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TRANSACTION COSTS, MULTIPLE EQUILIBRIA, AND CURRENCY DEVALUATION

Hong-Yu Lin

Department of Business and Management, Ming Chi University of Technology, Taiwan

ABSTRACT

This paper attempts to examine the effect of a currency devaluation on domestic output by incorporating the Coase (1937) assertion into a standard open economy model. Our results show that there will be multiple equilibria in the labor market, i.e. low or high employment equilibrium, because of transaction cost externalities. If the labor market is in the high-employment equilibrium, a currency devaluation will depress domestic output. Conversely, a currency devaluation will enhance domestic output when the labor market is in the low-employment equilibrium. This conclusion provides an explanation for the mixed effect of the currency devaluation on domestic output in the empirical studies.

Keywords: Transaction costs, Externalities, Multiple equilibria, Low-employment equilibrium, High-employment equilibrium, Currency devaluation.

JEL Classification: F41.

Contribution/ Originality

This study document is the first one that incorporates the transaction costs into an open-economy macroeconomic model and tries to explain through mathematical inference why the findings of the empirical studies produced mixed results of the devaluation effects on domestic output.

1. INTRODUCTION

Currency devaluation had been proved to have influences on stimulating the economic activities in theoretical treatments (Meade, 1951; Tsiang, 1961; Takayama, 1969). However, empirical studies showed that currency devaluation has contractionary effect on domestic output (Cooper, 1971; Gylfason and Risager, 1984; Branson, 1986; Chou and Chao, 2001). Many efforts had been devoted in finding a new theory to support this phenomenon. Furthermore, these theoretical literatures emphasized on the role of the labor market and discussed the reason of

obtaining the contractionary devaluation (Hanson, 1983; Edwards, 1986; Van Wijnbergen, 1986; Lai, 1990; Lai *et al.*, 1996). They concluded that since the labor cost is the dominant component for the cost in most production activities, the production cost is likely to increase as the wage of the labors rises in response to the domestic currency devaluation. This can be thought of as an upward shift in the aggregate supply curve, which would result in a lower level of domestic output.[1]

However, these literatures only emphasize on the rising wage of the labors in response to the domestic currency devaluation but ignore the existence of the transaction cost in the labor market[2]. In addition, they didn't have the mixed effect of currency devaluation on domestic output that was found in empirical studies.[3] Hence, constructing a theoretical framework to explain this mixed effect will be our focus in this paper.

Coase (1937) argued that the free complete information in the labor market has to be replaced by the costliness of obtaining information from the labor market and the employer does not know if his settlement on the wage rate is the market rate after negotiation nor does he know if the employee has the intention or ability to provide a high quality contract. In reality, it is costly for the employer to identify the right labors and the relevant wage rate each time. This observation of Coase (1937) matched the reality and attracted enormous attentions that subsequently developed the transaction cost economics.[4]

Diamond (1982) introduced Coase (1937) concept of transaction costs into macroeconomic model to discuss the unemployment problem. In Diamond (1982) model, he denied the existence of Walrasian auctioneer and claimed that the trader can only find his trading partners through searching procedure (the probability for finding the trading partners is a stochastic process). Because of the stochastic process, the search externality is found in his economic model, which causes the multiple equilibria in the labor market and the unsolvable low-employment equilibrium in the economic system.

Howitt (1985) classified the distinctive characteristics between the labor and firm. He also internalized the transaction costs. Consequently, he discovered that the economic system could have externalities because of transaction costs. This existence of externalities causes multiple equilibria and forces the economic system to stay in the low-employment equilibrium in the long run. Diamond (1982) and Howitt (1985) models further interpreted the traditional Keynesian's persistence of large-scale unemployment with the concept of the transaction costs in the macroeconomic model. Their approaches proved the traditional Keynesian's persistence without the ad hoc assumption of price stickiness. However, Coase (1937) assertion had never been applied

[1] Lizondo and Montiel (1989) provide a detailed overview.

[2] That is, they think that employers and employees can observe the market's equilibrium price and traders can meet with trading partners without incurring any cost in a labor market.

[3] See, for example, Gylfason and Schmid (1983) and Connolly (1983) found devaluations having expansionary effect on domestic output.

[4] See Kreps (1990).

in discussing the mixed effect of a currency devaluation on domestic output. Hence this paper attempts to examine the effect of a currency devaluation on domestic output by introducing the Coase (1937) assertion into a standard open economy model.

This paper is organized as follows: The model and aggregate supply function with the existence of the transaction cost are explained in Section 1. In Section 2 the effect of a currency devaluation on domestic output is investigated and Section 3 concludes this study.

2. THE MODEL

We assume in a small open economy with fixed exchange rates, domestic production is limited to a single final composite commodity. The produced commodities will satisfy the domestic and export demand. Domestic and imported products are imperfect substitutes. The model is demonstrated as follows:

$$Y = C(Y) + I(r) + G + T(q,Y), \quad (1)$$

$$L(Y,r) = M/P, \quad (2)$$

$$T(q,Y) + K(r) = F, \quad (3)$$

$$Y = S^L(E,P^*,P), \quad (4)$$

$$Y = S^H(E,P^*,P), \quad (4')$$

where Y: domestic output; C: consumption expenditure; I: investment expenditure; r: domestic interest rate; G: government expenditure; T: balance of trade; $q = EP^*/P$: terms of trade; E: exchange rate (defined as domestic currency price of foreign currency); P^*: foreign currency price of imports; P: domestic currency price of domestic output; L: real money demand; M: nominal money supply; K: net capital inflow; F: balance of payments; r^*: foreign interest rate; S^L and S^H: aggregate supply functions of the labor market in the low-employment equilibrium and the high-employment equilibrium. According to the common macroeconomics, the variables should be limited as follows: $0 < C_Y < 1$, $I_r < 0$, $T_q > 0$[5], $T_Y < 0$, $L_Y > 0$, $L_r < 0$, $K_i > 0$.

Equation (1) represents the equilibrium condition of the commodity market while equation (2) represents the equilibrium condition of the money market. We assume that any balance-of-payments surplus or deficit will not feed into the nominal money supply because of full

[5] $T_q > 0$ denotes that Marshall-Lerner condition is valid.

sterilization. Equation (3) states that the overall balance of payments is the sum of the current and capital accounts. Equations (4) and (4') are the deduced aggregate supply function with the consideration of transaction costs in the labor market. Once the transaction costs are considered, the labor market becomes multiple equilibria. Consequently, we need equations (4) and (4') to represent the aggregate supply functions under different equilibrium situations. The aggregate supply functions can be derived as follows.[6]

There are two types of traders in the labor market, i.e. identical firms and identical labors. Buying and selling labor services will involve transaction costs. We interpret transaction costs as the costs of communicating buying offers and selling bids, from which externalities arise because one agent's transaction costs are lower (higher) if the market becomes thicker (thinner). The unit cost of each transaction depends inversely upon the amount of activities in the market.

Assume that all transaction costs in the labor market are incurred in the form of labor service consumption. Let $\tau(\bar{n})$ denotes selling cost per unit faced by a labor where $\bar{n}$ is aggregate labor service per capita. Following Howitt (1985), we assume that $\tau'(\bar{n}) < 0$, which is similar to that in Diamond (1982), namely that the trade technology exhibits increasing returns to scale. In order to simplify, we assume that the transaction costs incurred by each firm for buying labor services is proportional to the quantity bought with a constant β_n, where $\beta_n \in (0,1)$. Therefore, if a firm hires *n* labor, it will have $n(1-\beta_n)$ workforces for production. Also, different *n* can be chosen to maximize a firm's profit using the following function.[7]

$$\max_n Pf(n(1-\beta_n)) - w^d n,$$

where w^d is the nominal wage, or demand wage. The production function $f(\cdot)$ satisfies,

$$f'(\cdot) > 0,\ f''(\cdot) < 0, \text{ for all } n>0,$$

where

$$\lim_{n\to 0}(f(\cdot), f'(\cdot)) = (0,\infty),\ \lim_{n\to\infty}(f(\cdot), f'(\cdot)) = (\infty,0). \qquad (5)$$

The firm's optimal decision can be expressed as

$$Pf'(n(1-\beta_n))(1-\beta_n) = w^d. \qquad (6)$$

[6] The following inference is mainly derived from Howitt (1985). model.

[7] For a firm, the price of the product is *p* for export and domestic sale. Therefore, a firm will only concentrate on price *p* not *q*. See Casas (1975) or Lai (1990)

In addition, we assume that each labor's utility function has the following form,

$$\mu(\frac{w^s}{g})n - c(l),$$

where μ denotes the constant marginal utility of real wealth and w^s represents the nominal wage (supply wage).[8] Since the labors consume both domestic and imported products, we use the general price index, $g = \theta EP^* + (1-\theta)P$, to define the real wage. Note that θ represents the fraction of the expenditure spent on imports and *l* is supply of labor services. Assume that there is an upper limit $\bar{l} > 0$ to each labor's potential labor services supply and that the cost function *c* is defined over the interval [0, $\bar{l}$), with the following constraints.

$$c'(l) > 0,\ c''(l) > 0, \text{ for all } l \in (0, \bar{l}),$$

where

$$c'(0) = 0,\ \lim_{l \to \bar{l}} c'(l) = \infty. \qquad (7)$$

The labor must supply $n(1+\tau(\bar{n}))$ if he sells *n*. Thus the labor's decision is to choose *n* so that his utilization can be maximized. This maximized function is demonstrated as follows:

$$\max_n \mu(\frac{w^s}{g})n - c(n(1+\tau(\bar{n}))).$$

The first order condition related to this maximized function is

$$w^s = \frac{g}{\mu} c'(n(1+\tau(\bar{n})))(1+\tau(\bar{n})). \qquad (8)$$

Since the equilibrium condition of labor market is $w^d = w^s = w$ (*w* is equilibrium nominal wage), we substitute equations (6) and (8) into equilibrium condition and have[9]

$$Pf'(n(1-\beta_n))(1-\beta_n) = \frac{g}{\mu} c'(n(1+\tau(n)))(1+\tau(n)). \qquad (9)$$

[8] As long as the household's utility function is homogeneous of degree one, μ will be a constant. See Howitt (1985) or Blanchard and Kiyotaki (1987).

[9] We now omit bar from the aggregate labor services per capita.

We illustrate equation (9) using Figure 1.[10, 11]

Figure-1. The equilibrium situations of the labor market

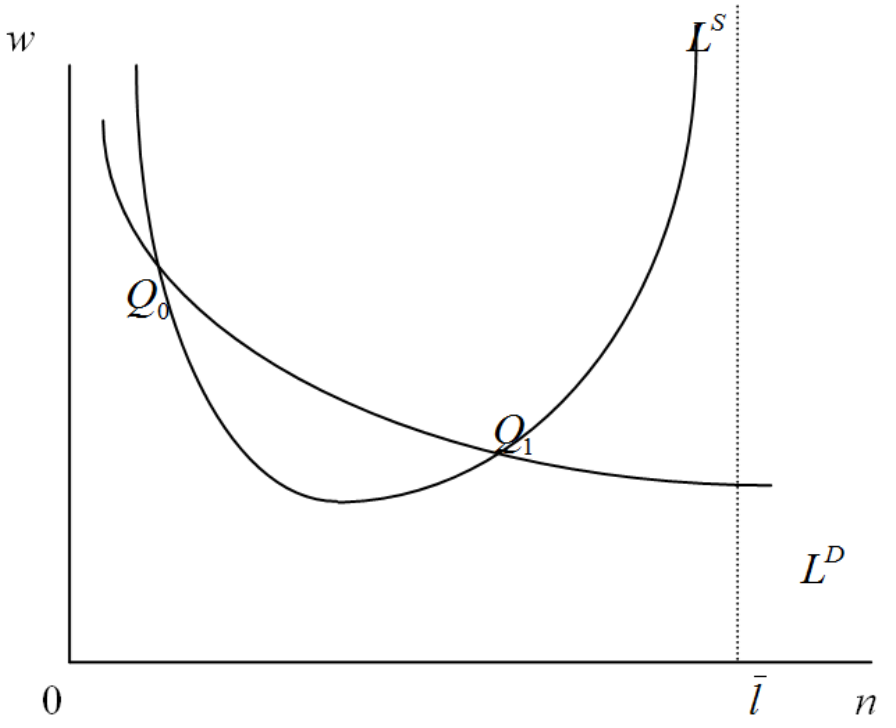


Figure 1 indicates that the equilibrium in labor market won't be unique due to the externalities caused by transaction costs. Moreover, increasing the labor services trades will result in the decrease of the unit costs for selling labor services and the supply wage. Then the slope for the labor supply curve, L^s (the right hand side of equation (9)), becomes negative. In addition, the increasing trades of the labor services will raise the costs derived from the cost function (equation (7)) which indicates the reverse of the supply wage and the positive slope of the labor supply curve. Hence, the labor supply curve becomes U shape and intersects with the negative sloped labor demand curve (the L^D curve, the left of equation (9)) at two points, which means the market equilibrium can stay in the low-employment equilibrium (Q_0) or the high-employment equilibrium (Q_1).

[10] Here we must claim: while investigate the slope of L^s curve, we additionally include one assumption that $1+\tau(n)+n\tau'(n)>0$. See Howitt (1985) for details.

[11] Following the stability condition of Silberberg (1990), we require that labor supply curve to be steeper than labor demand curve if labor supply curve is negatively sloped.

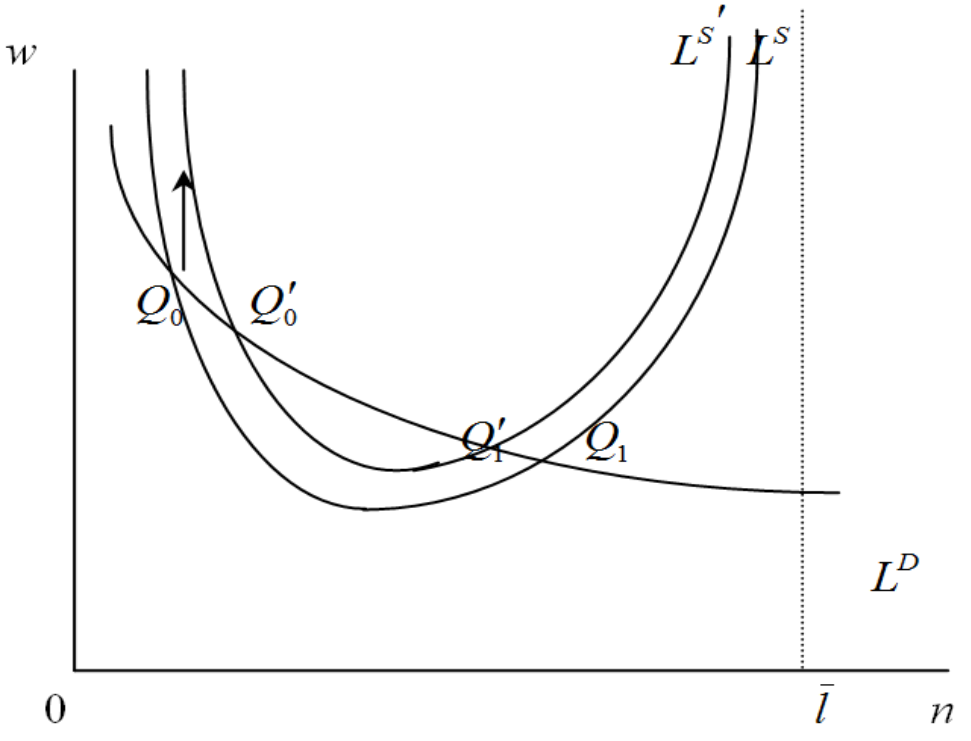
Differentiate equation (9), and use the initial of $P = P^* = E = 1$, we can obtain

$$\{(1-\beta_n) f''(n(1-\beta_n))(1-\beta_n) - \frac{1}{\mu}[(1+\tau(n))c''(n(1+\tau(n)))(1+\tau(n)+n\tau'(n)) +$$

$$c'(n(1+\tau(n)))\tau'(n)]\}dn = \frac{\alpha}{\mu}c'(n(1+\tau(n)))(1+\tau(n))(dE + dP^* - dP). \quad (10)$$

Equation (10) demonstrates that the domestic currency devaluation or an increase in foreign prices will depress (enhance) the amount of labor demand and vice versa when the labor supply curve has a positive (negative) slope. Figure 2 illustrates the phenomenon described in equation (10).

Figure-2. The labor market equilibrium under a currency devaluation



In response to the devaluation of the domestic currency, L^S curve will shift to $L^{S'}$ curve. The new equilibrium will occur at Q_0' and Q_1', which indicates that the labor employment will increase if the labor market originally stays in the low-employment equilibrium. Conversely, the labor employment will decrease if the labor market originally is in the high-employment equilibrium. The same analysis can be applied to P^* and *P* and will not be discussed further in this paper.

We can explain these results with economic intuitions. When the labor market is in the low-employment equilibrium, the labors will ask for a wage raise if the domestic currency devaluates. However, because of the transaction cost externalities, the firms can increase the amount of labor demand to reduce the selling cost per unit faced by labors. The labors are willing to accept a cut on their wages in return of an increase of labor employment.

Conversely, the amount of the employed labors will decrease when the labor market is in the high-employment equilibrium, which is due to the domination of cost of supplying labor services ($c'(l)$) over the transaction cost externalities. The firms cannot increase the amount of the labor employment to satisfy the wage raise request from the labors. Therefore, the firms will lower the amount of the employed labors to reduce the production cost.

If we further differentiate the production function and substitute this differentiation into equation (10), we will obtain equation (11).

$$\{(1-\beta_n) f''(n(1-\beta_n))(1-\beta_n) - \frac{1}{\mu}[(1+\tau(n))c''(n(1+\tau(n)))(1+\tau(n)+n\tau'(n)) + c'(n(1+\tau(n)))\tau'(n)]\}dY$$

$$= \frac{\alpha f'(n(1-\beta_n))(1-\beta_n)}{\mu} c'(n(1+\tau(n)))(1+\tau(n))(dE + dP^* - dP). \quad (11)$$

When the labor market stays in the low-employment equilibrium, we can identify the following equalities from equation (11).

$$Y = S^L(E, P^*, P) \text{ and } -S_P^L = S_{P^*}^L = S_E^L > 0.$$

These equalities are exactly the same as equation (4), which indicates that increasing domestic price will result in the decrease of domestic output while the increase of domestic output results from the domestic currency devaluation or foreign price increase. Conversely, if the labor market stays in the high-employment equilibrium, then

$$Y = S^H(E, P^*, P) \text{ and } S_P^H = -S_{P^*}^H = -S_E^H > 0.$$

It shows that domestic output will increase because of domestic price increase but will decrease due to the domestic currency devaluation or an increase in foreign price (equation (4')).

3. THE EFFECT OF DEVALUATION

In this section we will concentrate on the effect of currency devaluation on domestic output. Since the existence of the transaction costs will cause the transaction cost externalities and multiple equilibria in the labor market, the labor market will be in either the low-employment equilibrium or the high-employment equilibrium. We will discuss the effect of currency devaluation on domestic output under these two situations accordingly.

When the labor market is in the low-employment equilibrium and the exchange rates are fixed, equations (1)-(4) can be solved to determine *Y*, *r*, *P*, and *F*. Total differentiating equations (1)-(4) and using Cramer's rule, we can derive equation (12) as follows:

$$\frac{\partial Y}{\partial E}=\frac{S_E^L I_r M}{[(1-C_Y-T_Y)L_r+I_r L_Y]S_P^L+I_r M+L_r T_q}>0 \qquad (12)$$

Equation (12) shows that currency devaluation will enhance domestic output when the labor market is in the low-employment equilibrium.

When the labor market is in the high-employment equilibrium and the exchange rates are fixed, equations (1)-(3) and (4') can determine *Y*, *r*, *P*, and *F*. Total differentiating these four equations and using Cramer's rule, we obtain equation (12').

$$\frac{\partial Y}{\partial E}=\frac{S_E^H I_r M}{[(1-C_Y-T_Y)L_r+I_r L_Y]S_P^H+I_r M+L_r T_q}<0 \qquad (12')$$

Equation (12') states that a currency devaluation will depress domestic output when the labor market is in the high-employment equilibrium.

Based on these results, we find that the effect of currency devaluation on the economic activity is mixed. That is, the devaluation has an expansionary effect when the labor market is in the low-employment equilibrium but will cause economic contraction when the labor market is in the high-employment equilibrium. These results confirm the empirical finding of the mixed devaluation effect on domestic output and contradict Johnson's (1976) conclusions.[12]

A diagrammatic presentation will be helpful in understanding these results, which will only be possible after Equations (14) and (15) are developed.

Equation (14) represents the *P* and *Y* combinations that satisfy the equilibriums of the goods and the money market. To obtain equation (14), we total differentiate equations (1) and (2). These two differentiated equations are combined with the replacement of *r*. Note that the replacement of *r* is achieved using the same differentiated equations.

$$[(1-C_Y-T_Y)L_r+I_r L_Y]dY+[I_r M+T_q L_r]dP=$$

$$L_r dG+I_r dM+T_q L_r(dE+dP^*). \qquad (14)$$

The locus formed by *P* and *Y* combinations is the aggregate demand curve, *AD* curve. From equation (14), we know that the slope of the *AD* curve is

$$\left.\frac{\partial P}{\partial Y}\right|_{AD}=\frac{-[(1-C_Y-T_Y)L_r+I_r L_Y]}{I_r M+T_q L_r}<0.$$

[12] Johnson (1976) noted that the devaluation could be expected to raise output if there are unemployed resources and to raise domestic prices if there aren't.

From equations (4) and (4'), the loci for the equilibrium of the labor market formed by *P* and *Y* combinations can be achieved and are represented as AS^L and AS^H curves, respectively. The slopes of the AS^L and the AS^H are

$$\left.\frac{\partial P}{\partial Y}\right|_{AS^L} = \frac{1}{S_P^L} < 0, \quad \left.\frac{\partial P}{\partial Y}\right|_{AS^H} = \frac{1}{S_P^H} > 0. \qquad (15)$$

We draw the *AD* and AS^L curves on Figure 3 and assume that the economic system is initially at the point Q_0, which corresponds to the domestic price P_0 and output Y_0, respectively.

Figure-3. The effect of a currency devaluation on domestic output when the labor market is in the low-employment equilibrium

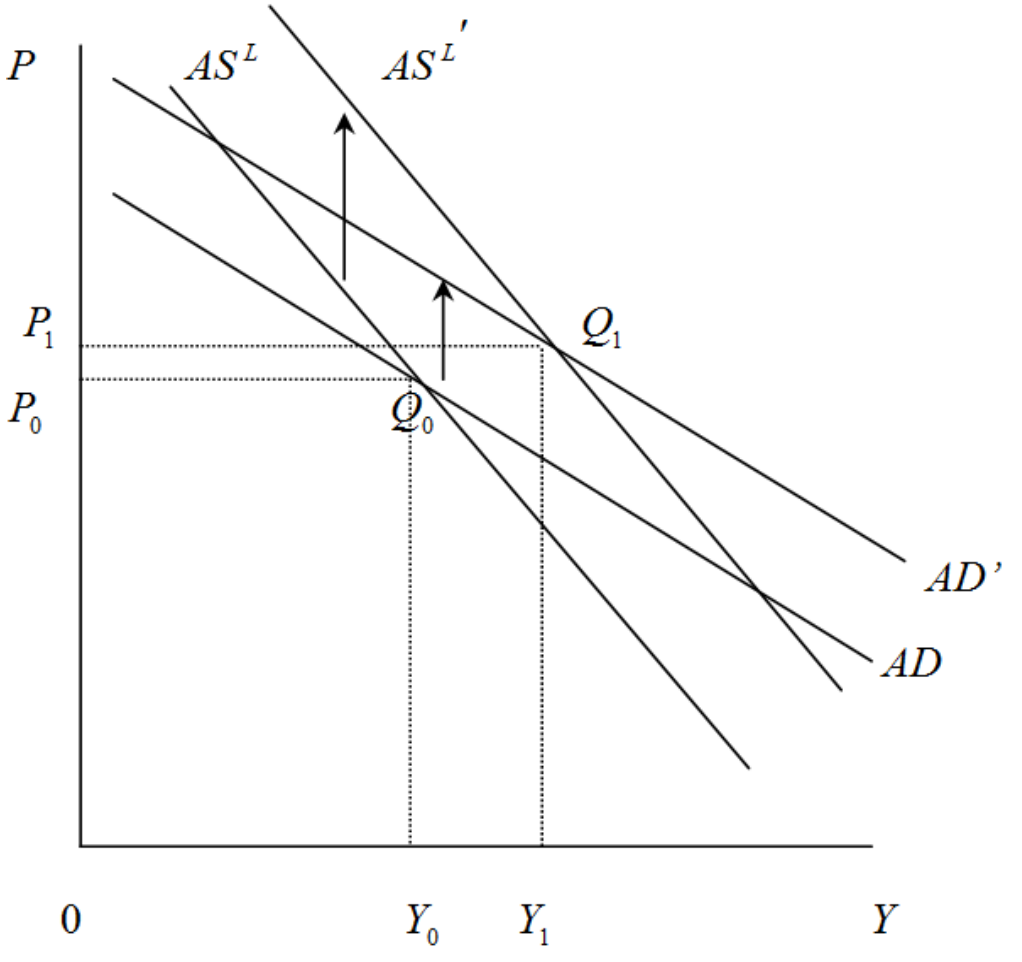
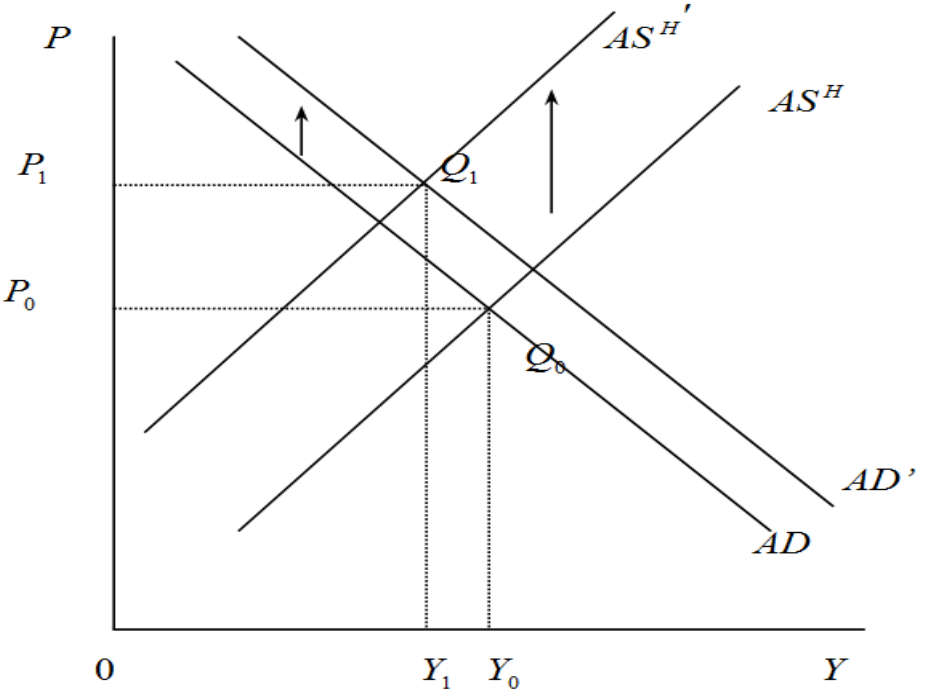


Figure 3 shows that the *AD* and AS^L curves shift upward when the currency devaluates. However, the shifting distance of the AS^L curve is larger than that of the *AD* curve.[13] This implies that domestic output will increase when the economic system reaches the new equilibrium point Q_1 .[14]

Figure-4. The effect of a currency devaluation on domestic output when the labor market is in the high-employment equilibrium



[13] From equation (4), we know: $\partial P/\partial E\big|_{AS^L} = 1$; from equation (14), we know: $0 < \partial P/\partial E\big|_{AD} = T_q L_r/(I_r M + T_q L_r) < 1.$

[14] Because the stability condition requires that AS^L curve is steeper than *AD* curve, $[(1-C_Y-T_Y)L_r + I_r L_Y 1 S_P^L] + I_r M + T_q L_r < 0$. Therefore: $\partial Y/\partial E > 0$, and $\partial P/\partial E > 0$ or $\partial P/\partial E < 0.$

Figure 4 shows the interaction between the *AD* and AS^H under currency devaluation. The initial equilibrium is assumed to be at point Q_0 and the associated domestic price and output are P_0 and Y_0, respectively. Figure 4 indicates that the *AD* and AS^H curves shift upward when the currency devaluates. The shifting distance of the AS^H curve is larger than that of the *AD* curve[15], which implies that domestic output decreases and the domestic price rises when the economic system reaches the new equilibrium point Q_1. Moreover, this result indicates that a currency devaluation results in stagflation.

The diagrammatic analyses can be explained by using the aggregate supply function. When the labor market is in the low-employment equilibrium, the domestic currency devaluation will result in the wage raise request from the labors. Because of the transaction cost externalities, the firms can increase the amount of the employed labor services to reduce the selling cost per labor unit and the labors will be willing to lower their wages. Therefore, domestic output will increase when the labor market is in the low-employment equilibrium.

If the labor market is in the high-employment equilibrium, the domestic currency devaluation will cause the wage raise request from the labors as well. In this case, despite of the existence of transaction cost externalities, the cost of supplying labors ($c'(l)$) dominates and in turn the firms can only lower the amount of the employed labor services to reduce the production cost that results from raising wages. When the domestic currency devaluation devaluates, the *AD* curve will move towards right to stimulate the amount of the employed labor services. This stimulation is nevertheless less than the decrease of the employed labor services amount resulted from the increase of the production cost. Hence, domestic output will decrease when the labor market is in the high-employment equilibrium.

From the previous inference, nominal wage is an important factor in determining the effect of a currency devaluation on domestic output. Examples are not hard to find. When Chile devalued its currency in 1981, the nominal wage rose due to currency devaluation and caused the unemployment rate to rise sharply.[16] Another example, the currency of Taiwan devaluates from 2001 to 2002 but the real GDP of Taiwan still grew during this period. The reason of this phenomenon might be the decrease of the nominal wage. According to the statistical data from

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[15] From equation (4'), we know: $\partial P/\partial E\big|_{AS^H} = 1$; from equation (14), we know: $0 < \partial P/\partial E\big|_{AD} = T_q L_r/(I_r M + T_q L_r) < 1$.

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[16] See Caves, Frankel and Jones (2001) for details.

Taiwanese Economic Journal (TEJ) Data bank, the exchange rates of new Taiwan dollar against U.S. dollar in 2001 and 2002 devaluated from 32.397 to 34.753. However, the real GDP of Taiwan in 2002 grew 3.49% while the average yearly wage for industrial and service business decreases as shown in Table 1.

4. CONCLUSION

This paper examines the effect of a currency devaluation on domestic output by incorporating Coase (1937) assertion into a standard open economy model. Our results show that the labor market have multiple equilibria, i.e. the low-employment equilibrium or the high-employment equilibrium because of transaction cost externalities. If the labor market is in the high-employment equilibrium, currency devaluation will depress domestic output because of the increase of nominal wage and subsequently decrease the labor services employed. Conversely, when the labor market is in the low-employment equilibrium, currency devaluation will lead to the decrease of nominal wage and the increase of labor servicess employed so that domestic output will be enhanced. This conclusion provides an explanation for the mixed effect of the devaluation on domestic output in the empirical studies.

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Table-1. The average yearly wage for industrial and service business

Year	Average yearly wage (in New Taiwan dollars)		
	Industrial	**Service**	**Industrial and Service**
2001	39,184	44,802	42,042
2002	38,995	44,229	41,667