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Unemployment and optimal exchange rate in an open economy☆

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ABSTRACT

China has been criticized for adopting a low yuan policy to take unfair advantage of its trading partners. This paper considers the optimal exchange rate policy of a Keynesian open economy with unemployed resources. In the case of Cobb-Douglas utility and production functions, indirect utility is monotone-increasing and concave in the exchange rate. Yuan devaluation is shown to reduce unemployment. Moreover, the optimal exchange rate is one which guarantees full employment. The United States may want to choose a different rate which ensures full employment. The two countries could negotiate an intermediate exchange rate for which some unemployment exists in both countries.

1. Introduction

Due to its mounting currency reserves since the 1990s, China's exchange rate policy has been under intense scrutiny. According to the State Administration of Foreign Exchange of People's Bank of China (PBC), China's foreign exchange reserve was $22 billion in 1993. China's foreign exchange reserve has since increased steadily, to $3.1 trillion in October 2016. Such a dramatic rise in China's cumulative trade surplus has provoked much debate concerning China's currency valuation.

Most major currencies except the renminbi are freely floating vis-à-vis other currencies, except the renminbi. It is argued that China may be deliberately depressing the yuan in the hope of stimulating domestic production. In the celebrated Mundell (1963)-Fleming (1962) model, currency devaluation influences a country's balance of payments, thereby affecting production and unemployment. In a study of ten countries, Gylfason and Schmid (1983) show that devaluation has positive output effects.

In an open economy, the government may be more interested in the output effects of currency devaluation. Helpman (1976) considered a single-period framework with a nontraded good and showed that devaluation increases employment, while Cuddington (1981) investigated the contemporaneous effect of devaluation. More recently, Batra and Beladi (2013) suggest that both China and Japan kept their currency values low relative to those of other nations such as the United States and Europe in order to maintain unemployment below a target rate.[1] Jin and Choi (2013) noted that while some profits might be generated in the short run by slightly deviating from the equilibrium exchange rates, excessive hoarding of reserve assets in the long run can only result in losses to PBC's balance of payment account. Jin et al. (2016) showed that in a two-period model nonintervention is the optimal exchange rate policy. However, the prevailing view is that China has intentionally depressed the value of the yuan to gain unfair advantages in the global market. (Cheung et al., 2009; Cheung, 2012).

In a developing country like China, the goal of keeping the unemployment rate low might take precedence over other economic issues. Reducing unemployment may be the principal motive for adopting the low yuan policy. For instance, Overholt (2010) argues that yuan appreciation would increase China's unemployment. Developing countries often encourage trade surpluses to prepare for future contingencies. Goldstein and Lardy (2006) suggest that China's undervaluation of the renminbi contributed to growing trade surpluses. Also, China wants the renminbi to be an international reserve currency, but the Chinese government is reluctant to make the yuan fully convertible.

This paper investigates the optimal exchange rate for a Keynesian

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[1] The Chinese currency devaluation may not be the only source of U.S. trade deficits. For instance, Beladi and Oladi (2014) suggest that outsourcing may widen U.S. trade deficits. Also, Yue and Zhang (2013) emphasize that the U.S. trade deficit would not be reduced very much by a change in the Chinese exchange rate.

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open economy.[2] Open-economy macroeconomic models are predominantly based on an economy producing a single homogeneous good.[3] Frenkel and Ros (2006) developed an unemployment model in which countries produce a nontraded good and a traded good to analyze the effect of exchanges on unemployment. Vasylenko and Vasylenko (2005) first considered the conditions for trade balance stabilization with two traded sectors. The present paper's main contribution is to analyze the effect of currency devaluation on unemployment and welfare in an open economy which produces two tradable goods. Currency devaluation changes the relative price of the exportable. Trade is balanced and hence no currency misalignment occurs.[4] Using the Cobb-Douglas utility and production functions, we show that under certain conditions, the exchange rate which guarantees full employment is the optimal policy.

Section 2 introduces the basic two-sector, two-country model with unemployment. Section 3 investigates the effect of yuan devaluation on exchange rate pass-through into the yuan price of China's exportable good. Section 4 considers the effect of yuan devaluation on income and welfare, while Section 5 explores the effect on unemployment. Section 6 offers a numerical example to illustrate the main propositions. Section 7 provides concluding remarks.

2. The two-sector Keynesian model with unemployment

In this section we consider a Keynesian open economy model with two goods to consider China's optimal exchange rate policy. Let China's importable good Z be the numéraire, i.e., its dollar price $P^* = 1$, and let δ denote the yuan price of the dollar. Exchange rate pass-through into the import price is perfect, [5] and the yuan price of the importable is P. An increase in δ represents an increase in the yuan price of the dollar, and hence a yuan depreciation. We assume that the dollar price of the importable good P^* is fixed in the importing country, and its yuan price is $P = P^*\delta$, where δ is the yuan price of the dollar.

Each country is assumed to fix the price of its exportable in terms of its own currency. That is, the yuan price of good C, which China exports, is b, while its dollar price is denoted by b^*. Likewise, the dollar price P^* of good Z is fixed, equal to unity. The yuan price of good Z is denoted by P. The relative price of good Z in China can be written as: $\frac{P}{b} = \frac{P^*\delta}{b} = \frac{P^*}{b/\delta} = \frac{P^*}{b^*}$. That is, the relative price of good Z is the same in both countries, regardless of the exchange rate. However, a change in the exchange rate may affect the relative price of good Z.

2.1. Assumptions

We now consider a two-sector Keynesian model of two countries producing two goods, C and Z. Unemployment exists in both the capital and labor markets. The wage rate w and capital rental r are assumed to be fixed in the short run. As a basis for analyzing the effects of yuan devaluation, we employ the following assumptions:

(i) Two factors, capital K and labor L, are used to produce two goods, C and Z. China is assumed to export C and import Z.[6]
(ii) The dollar price of good Z is normalized, i.e., $P^* = 1$.
(iii) The Chinese government pegs the yuan to the dollar, and the yuan price of the importable is $P = P^*\delta = \delta$.
(iv) Cobb-Douglas production functions are used in both industries.
(v) Unemployment exists in both capital and labor markets.
(vi) Consumer preferences are represented by a Cobb-Douglas utility function in both countries.

2.2. China

China produces two goods, using two factors: capital (K) and labor (L) inputs. Domestic outputs of the traded goods are given by $C = F(L_C, K_C) = A_C L_C^{\alpha_1} K_C^{\beta_1}$,and $Z = G(L_Z, K_Z) = A_Z L_Z^{\alpha_2} K_Z^{\beta_2}$, where L_j and K_j denote the amounts of labor and capital inputs employed in sector $j = C, Z$. Both production functions are assumed to exhibit decreasing returns to scale (DRS), i.e., $\alpha_1 + \beta_1 < 1$, and $\alpha_2 + \beta_2 < 1$. DRS implies that the production functions $F(.)$ and $G(.)$are monotone-increasing and concave.[7]

2.3. China's supplies of tradable goods

Since labor and capital inputs are not fully employed and are immobile internationally, $w \neq w^*$ and $r \neq r^*$. Let Π_C and Π_Z denote the profits of industries, C and Z, respectively. Total profit of the Chinese economy in yuan is

$$\Pi = \Pi_C + \Pi_Z = bA_C L_C^{\alpha_1} K_C^{\beta_1} + PA_Z L_Z^{\alpha_2} K_Z^{\beta_2} - wL_C - rK_C - wL_Z - rK_Z, \tag{1}$$

where b and P are the yuan prices of goods C and Z, L_i, and $K_i$are input demands of labor and capital in sector $i = C, Z$. Let $\overline{L}$ and $\overline{K}$ denote China's labor and capital endowments. The central planner's problem is to choose L_C, L_Z, K_C, and K_Z subject to $L_C + L_Z < \overline{L}$, $K_C + K_Z < \overline{K}$. Due to unemployment, a production mix of C and Z does not occur along a production possibility frontier (PPF). The first order conditions are

$$\begin{aligned} &b\alpha_1 A_C L_C^{\alpha_1 - 1} K_C^{\beta_1} = w, \quad b\beta_1 A_C L_C^{\alpha_1} K_C^{\beta_1 - 1} = r, \\ &P\alpha_2 A_Z L_Z^{\alpha_2 - 1} K_Z^{\beta_2} = w, \quad P\beta_2 A_Z L_Z^{\alpha_2} K_Z^{\beta_2 - 1} = r. \end{aligned} \tag{2}$$

The input demands for labor and capital in the production of the two goods are as follows:

$$\begin{aligned} L_C &= \left(\frac{b{\alpha_1}^{1-\beta_1}{\beta_1}^{\beta_1} A_C}{w^{1-\beta_1} r^{\beta_1}}\right)^{1/(1-\alpha_1-\beta_1)}, \; K_C = \left(\frac{b{\alpha_1}^{\alpha_1}{\beta_1}^{1-\alpha_1} A_C}{w^{\alpha_1} r^{1-\alpha_1}}\right)^{1/(1-\alpha_1-\beta_1)}, \\ L_Z &= \left(\frac{P{\alpha_2}^{1-\beta_2}{\beta_2}^{\beta_2} A_Z}{w^{1-\beta_2} r^{\beta_2}}\right)^{1/(1-\alpha_2-\beta_2)}, \; K_Z = \left(\frac{P{\alpha_2}^{\alpha_2}{\beta_2}^{1-\alpha_2} A_Z}{w^{\alpha_2} r^{1-\alpha_2}}\right)^{1/(1-\alpha_2-\beta_2)}. \end{aligned} \tag{3}$$

The optimal supplies of goods, C and Z, are functions of factor prices, w and r:

$$\begin{aligned} C(b, P) &= A_C L_C^{\alpha_1} K_C^{\beta_1} = \left(\frac{b^{\alpha_1+\beta_1}{\alpha_1}^{\alpha_1}{\beta_1}^{\beta_1} A_C}{w^{\alpha_1} r^{\beta_1}}\right)^{1/(1-\alpha_1-\beta_1)}, \\ Z(b, P) &= A_Z L_Z^{\alpha_2} K_Z^{\beta_2} = \left(\frac{P^{\alpha_2+\beta_2}{\alpha_2}^{\alpha_2}{\beta_2}^{\beta_2} A_Z}{w^{\alpha_2} r^{\beta_2}}\right)^{1/(1-\alpha_2-\beta_2)}. \end{aligned} \tag{4}$$

2.4. China's demands for tradable goods

The preferences of Chinese consumers are represented by a Cobb-Douglas utility function,

$$U(c, z) = c^{\gamma} z^{1-\gamma}, \tag{5}$$

where c and z are China's consumption of the exportable and

[2] Of course, the first-best policy is to remove wage and rent rigidity in the factor markets. Given this rigidity, Chinese government may be using yuan devaluation as a second-best policy.

[3] In the same vein, Bruno (1976) considered a two-sector model, but defined the exchange rate as the ratio of the price of the tradable good to that of the nontradable good.

[4] See Holtemöller and Mallick (2013) for a model of currency misalignment. They show that the higher the flexibility of the currency regime, the lower is the misalignment.

[5] Devereux (2000) analyzed the impact of devaluation on the trade balance when exchange rate pass-through is imperfect.

[6] For instance, if China is abundant in labor and production of C is labor-intensive, China is expected to export good C and import good Z.

[7] For instance, $F_{LL} = \alpha_1(\alpha_1 - 1)A_C L_C^{\alpha_1 - 2} K_C^{\beta_1} < 0$, $F_{KK} = \beta_1(\beta_1 - 1)A_C L_C^{\alpha_1} K_C^{\beta_1 - 2} < 0$, $F_{LK} = \alpha_1\beta_1 A_C L_C^{\alpha_1 - 1} K_C^{\beta_1 - 1} > 0$, and $F_{LL}F_{KK} - (F_{LK})^2 = \alpha_1\beta_1(1 - \alpha_1 - \beta_1)(A_C L_C^{\alpha_1 - 1} K_C^{\beta_1 - 1})^2 > 0$.