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TRANSACTION COSTS, MULTIPLE EQUILIBRIA, AND THE MUNDELL PROPOSITION

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ABSTRACT

This paper inserts Coase (1937) assertion into Mundell (1963) model. That is, investigating the robustness of Mundell (1963) proposition with the consideration of transaction costs in the labor market. The result shows that the existence of transaction costs makes the externalities of transaction costs in the labor market. Therefore, labor market appears to be multiple equilibria. If labor market appears as low-employment equilibrium, the Mundell proposition cannot work thoroughly under both fixed and flexible exchange rates. If labor market appears as high-employment equilibrium, the Mundell proposition is valid under fixed exchange rates but will be invalid under flexible exchange rates.

Keywords: Transaction costs, Multiple equilibria, The mundell proposition.

JEL Classification: F41.

1. INTRODUCTION

The importance of the Mundell (1963) paper[1] has been recognized in the international finance for decades. His paper demonstrated the effect of the fiscal policy and the monetary policy on domestic output under the conditions of fixed domestic product price, perfectly mobile international capital and no sterilization operations. He concluded that the fiscal policy can achieve maximum output with fixed exchange rates but will have no effect on output with flexible exchange rates. Also, he showed that the monetary policy can cause maximum output with flexible exchange rates but has no effect on output with fixed exchange rates. This concept is called the Mundell (1963) proposition.

For the past three decades, lots of literatures have challenged the validity of the Mundell (1963) proposition (Dornbusch, 1976; Findlay and Rodriguez, 1977; Van Wijnbergen, 1979;

[1] Marston, (1985). think that few studies in international economics have had as much impact on the direction of research as Mundell, (1963).

Dornbusch, 1980; Marston, 1982; Lai, 1984; Chang *et al.*, 1999). In the literatures, Dornbusch (1976), Van Wijnbergen (1979), and Lai (1984) examined Mundell (1963) model under the assumption of fixed product price. However, the assumption of fixed product price implies that economic agents behave irrationally or their models are internally inconsistent or both[1]. Therefore, Marston (1982), Lai (1993), and Chang *et al.* (1999) dealt with labor market explicitly. Marston (1982) assumed that the wage is determined by the rule of indexation and that employment is unilaterally determined by the firm. Lai (1993) used the efficiency wage hypothesis to describe the labor market. Chang *et al.* (1999) assumed that the union and the firm engage in an efficient bargaining process over wages and employment. Marston (1982), Lai (1993), and Chang *et al.* (1999) concluded that Mundell proposition is invalid under flexible exchange rates but is valid with fixed exchange rates. Although lots literatures have been devoted in analyzing Mundell proposition by dealing with labor market explicitly, the existence of transaction costs in the labor market is always ignored in these research. That is, *they think that* employers and employees can observe the market's equilibrium price and trader can meet with trading partners without any costs in a labor market. 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. Coase (1937) thought that employer does not know if his settlement on the wage rate is the market rate after negotiation. Also, the employer does not know if the employee has the intention or ability to provide a high quality contract. In the reality, it is costly for the employer to identify the right labor and relevant wage rate each time. The observation of Coase (1937) matched the reality and attracted enormous attentions that developed the transaction cost economics[2].

Diamond (1982) introduced Coase (1937) concept of transaction costs into macroeconomic model to discuss the unemployment problem. In Diamond (1982) model, he claimed that the trader only finds 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. This externality causes the multiple equilibria in the market and the unsolvable low-employment equilibrium in the economic system. Howitt (1985) classified the distincted characteristics of the labor and firm and internalized the transaction costs. Consequently, he discovered that the economic system could have the externalities of transaction costs because of transaction costs. This outcome generates multiple equilibria and makes the economic system stay in the low-employment equilibrium *for long*. Diamond (1982) and Howitt (1985) models interpreted the traditional Keynesian's persistence on the economic feature of large-scale unemployment with the concept of the transaction costs in the macroeconomic model. Also, their approaches proved the traditional Keynesian's persistence without the ad hoc assumption of price stickiness. However, the existing literatures only apply Coase (1937) assertion in the closed economy. Hence, this paper studies the problem in the field of an open economy. More

[1] See, for example, Takayama, (1969). Barro, (1977) and Startz, (1989).

[2] Kreps, (1990).

specifically, this paper evaluates the validity of Mundell (1963) proposition by infusing Coase (1937) assertion into Mundell (1963) model. Our results show that the Mundell proposition is not always valid under either fixed exchange rates or flexible exchange rates when the transaction cost is considered within the labor market. This paper is organized as followed. Section 1 addresses the motivation and literature reviewed for this paper. We specify the aggregate supply function with the feature of the transaction costs in Section 2. The robustness of Mundell Proposition is analyzed in Sections 3 and 4. Section 5 provides the conclusions.

2. THE MODEL

We assume that this country is a small open economy and produces a single final composite commodity. The produced products will gratify the domestic and exported demand. Both kinds of domestic and imported products are imperfect substitutes and are consumed by the domestic consumers. In addition, we assume that there is a single traded bond with the domestic bond market perfectly integrated with that in the rest of the world. The model is demonstrated as followed.

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

$$L(Y, r) = (D + R)/P, \quad (2)$$

$$r = r^*, \quad (3)$$

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

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

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; Y^*: foreign output; *L*: real money demand; *D*: domestic credit; *R*: official foreign reserves; r^*: foreign interest rate; S^L、S^H: aggregate supply functions of labor market in low-employment equilibrium and in high-employment equilibrium. According to the common macroeconomics, the variables should be limited as followed: $0 < C_Y < 1$, $I_r < 0$, $T_q > 0$[3], $T_Y < 0$, $T_{Y^*} > 0$, $L_Y > 0$, $L_r < 0$.

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

Equation (1) represents the equilibrium condition of the commodity market while equation (2) represents the equilibrium condition of the money market. With the assumptions of perfect substitutability between domestic and foreign bonds as well as of static expectations, equation (3) shows that the domestic interest rate equals to the foreign interest rate[4]. Equations (4) and (4') are the deduced aggregate supply functions with the consideration of transaction costs in the labor market. Once we consider the transaction costs, the labor market becomes multiple equilibria. Consequently, we need equations (4) and (4') to represent the aggregate supply functions under distinct equilibria. The aggregate supply functions can be derived as followed[5].

There are two types of traders in the labor market, identical firms and identical labors.[6] Buying and selling labor services involve transaction costs. We interpret transaction costs as the costs of communicating buying and selling offers. These transaction costs involve externalities. These externalities arise because one agent's transaction costs are lower (higher) if the market becomes thicker (thinner). The unit cost of 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 services used up. Let $\tau(\bar{n})$ denotes selling cost per unit faced by a labor where $\bar{n}$ is aggregate labor services 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. To simplify our problem, we assume that the transaction costs incurred by each firm for buying labor is proportional to the quantity bought with a proportional constant $\beta_n \in (0,1)$. Therefore, if a firm hires *n*, it will have $n(1-\beta_n)$ for production. Also, *n* can be chose to maximize a firm's profit using the following function.

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

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

$f'(\cdot) > 0$, $f''(\cdot) < 0$, for all $n>0$.

[4] Mundell, (1963). Assumption of the capital is perfectly mobile, to view from the point of dynamic analysis, has logical consistency with loanable funds theory. Hence, the interest rate parity under the capital is perfectly mobile reflects that bond market always maintains equilibrium. Chen, Lai and Tsaur, (1988).

[5] The following inference is mainly derived from Howitt, (1985).

[6] The better description should includes "identical firms and identical households", and households play roles as consumers and labors simultaneously.

where

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

The firm's optimal decision can be expressed as

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

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

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

where μ denotes the constant marginal utility of real wealth and w^s represents the nominal wage (supply wage)[7]. 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 expenditure spent on imports, and *l* is supply of labor. Assume that there is an upper limit $\bar{l} > 0$ to each labor's potential labor supply and that the cost function *c* is defined over the interval $[0, \bar{l})$, with

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

where

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

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 utility can be maximized. This maximization function is demonstrated as followed.

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

The first order condition related to the labor's maximizing problem is

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

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[8]

[7] 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).

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

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

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

Figure-1. The equilibrium situation of the labor market

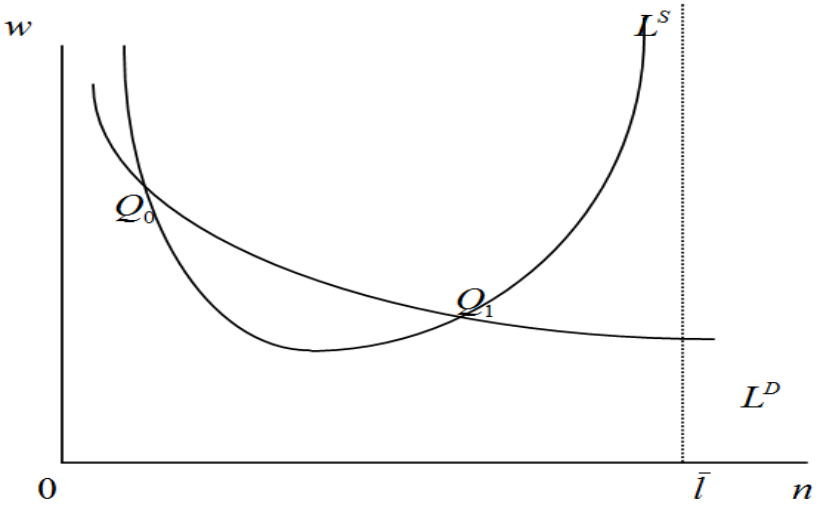


Figure 1 indicates that the equilibrium in the labor market won't be unique due to the externalities of transaction costs. Moreover, increasing the trading amounts of labor services will result in the decreasing of the unit costs for selling labor services and the supply wage. Then, the slope for the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

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

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

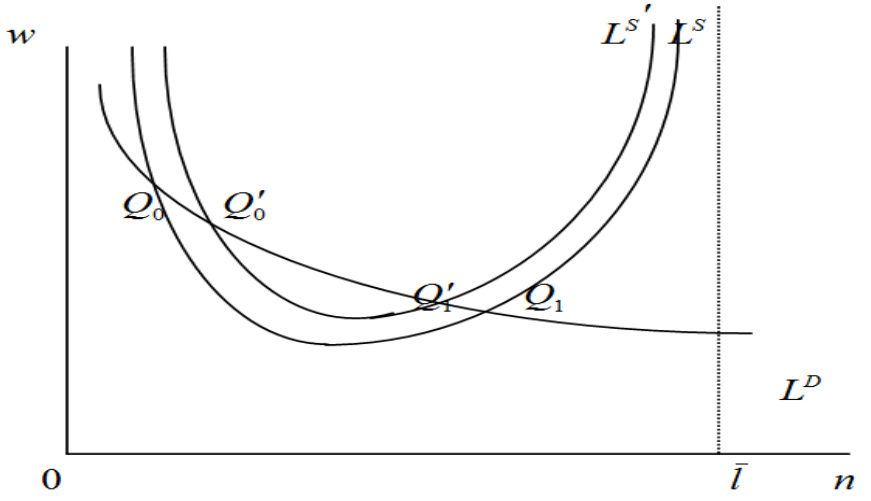
[10] Following the stability condition of Silberberg, (1990). We require that labor supply curve is steeper than labor demand curve if labor supply curve is negative slope.

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

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

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

Figure-2. The equilibrium situation of the labor market under currency devaluation



In response to the depreciation of 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 low-employment equilibrium. On the contrary, the labor employment will decrease if the labor market originally stays in high-employment equilibrium. The same analysis can be applied for 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 labor will ask for a wage raise if the domestic currency devaluates. However, because of the externalities of transaction costs, the firms can increase the amount of the employees to reduce the selling cost per unit faced by labors. Therefore, the labor is willing to accept a cut on their wages and the amount of the employed labor will increase.

On the other hand, the amount of the employed labor will decrease when the labor market is in the high-employment equilibrium. This is because the cost of supplying labor ($c'(l)$) dominates

the externalities of transaction costs, the firms can not increase the amount of the employed labor to quieten down the wage raise requested from the labor. Therefore, the firms will lower down the amount of the employed labor to reduce the production cost.

Differentiate production function and use this differentiation into the equation (10), we obtain

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

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

Equation (11) shows that when the labor market stays in low-employment equilibrium,

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

The equalities showed above is exactly the same as equation (4). This result indicates that increasing domestic price will result in domestic output decreasing while the increasing of the domestic output is resulted from domestic currency devaluation or foreign price increasing. On the other hand, if the labor market stays in high-employment equilibrium, then

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

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

3. THE EFFECTIVENESS OF MACROECONOMIC POLICIES UNDER FIXED EXCHANGE RATES

In this section we will discuss the effects of the fiscal and monetary policies under fixed exchange rates. Because of the externalities of transaction costs, the labor market appears to be multiple equilibria that indicate the possibilities of the low-employment equilibrium or the high-employment equilibrium for the labor market. Furthermore, if we want to know the effects of the fiscal and monetary policies under fixed exchange rates, we must discuss the labor market under two different situations, low-employment equilibrium and high-employment equilibrium.

First of all, we will discuss the labor market in the low-employment equilibrium. Under fixed exchange rates, equations (1)-(4) can be simultaneously solved simultaneously to determine *Y*, *r*, *P*, and *R*. Differentiate equations (1)-(4) and use the Cramer's rule, we obtain

$$\frac{\partial Y}{\partial G} = \frac{S_P^L}{(1-C_Y-T_Y)S_P^L + T_q} < 0, \qquad (12)$$

$$\frac{\partial Y}{\partial D} = 0. \qquad (13)$$

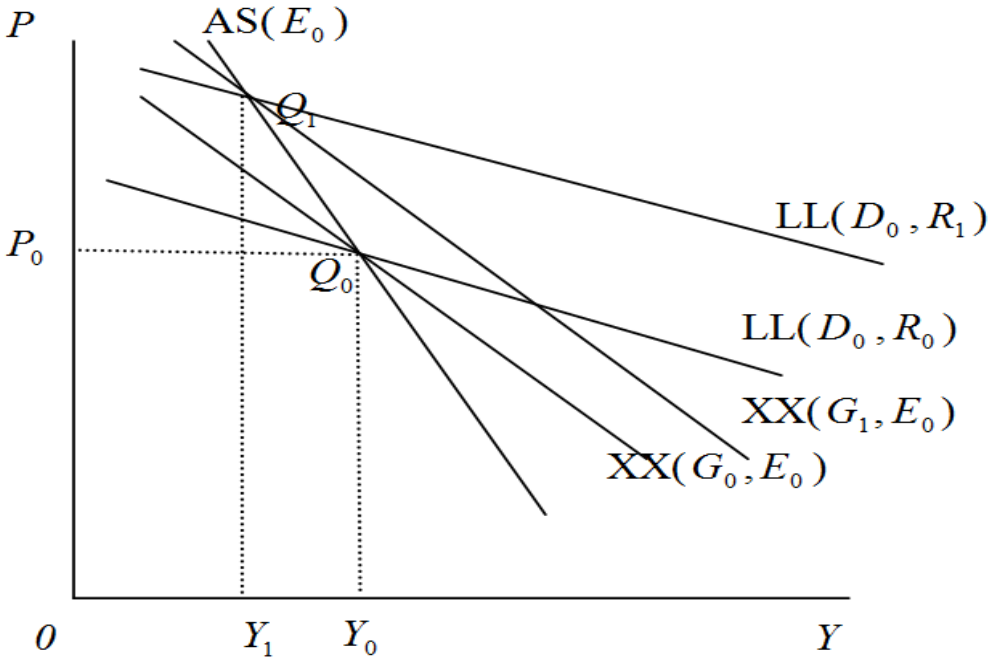
Equations (12) and (13) demonstrate the effect of the fiscal policy and the monetary policy on domestic output, respectively. Furthermore, the fiscal policy conflicts the maximum output effect addressed in Mundell (1963) and causes negative effect on domestic output when the labor market stays in low-employment equilibrium. However, the monetary policy has no effect on domestic

output that coincides with Mundell (1963) conclusion. Theses results verify that the Mundell (1963) proposition is not always valid when the labor market is at the low-employment equilibrium.

We use Figures 3 and 4 to demonstrate this phenomenon. If we apply equation (3) into equations (1) and (2), we can get two loci of *P* and *Y*. One locus satisfies the equilibrium of the commodity market and the bond market while the other satisfies the equilibrium of the money market and the bond market. We make these two loci as the XX curve and the LL curve. In addition, we can also obtain the locus of *P* and *Y* with the satisfaction of labor market equilibrium from equation (4). We make the locus as the AS curve[11, 12].

We assume that the government spending, domestic credit, foreign reserves, and exchange rates in the initial period are represented as G_0, D_0, R_0, and E_0, respectively. The primeval economic system is at Q_0. The corresponding price and output are P_0 and Y_0, respectively.

Figure-3. The effect of the fiscal policy under fixed exchange rates and low-employment equilibrium

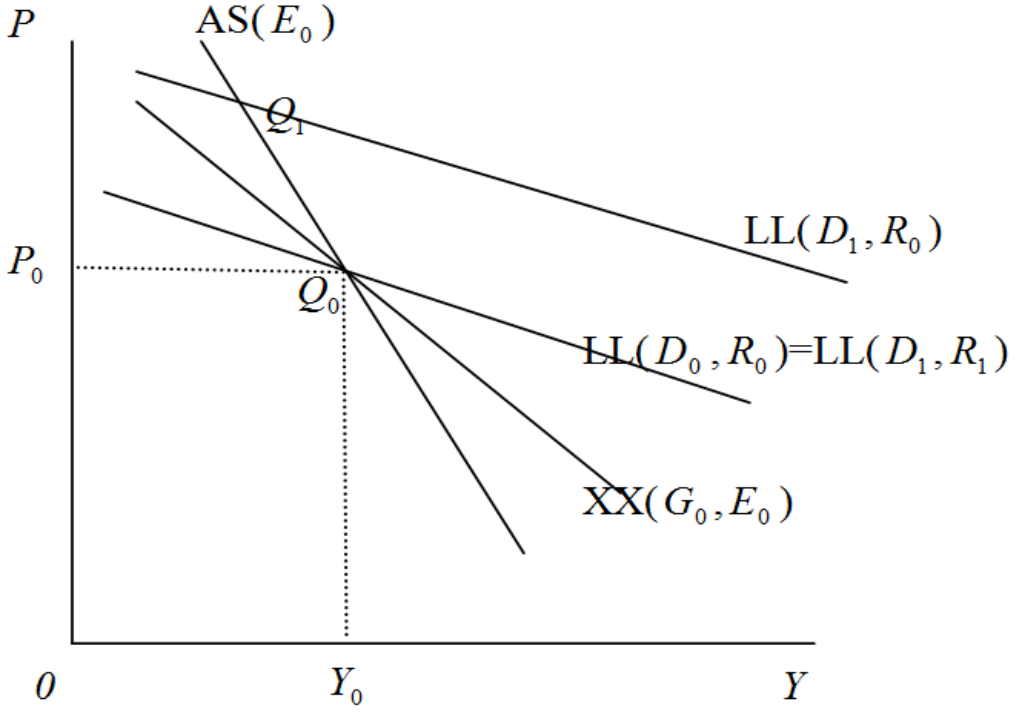


[11] Derivation of the slope of XX, LL, and AS curves, see Appendix.

[12] Following Takayama, (1969). Or Casas, (1975). We adopt the hypothesis of Walrasian price adjustment, that is, domestic price rises when quantity demanded exceeds quantity supplied; the stability condition requires that AS curve is steeper than XX curve.

When government spending increases from G_0 to G_1, the XX(G_0, E_0) curve shifts rightward to XX(G_1, E_0) and intersects AS(E_0) at Q_1. Although the commodity market and the labor market are in equilibrium, Q_1 is located at the upright of LL(D_0, R_0) curve which indicates the existence of excess demand in the money market. According to Walras' Law, we have excess supply in the foreign exchange market. Under fixed exchange rates, the official foreign reserves increase from R_0 to R_1 and the LL(D_0, R_0) curve shifts rightward to LL(D_0, R_1). This phenomenon concludes that Q_1 is the new equilibrium point after increasing government spending. Moreover, the domestic output Y_1 is less than Y_0 which means the invalidity within the Mundell proposition.

Figure-4. The effect of the monetary policy under fixed exchange rates and low-employment equilibrium



Under the same situations, we use Figure 4 to demonstrate equation (13). When domestic credit increase from D_0 to D_1, the LL(D_0, R_0) will shift rightward to LL(D_1, R_0) and intersect

AS(E_0) at the point Q_1. Since the money market and the labor market are in equilibrium, Q_1 is located at the right side of XX(G_0, E_0) that shows excess supply in the commodity market. According to Walras' Law, we have excess demand in the foreign exchange market. Under fixed exchange rates, the official foreign reserves reduce from R_0 to R_1 and LL(D_1, R_0) curve shifts leftward to LL(D_1, R_1)=LL(D_0, R_0). Therefore, Q_0 is still the equilibrium point after increasing the domestic credit. From Figure 4, the domestic output does not change after achieving the new equilibrium which shows the validity of Mundell (1963) proposition.

When the labor market stays in high-employment equilibrium and the exchange rates are fixed, solving equations (1)-(4') can determine *Y*, *r*, *P*, and *R*. Differentiate equations (1)-(4') and use the Cramer's rule, we have

$$\frac{\partial Y}{\partial G} = \frac{S_P^H}{(1 - C_Y - T_Y)S_P^H + T_q} > 0, \qquad (14)$$

$$\frac{\partial Y}{\partial D} = 0. \qquad (15)$$

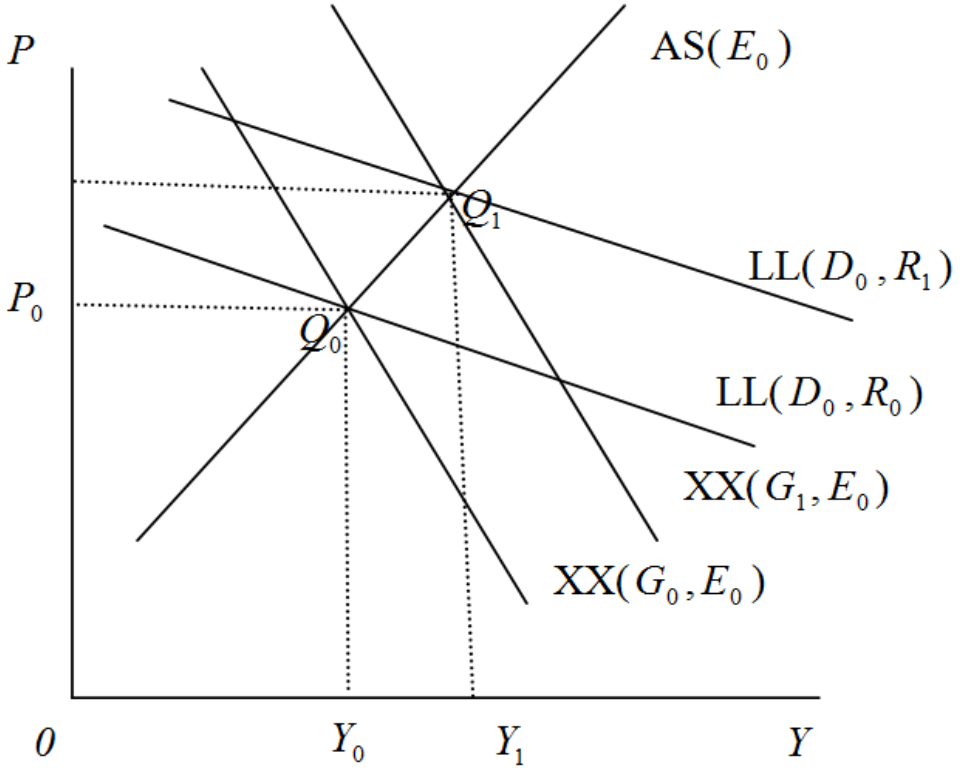
Equations (14) and (15) indicate that the fiscal policy has positive effect on domestic output while the monetary policy has no influences on domestic output. This result shows that the Mundell proposition holds when the labor market stays in high-employment equilibrium. We use Figures 5 and 6 to illustrate Equations (14) and (15).

If we substitute equation (3) into equations (1) and (2), we can get two loci of *P* and *Y*. One locus satisfies the equilibrium of the commodity market and the bond market while the other satisfies the equilibrium of the money market and the bond market. Also, we represent these two loci using XX curve and LL curve. Besides, we can also obtain the locus *P* and *Y* from equation (4') to satisfy the labor market equilibrium. We represent this locus using AS curve.[13]

We assume that the economic system is Q_0 intersected XX(G_0, E_0) curve, LL(D_0, R_0) curve, and AS(E_0) curve. The corresponding price and output are P_0 and Y_0, respectively.

[13] For reference of inferring slopes of XX, LL, and AS curve, see Appendix.

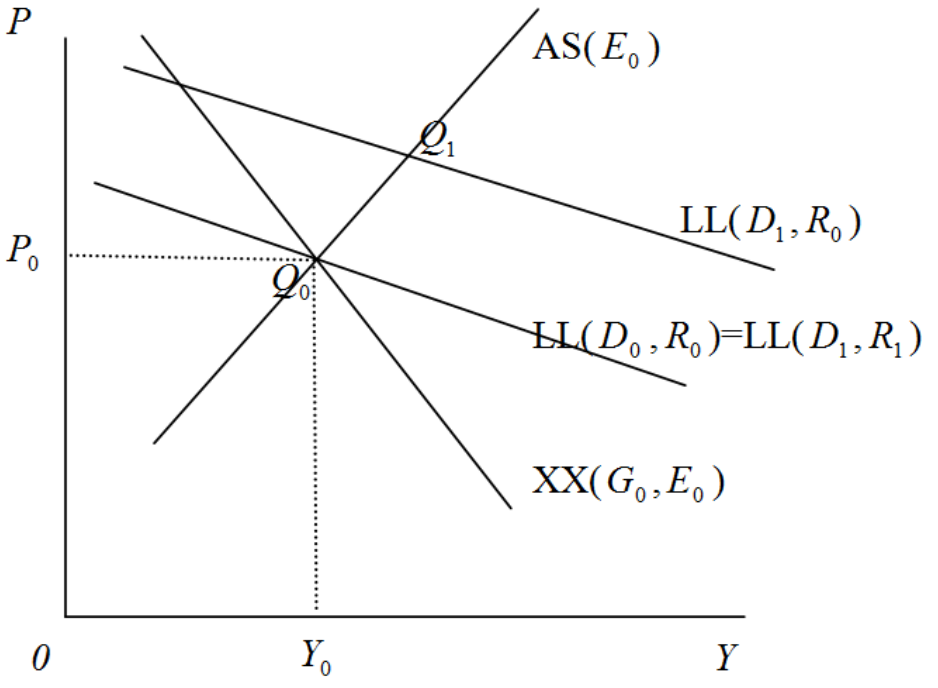
Figure-5. The effect of the fiscal policy under fixed exchange rates and high-employment equilibrium



When the government spending increases from G_0 to G_1, XX(G_0, E_0) curve shifts rightward to XX(G_1, E_0) and intersects AS(E_0) at Q_1. This shows that the commodity market and the labor market are in equilibrium. Since Q_1 is at the upright of LL(D_0, R_0), the money market exists excess demand. According to Walras' Law, the excess demand in the money market reflects the excess supply in the foreign exchange market. Under fixed exchange rates, the official foreign reserves must be increased so that LL(D_0, R_0) curve shifts rightward to LL(D_0, R_1). This phenomenon concludes that Q_1 is the new equilibrium point after increasing government spending. Moreover, the domestic output Y_1 is greater than Y_0 which means the validity within the Mundell proposition.

We then use Figure 6 to explain equation (15).

Figure-6. The effect of the monetary policy under fixed exchange rates and high-employment equilibrium



Under the same situations, the LL(D_0, R_0) will shift rightward to LL(D_1, R_0) and intersect AS(E_0)at Q_1 when domestic credit increase from D_0 to D_1. This indicates that the money market and the labor market are in equilibrium. However, it means the commodity market carries excess supply since Q_1 is on the right side of XX(G_0, E_0). According to Walras' Law, this situation reflects that the foreign exchange market carries excess demand. Under fixed exchange rates, the official foreign reserves will be reduced from R_0 to R_1 and LL(D_1, R_0) curve shifts leftward to LL(D_1, R_1)=LL(D_0, R_0). Therefore, Q_0 is still the equilibrium point after the increasing of domestic credit. From Figure 6, there is no change in the domestic output and the Mundell (1963) proposition is valid.

According to these analyses, the slope of AS curve under fixed exchange rates is the main reason that swings the effect of the fiscal policy and determines the validity of the Mundell proposition. Because the fiscal policy prescribes a negative effect on domestic output when the slope of AS curve is negative that is due to the externalities of transaction costs dominate the cost of supplying labor (the labor market is in the low-employment equilibrium). On the other hand, the

fiscal policy shows a positive effect on domestic output when the slope of AS curve is positive that is due to the cost of supplying labor dominate the externalities of transaction costs (the labor market is in the high-employment equilibrium).

Our findings under fixed exchange rates and the low-employment equilibrium oppose Mundell's statement for the effect of the fiscal policy on domestic output. However, our results under fixed exchange rates and the high-employment equilibrium coincide with Mundell's statement for the effect of the fiscal policy on domestic output. Since the externalities of the transaction costs have significant influences on the slope of AS curve, its existence will be the critical factor for the validation of Mundell's statement on the effect of the fiscal policy on domestic output.

Besides, whether the slope of AS curve is positive or not, the monetary policy has no effect on domestic output under fixed exchange rates that is known as money neutrality. Therefore, both money neutrality and the Mundell proposition still hold even if the externalities of transaction costs exist.

4. THE EFFECTIVENESS OF MACROECONOMIC POLICIES UNDER FLEXIBLE EXCHANGE RATES

In this section, we will discuss the labor market in the low-employment equilibrium and the high-employment equilibrium under flexible exchange rates. When the labor market stays in the low-employment equilibrium, Equations (1)-(4) can be solved to determine *Y*, *r*, *P*, and *E* under flexible exchange rates. Differentiate equations (1)-(4) and use the Cramer's rule, we obtain

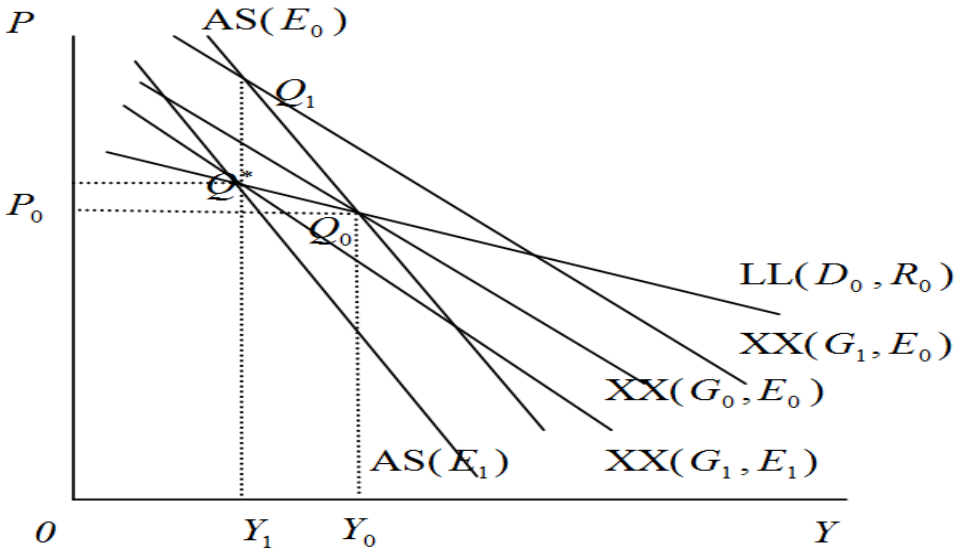
$$\frac{\partial Y}{\partial G} = \frac{S_E^L}{(1 - C_Y - T_Y)S_E^L - T_q} < 0, \qquad (16)$$

$$\frac{\partial Y}{\partial D} = 0. \qquad (17)$$

Equations (16) and (17) show that the fiscal policy has a negative effect on domestic output under flexible exchange rates which confirms the Mundell proposition. However, the monetary policy has no influences on domestic output under flexible exchange rates which confronts the Mundell proposition.

Likewise, we can elucidate the mathematical outcome of equations (16) and (17) from Figures 7 and 8. We also assume that the government spending, domestic credit, and exchange rates in the initial period are represented as G_0, D_0, and E_0, respectively. The primeval economic system is at Q_0 and the corresponding price and output are P_0 and Y_0, respectively.

Figure-7. The effect of the fiscal policy under flexible exchange rates and low-employment equilibrium

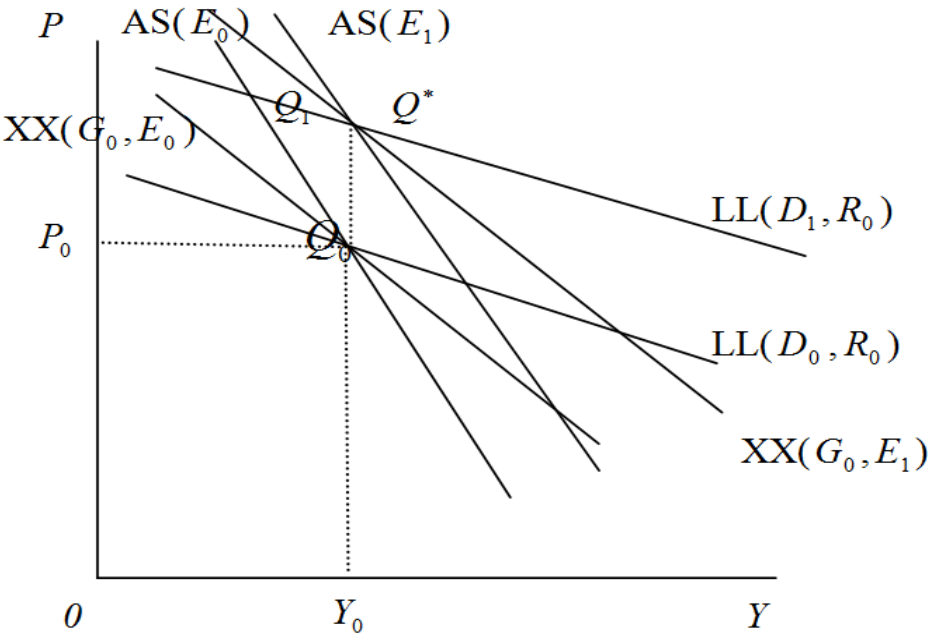


When the government spending increases from G_0 to G_1, XX(G_0, E_0) curve shifts rightward to XX(G_1, E_0) and intersects AS(E_0) at Q_1. Since flexible exchange rates require all the markets to maintain equilibrium and the changes of exchange rates will result in the same shifting distant for both XX curve and AS curve[14], exchange rates must appreciate from E_0 to E_1. This appreciation will shift XX(G_1, E_0) and AS(E_0) to XX(G_1, E_1) and AS(E_1). Therefore, we can conclude that Q^* is the new equilibrium point after increasing government spending. Moreover, the domestic output Y_1 is less than Y_0 which means the validity within the Mundell proposition.

In addition, we use Figure 8 to illustrate equation (17).

[14] $\left.\frac{\partial P}{\partial E}\right|_{XX} = \left.\frac{\partial P}{\partial E}\right|_{AS} = 1.$

Figure-8. The effect of the monetary policy under flexible exchange rates and low-employment equilibrium



When the domestic credit increase from D_0 to D_1, the LL(D_0 , R_0) will shift rightward to LL(D_1, R_0) and AS(E_0) intersects at point Q_1. To reach a new equilibrium for all the markets, exchange rates must be depreciated from E_0 to E_1 so that XX(G_0, E_0) and AS(E_0) can shift to XX(G_0, E_1) and AS(E_1). Therefore, Q^* becomes the new equilibrium point after increasing the domestic credit. From Figure 4, when the new equilibrium is achieved, there is no change in the domestic output. That is, the Mundell (1963) proposition is invalid.

Furthermore, we will discuss the situation of the labor market in the high-employment equilibrium under flexible exchange rates. We solve equations (1)-(4') to determine *Y*, *r*, *P*, and *E*. Then, we differentiate equations (1)-(4') using the Cramer's rule to obtain equations (18) and (19).

$$\frac{\partial Y}{\partial G} = \frac{S_E^H}{(1-C_Y-T_Y)S_E^H - T_q} > 0, \qquad (18)$$

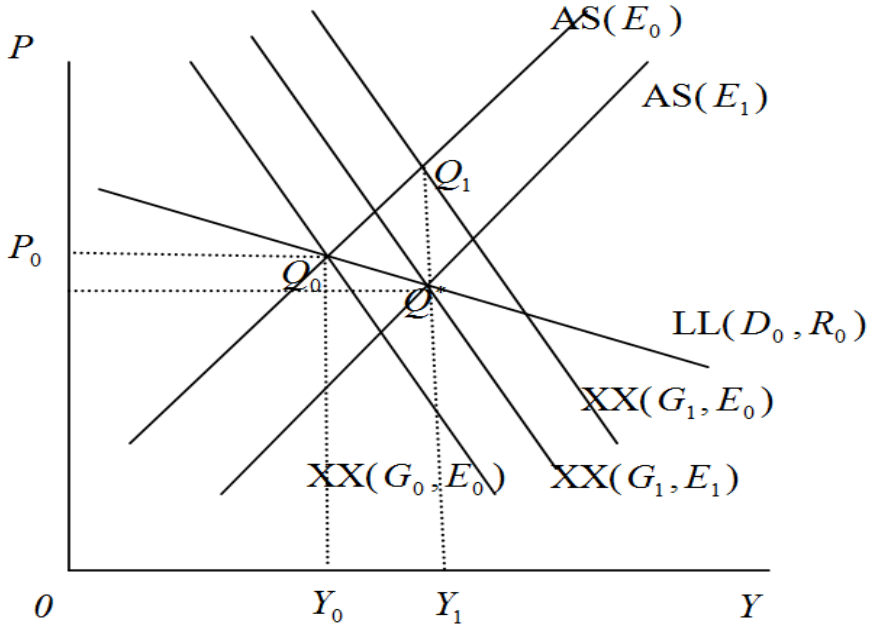
$$\frac{\partial Y}{\partial D} = 0. \qquad (19)$$

Equations (18) and (19) show that the fiscal policy has positive effect on domestic output while the monetary policy has no influences on domestic output. These results confront the

Mundell proposition and show the invalidity within the Mundell proposition when the labor market stays in high-employment equilibrium.

We use Figures 9 and 10 to demonstrate this conclusion. We adapt the ssame assumptions from previous discussion of fixed exchange rates. That is, the government spending, domestic credit, and exchange rates in the initial period are represented as G_0, D_0, and E_0, respectively. The primeval economic system is at Q_0 with P_0 and Y_0 as price and output, respectively.

Figure-9. The effect of the fiscal policy under flexible exchange rates and high-employment equilibrium



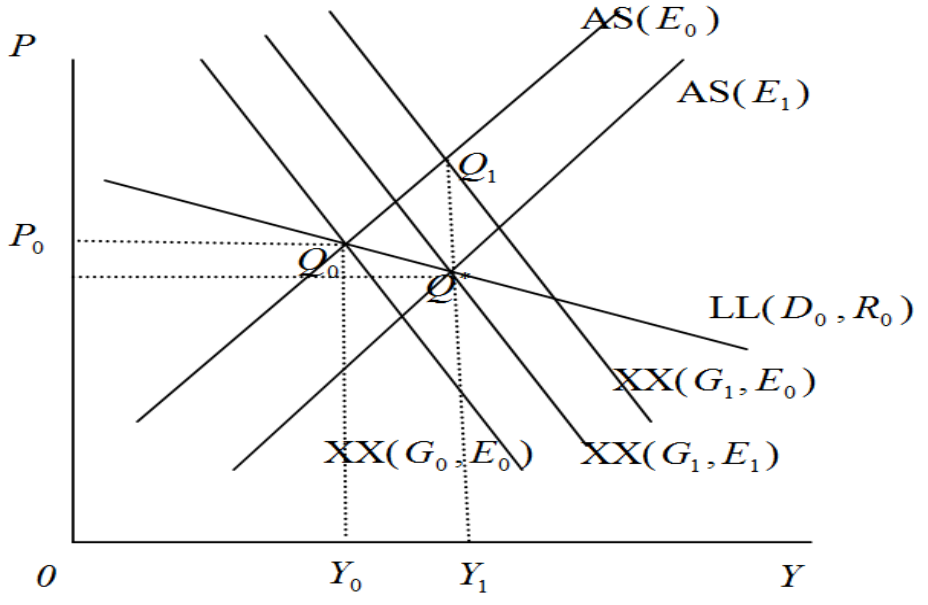
When the government spending increases from G_0 to G_1, XX(G_0, E_0) curve shifts rightward to XX(G_1, E_0) and intersects AS(E_0) at Q_1. Since flexible exchange rates require all the markets to maintain equilibrium and change the exchange rates will result in the same shifting distant for both XX curve and AS curve[15], exchange rates must appreciate from E_0 to E_1. This appreciation will shift XX(G_1, E_0) and AS(E_0) to XX(G_1, E_1) and AS(E_1). This phenomenon

[15] $\left.\frac{\partial P}{\partial E}\right|_{XX} = \left.\frac{\partial P}{\partial E}\right|_{AS} = 1.$

concludes that Q^* is the new equilibrium point after increasing government spending. Moreover, the domestic output Y_1 is greater than Y_0 which means the invalidity within the Mundell proposition.

Besides, we use Figure 10 to explain equation (19).

Figure-10. The effect of the monetary policy under flexible exchange rates and high-employment equilibrium



When the domestic credit increases from D_0 to D_1, LL(D_0 , R_0) will shift rightward to LL(D_1 , R_0) and intersect AS(E_0)at Q_1. To reach a new equilibrium for all the markets, the exchange rates must be depreciated from E_0 to E_1 so that XX(G_0 , E_0) and AS(E_0) can shift to XX(G_0 , E_1) and AS(E_1). Therefore, Q^* becomes the new equilibrium point after increasing the domestic credit. From Figure 10, the domestic output will not change with the new equilibrium. This finding indicates that the Mundell (1963) is invalid.

To sum up, the slope of AS curve under flexible exchange rates is still the major factor that swings the effect of fiscal policy on domestic output and determines the verification of Mundell's statement for the fiscal policy. Moreover, the slope of AS curve is affected by the externalities of transaction costs. When the externalities of transaction costs dominate the cost of supplying labor (the labor market is in the low-employment equilibrium), the slope of AS curve becomes negative

and the fiscal policy exhibits negative efficacy on domestic output. This outcome corroborates Mundell's description for the fiscal policy. On the other hand, the slope of AS curve is positive when the labor market is in the high-employment equilibrium. However, positive slope for AS curve will cause the fiscal policy to have positive effect on domestic output. Therefore, Mundell's statement on the fiscal policy is not valid which shows the critical influences for the externalities of transaction costs on the Mundell proposition under flexible exchange rates.

Besides, whether the slope of AS curve is positive or not, the monetary policy has no effect on domestic output under flexible exchange rates that is known as money neutrality. Therefore, money neutrality still holds even if the externalities of transaction costs exist, and the Mundell proposition is invalid.

5. CONCLUSION

Based on the Mundell (1963) model, this paper evaluates the robustness of the Mundell (1963) proposition with the consideration of transaction costs. Table 1 demonstrates the validity of the Mundell proposition under different conditions with transaction costs.

Table-1. The validity of Mundell Proposition

		Fixed exchange rates	**Flexible exchange rates**
Fiscal policy	Low-employment equilibrium	Invalid	Valid
	High-employment equilibrium	Valid	Invalid
Monetary policy	Low-employment equilibrium	Valid	Invalid
	High-employment equilibrium	Valid	Invalid

According to our analysis in the previous sections, the monetary policy has no effect on the domestic output in any exchange rate regime that is also known as money neutrality. Hence, the Mundell proposition is valid under fixed exchange rates but is invalid under flexible exchange rates with the monetary policy. Furthermore, since the slope of the aggregate supply curve is negative under low-employment equilibrium, the fiscal policy will have negative effect on the domestic output. Therefore, the Mundell proposition for the fiscal policy in low-employment equilibrium is invalid under fixed exchange rates but will be valid under flexible exchange rates. When the labor market stays in high-empolyment equilibrium, the slope of the aggregate supply curve becomes positive that causes the fiscal policy to have positive effect on the domestic output. Hence, the Mundell proposition for the fiscal policy in high-employment equilibrium is valid under fixed exchange rates but is invalid under flexible exchange rates. Our conclusions indicate that the Mundell proposition is not robust with the consideration of transaction costs in the labor market. Also, this research confronts the conclusions of Marston (1982), Lai (1993) and Chang *et al*. (1999) in which they evaluated the Mundell proposition with the labor market.

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APPENDIX

Derivation of the slope of the XX, the LL, and the AS curves

We apply equation (3) into equations (1) and (2), and totally differentiating them, we can get the slopes of the XX curve and the LL curve, that are

$$\left.\frac{\partial P}{\partial Y}\right|_{XX} = \frac{-(1-C_Y-T_Y)}{T_q} < 0,$$

$$\left.\frac{\partial P}{\partial Y}\right|_{LL} = \frac{-L_Y}{M} < 0.$$

Besides, we can also obtain the slopes of the AS curves from equations (4) and (4'),

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