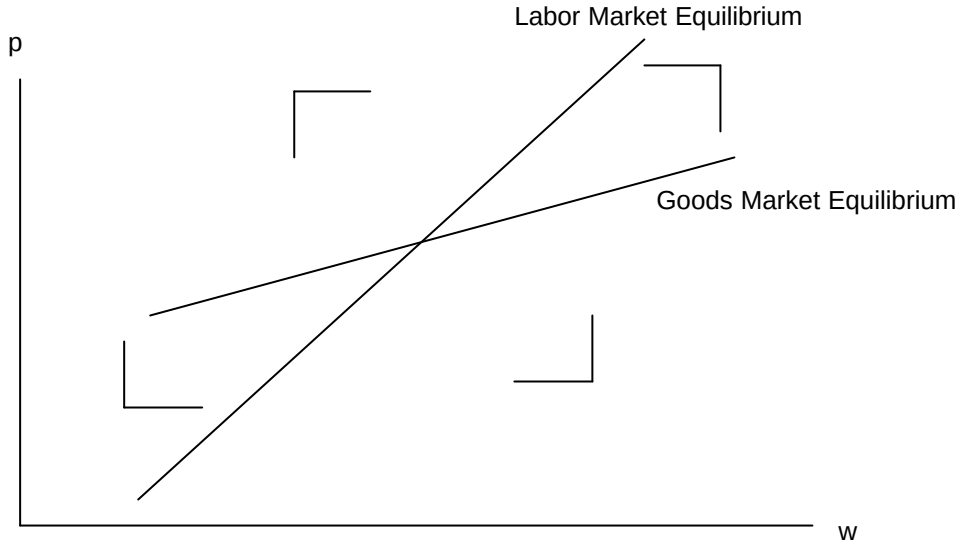
$$\det(A) = a_{11}a_{22} - a_{12}a_{21} = \tau\omega\frac{\sigma(1+\alpha\theta)}{\alpha} > 0$$

$$tr(A)^2 - 4\det(A) = \left(\frac{\sigma(1+\alpha\theta)}{\alpha} - \tau(\omega+\beta)\right)^2 + 4\tau\beta\frac{\sigma(1+\alpha\theta)}{\alpha} > 0$$

The solutions are globally stable as $tr(A) < 0$, $\det(A) > 0$, and $tr(A)^2 - 4\det(A) > 0$.

Proposition 3:

The steady state, or the static macroeconomic equilibrium, of Hong Kong is stable. Suppose there is a shock to the economy and hence an initial deviation from the static macroeconomic equilibrium, the price level and the nominal wage rate will converge back to their steady state values after a period of adjustment.



6. A Dynamic Model with Rational Expectations

Goods market equilibrium

$$a_1 + b(p_{1t} - w_{1t}) = f_1 - l\left[i_3 - [E_t(p_{1,t+1}) - p_{1t}]\right] + g(e_1 - p_{1t}) - d(e_2 - p_2) + h_{12}y_2 + h_{13}y_3$$

$$(\boldsymbol{b} + l + g)p_{1t} = \boldsymbol{b}w_{1t} + lE_t(p_{1,t+1}) + f_1 - li_3 + \boldsymbol{g}e_1 - \boldsymbol{d}(e_2 - p_2) + \boldsymbol{h}_{12}y_2 + \boldsymbol{h}_{13}y_3$$

Combining goods market equilibrium with labor market equilibrium

$$p_{1t} = \frac{l}{l+g}E_t(p_{1,t+1}) + \frac{1}{l+g}\left[f_1 - l\,i_3 + ge_1 - d(e_2 - p_2) + h_{12}y_2 + h_{13}y_3 - \frac{ba}{1+aq}\bar{l}_1 + \frac{ba}{1+aq}a_1\right]$$

We use the following AR(1) process

$$y_{3t} = r + sy_{3,t-1} + v_t$$

to represent the aggregate output of the U.S., then

$$\frac{1}{\boldsymbol{h}_{13}}[(l+g)p_{1t} - lE_t(p_{1,t+1}) - (l+g)u_t] = r + sy_{3,t-1} + v_t$$

Let the rational expectation solution for p_{1t} be in the form of

$$p_{1t} = f_0 + f_1 y_{3,t-1} + f_2 u_t + f_3 v_t$$

Then

$$E_t(p_{1,t+1}) = f_0 + f_1 y_{3t} = f_0 + f_1(r + s y_{3,t-1} + v_t)$$

Comparing coefficients, we get

$$f_0 = \frac{(l+g)r\eta_{13}}{(l+g-ls)g}, \quad f_1 = \frac{s\eta_{13}}{l+g-ls}, \qquad f_2 = 1, \qquad f_3 = \frac{\eta_{13}}{g}$$

Therefore, the rational expectation price level will be

$$p_{1t} = \frac{(l+g)r\eta_{13}}{(l+g-ls)g} + \frac{s\eta_{13}}{l+g-ls} y_{3,t-1} + \frac{\eta_{13}}{g} v_t + u_t$$

$$= \frac{lrs\eta_{13}}{(l+g-ls)g} + \frac{(rs-l)s\eta_{13}}{(l+g-ls)g} y_{3,t-1} + \frac{\eta_{13}}{g} y_t + u_t$$

<u>Proposition 4</u>:

(A) If the aggregate output of the U.S. follows an AR(1) process

$$y_{3t} = r + y_{3,t-1} + v_t$$

Then the price level in Hong Kong, when expectation are formed rationally, follows

$$p_{1t} = \frac{lrs\eta_{13}}{(l+g-ls)g} + \frac{(rs-l)s\eta_{13}}{(l+g-ls)g} y_{3,t-1} + \frac{\eta_{13}}{g} y_t + u_t$$

(B) If the growth rate of the aggregate output of the U.S. follows an AR(1) process

$$y_{3t} - y_{3,t-1} = r + s(y_{3,t-1} - y_{3,t-2}) + v_t$$

Then the price level in Hong Kong, when expectation are formed rationally, follows

$$p_{1t} = \frac{(l+g)lr\eta_{13}}{(l+g-ls)g^2} - \frac{ls\eta_{13}}{(l+g-ls)g} y_{3,t-1} + \frac{(l+g)\eta_{13}}{(l+g-ls)g} y_{3t} + u_t$$

where, in both cases

$$u_t = \frac{1}{\lambda+\gamma}\left[f_1 - \lambda i_3 + \gamma e_1 - \delta(e_2 - p_2) + \eta_{12} y_2 - \frac{\beta\alpha}{1+\alpha\theta}\bar{l}_1 + \frac{\beta\alpha}{1+\alpha\theta} a_1 \right]$$

(C) If the probability of a devaluation of the RMB by the magnitude Δ *is* P*, then the price level in Hong Kong, when expectation are formed rationally, follows*

$$p_{1t} = -\frac{\delta\lambda P\Delta}{\gamma(\lambda+\gamma)} - \frac{\delta}{\gamma} e_2 + z_t - \frac{\delta}{\lambda+\gamma} e_t$$

where

$$z_t = \frac{1}{\lambda+\gamma}\left[f_1 - \lambda i_3 + \gamma e_1 + \delta p_2 + \eta_{12} y_2 + \eta_{13} y_3 - \frac{\beta\alpha}{1+\alpha\theta}\bar{l}_1 + \frac{\beta\alpha}{1+\alpha\theta} a_1 \right]$$

7. Concluding Remarks – Further Research

- A "benchmark" model.
- Capital inflow results in higher capital stock, raises productivity of labor.
- The property market plays an important role in the economy.
- Re-exports (outward processing).
- Tradable and non-tradable goods.