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# Adjustment in an Open Economy with Two Exchange-Rate Regimes

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**Abstract.** This paper examines adjustment in a model with three economies, two exchange-rate regimes, and varying capital mobility. In the benchmark scenario, the U.S. dollar fluctuates against the euro and the Chinese yuan, but capital mobility is high in the former and low in the latter case. This generates offsetting exchange-rate adjustments, which affect the efficacy of U.S. fiscal policy. In the next two scenarios, the yuan is fixed against the dollar. Rate pegging by a large country like China “interferes” with U.S. macro adjustment and undermines U.S. policy autonomy.

**JEL Classification:** F31, F32, F41

**Keywords:** Open economy macro, Exchange rate regimes, US-China payments adjustment, Production networks

## 1. Introduction

In recent years, the United States has operated under a mixed exchange-rate regime containing both fixed and floating elements. The country is officially classified as a “floater,” which accurately describes the nation’s official policy.<sup>2</sup> However, it has been unable to prevent a large country – China – from pegging its currency to the dollar.<sup>3</sup> If China were a small country, this policy would have no meaningful consequences for the United States. But China is not small and hence its exchange-rate management does have implications for the U.S.

This paper explores the consequences of China’s exchange-market intervention for U.S. monetary and fiscal policy. It does so with an open-economy model of a country which has a floating rate with one trading partner and a fixed rate with a second trading partner. The two trading partners are the European Monetary Union (EMU) or “Euroland,” whose currency is the euro, and the People’s Republic of China, whose currency is the yuan or RMB. The dollar floats freely against the euro, while its relationship to the yuan is managed by the central bank of China. This gives the U.S. a *de facto* “mixed” exchange-rate regime.

Section 2 presents the model and works out a benchmark scenario in which both exchange rates are fully flexible. In Section 3, China fixes its currency to the dollar and recycles dollars accumulated in the process of intervention by purchasing U.S. Treasury securities directly from the Federal Reserve. This is the “non-sterilization” scenario. In Section 4, intervention dollars are recycled in the open market for U.S. Treasury securities. This is the “sterilization” scenario. Section 5 concludes.

What distinguishes China from the many other countries that have pegged their currencies to the U.S. dollar is that the People’s Republic is large enough to

affect macro adjustment in the American economy. Its exchange-rate management has the capacity to interfere with the effectiveness of U.S. macro stabilization policies and to compromise the flexibility of the dollar against other currencies.

## 2. An Open Economy with Floating Rates

The basic frame of reference for the analysis that follows is the textbook model of the open economy, modified to provide a three-country perspective.<sup>4</sup> Specification of the U.S. monetary sector follows conventional lines:

$$H/P = L(y, i), \quad (1)$$

where  $L$  is the demand for real cash balances,  $y$  is real income and  $i$  is the nominal interest rate.  $P$  is the price level, which is taken as given in the short run, reflecting the well-known “sticky-price” assumption of many macro models. In the standard model, base money is specified as  $H = D + R$ , where  $D$  is domestic credit and  $R$  represents foreign exchange reserves held by the *domestic* central bank. In the case of China, however, it is the foreign central bank that holds reserves of the U.S. currency. Hence, the relevant expression is  $H = D - R^C + TB^C$ , where  $R^C$  represents dollar accumulation by the Chinese central bank through intervention in the foreign exchange market and  $TB^C$  represents purchases by the Chinese central bank of U.S. Treasury securities from the public.

Equilibrium in the goods-producing sector is specified along standard lines, except that the U.S. trade balance with each country appears separately in the equation.

$$I(i) + T^*(y^*, y, E^*) + T(y^C, y, E) - S(y) = -G, \quad (2)$$

where investment,  $I$ , is a negative function of the rate of interest, where U.S. trade with Europe,  $T^*$ , and with China,  $T$ , is positively related to each country’s real GDP ( $y^*$  and  $y^C$ , respectively), negatively to U.S. real GDP ( $y$ ) and positively to the two nominal exchange rates ( $E^*$  and  $E$ ), expressed as the dollar price of the respective foreign currencies. U.S. private real saving rises with real GDP, and  $G$  represents the real government budget deficit.

There are, finally, two basic balance-of-payments equations:

$$T^*(y^*, y, E^*) + K^*(i, i^*) = 0 \quad (3)$$

And

$$T(y^C, y, E) + K(i, i^C) = 0, \quad (4)$$

where  $K^*$  and  $K$  represent capital inflows into the U.S. from Europe and China, respectively. Inasmuch as the current account is a flow variable, we count on capital flows rather than the stock-adjustment components of the financial account to provide ongoing funding for current account imbalances. Cross-country interest differentials should cause agents to borrow where interest rates

are low and to lend where they are high. We assume that such financial intermediation between Euroland and the U.S. exhibits “high capital mobility,” while financial flows between the U.S. and China are subject to low mobility, in part because they are more vigorously controlled and regulated by the Chinese authorities.

As written, equation (4) assumes that all capital flows between the U.S. and China are autonomous. This assumption is appropriate when the yuan is fully flexible, which is the scenario of this section. Subsequently, equation (4) will be amended to accommodate the fixed-rate scenarios.

We begin by assuming that both exchange rates are fully flexible. This is the regime that Washington policy makers have been working to achieve by pressing China to allow the yuan’s value to be determined by market forces. As noted above, capital mobility is high with Europe and low with China.

### *2.1 Monetary Policy*

A monetary expansion in the United States produces well-known results. The expansion raises U.S. income and thereby causes both trade balances to deteriorate. It lowers the rate of interest, bringing about capital outflows, which impact negatively on U.S. financial accounts with both countries. As a result, the dollar depreciates against both currencies. If we assume for the present that the marginal import propensities in equations (3) and (4) are roughly similar, then the current account deteriorations are roughly similar as well.<sup>5</sup> In view of Europe’s higher capital mobility, however, the decline in the U.S. interest rate affects the financial account with that region more severely than that with China. Hence, the dollar’s depreciation against the euro is relatively larger. In the main, however, this result is consistent with well-known findings that depreciation enhances the effectiveness of monetary policy in achieving a reduction in the U.S. output gap.

The essential features of the adjustment are depicted in Figure 1. Note that the shift in goods-market equilibrium, represented by the ISXM curve, is the result of changes in both exchange rates and that there are separate curves for balance of payments equilibrium between the U.S. and its two trading partners. The steeper curve (BP) reflects the assumption of low capital mobility vis-à-vis China, while the flatter curve (BP\*) accommodates the high degree of capital mobility between the U.S. and Euroland. The monetary expansion shifts out the LM curve, while the depreciation of the dollar against the two currencies shifts the ISXM curve out and the two BP curves down. In the new equilibrium, U.S. output is higher and the interest rate lower than initially. The resulting improvement in output and employment is stronger than in the closed economy. This is the outcome that would pertain if the U.S. succeeded in persuading China to allow its exchange rate to become completely market-determined.<sup>6</sup>

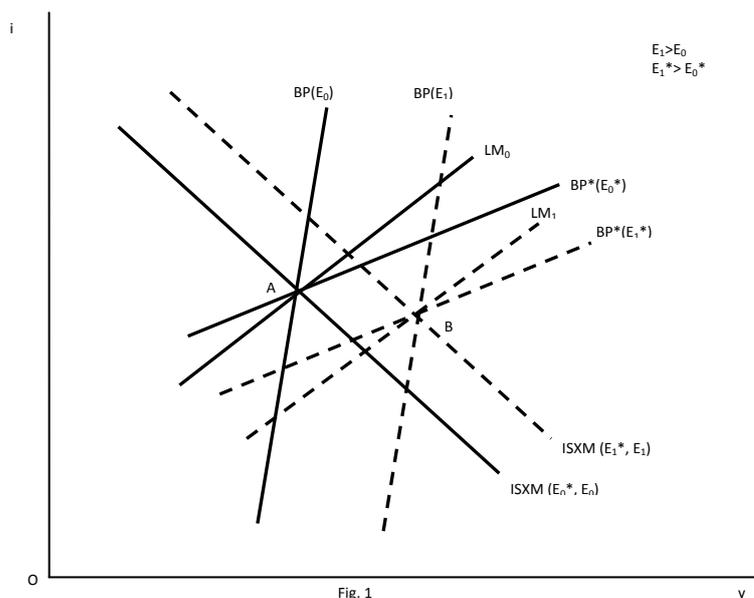
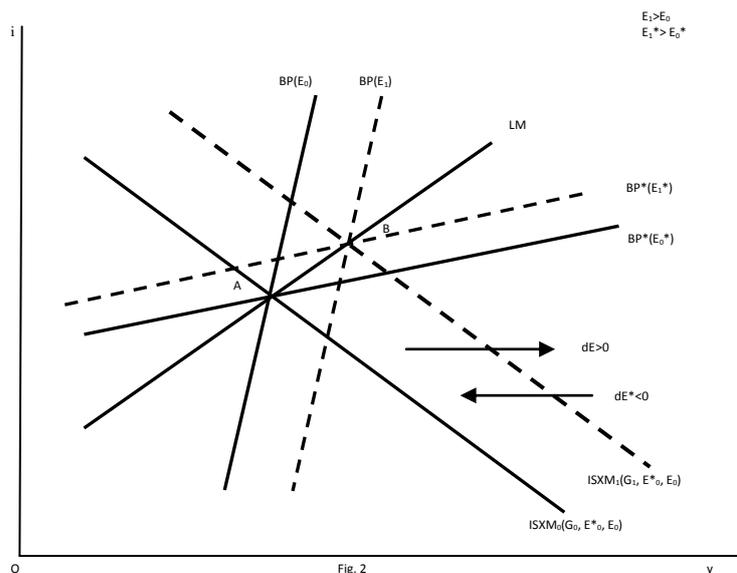


Fig. 1

## 2.2 Fiscal Policy

In the closed economy, a U.S. fiscal expansion shifts out the goods-market equilibrium curve along the stationary LM curve in Figure 2, raising output and the interest rate. In the open economy, however, the rise in output causes deterioration in both current accounts. The rise in the interest rate, on the other hand, improves the financial account with Europe by more than enough to offset the deterioration of the current account, therefore causing the dollar to appreciate against the euro. This, in turn, causes the goods-market equilibrium curve to shift inward, as indicated by the lower arrow, and the BP\* curve to shift up to BP\*(E<sub>1</sub>\*). The result is to reduce the effectiveness of the fiscal expansion in achieving a desired reduction in the output gap.

With respect to China, on the other hand, the interest-rate increase is not large enough to improve the financial account by as much as the rise in U.S. output has caused the bilateral current account to deteriorate. The dollar is forced to depreciate against the yuan, pushing the goods-market curve out, as indicated by the upper arrow, and the BP curve to BP(E<sub>1</sub>). These adjustments, therefore, work in directions opposite to those associated with the dollar's appreciation against the euro. The net effect on the ISXM curve depends on the magnitudes of the relevant interest-rate and exchange-rate elasticities between the U.S. and Europe and China, respectively. If the forces indicated by the two arrows are equal, then the ISXM curve will not move from the position it reached with the initial fiscal expansion. That is the case depicted in Figure 2. The likelihood of little or no movement in ISXM rises as the values of the U.S. marginal propensities to spend on imports from the two trading partners and the exchange-rate elasticities of the two bilateral trade balances, respectively, converge toward each other.



When the adjustments are perfectly offsetting, the effectiveness of the fiscal expansion does not change relative to the closed-economy outcome. On the other hand, if the European results dominate, then the effectiveness of fiscal expansion will be weaker. It will be stronger, if the Chinese side of the adjustment process dominates.

### 3. An Open Economy with Two Exchange-Rate Regimes

In this section we assume that China unilaterally pegs the yuan to the U.S. dollar. When the central bank intervenes in the foreign-exchange market and acquires dollars with yuan, it is assumed to convert those dollars into U.S. Treasury securities by purchasing them directly from the U.S. Federal Reserve.<sup>7</sup> It is important to keep in mind that intervention is carried out by the Chinese authorities rather than the Americans. As they do so, the level of China's reserves will be changing, but in equilibrium there is no ongoing intervention in this scenario. In equilibrium, autonomous current account imbalances are exactly offset by autonomous financial flows. In this instance,  $R^C$  and hence  $H$  are clearly endogenous.

#### 3.1 Monetary Policy

As before, a monetary expansion tends to put upward pressure on U.S. GDP and downward pressure on U.S. interest rates, causing deterioration in both current accounts and in both financial accounts. The Chinese authorities intervene in the foreign-exchange market by supplying yuan in exchange for dollars and use those dollars to purchase U.S. Treasury securities from the Fed. As a result, U.S. money supply shrinks until the initial rise in money supply due to the Fed's expansionary policy has been eliminated (as indicated by the westward arrow in Figure 3) and interest rates and GDP have returned to their original levels. The

monetary policy is completely ineffective in the pursuit of higher levels of output and employment.

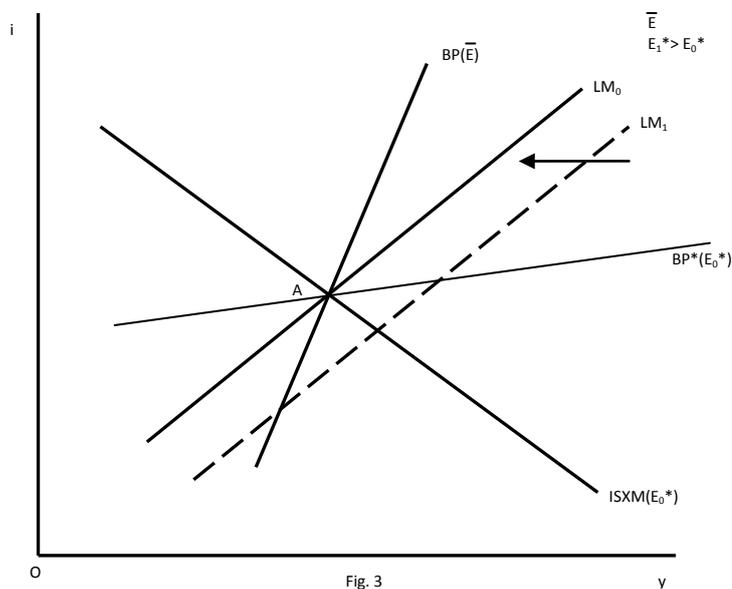


Fig. 3

It is worth noting in view of the flexibility of the dollar-euro rate, that the immediate effect of the policy is to push the rate up as it did in Figure 1. However, that higher rate and its effects on domestic income and employment are not sustainable, given the current account deficit with China, whose exchange-market intervention continues until the money supply has returned to its initial level.

While the end result is to an extent typical of fixed-rate regimes, the novelty here is that it occurs in the context of a free float between the dollar and the euro. The dollar depreciation against the euro, which would take place under floating rates, is prevented by the exigencies of a mixed-rate regime. The Chinese policy of pegging against the dollar has the effect of immobilizing the dollar against the euro. China's unilateral decision to attach its currency to the dollar prevents the U.S. from enjoying the benefits of monetary expansion under floating rates. In this situation, intervention by the Chinese central bank effectively makes the U.S. a non-floater.

### 3.2 Fiscal Policy

As before, a fiscal expansion shifts ISXM out and raises both GDP and the rate of interest. With high capital mobility between the U.S. and Europe, the resulting improvement of the financial account dominates the deterioration of the current account. The dollar appreciates against the euro, which shifts the ISXM and BP\* curves in Figure 4 to the left, thereby reducing the potency of the fiscal expansion in the pursuit of high domestic output and employment. Meanwhile, the U.S. balance of payments with China deteriorates, because bilateral current

account worsening exceeds bilateral financial account improvement. The Chinese authorities intervene to prevent the yuan from appreciating and then recycle the dollars acquired back to the U.S. by purchasing U.S. Treasury securities directly from the Fed. U.S. money supply shrinks, causing the LM curve to shift left in Figure 4. This reduction of liquidity has the effect of further limiting the expansion of output and employment.

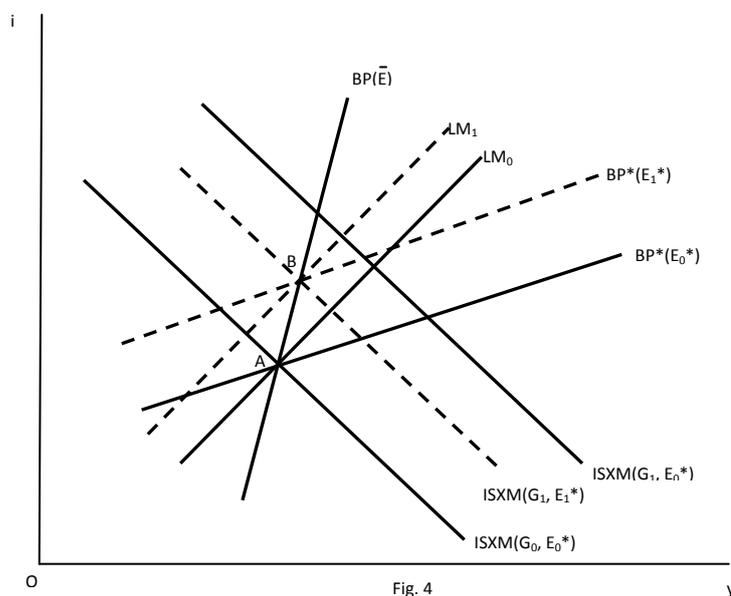


Fig. 4

#### 4. The Foreign Central Bank Asserts Control over the U.S. Money Supply

In this section, we assume that the Chinese authorities recycle intervention dollars directly into the U.S. financial system by purchasing Treasury securities from the public. In other words, the Chinese conduct “open-market operations” in the U.S. which have the effect of sterilizing the contractionary impact of their foreign-exchange market interventions on U.S. money supply.<sup>8</sup>

##### 4.1 Monetary Policy

We now rewrite equation (4) as follows:

$$T(y^c, y) + K^C(i, i^c) + R^C = 0, \quad (4a)$$

where  $R^C$  represents the ongoing official capital inflow from China. It means that any excess demand or supply in the bilateral autonomous balance of payments is automatically accommodated by the Chinese authorities. In other words, the autonomous imbalance is made “permanent” by this recycling policy.

A U.S. monetary expansion shifts the LM curve out in Figure 5 and puts upward pressure on output and downward pressure on interest rates, worsening both current and capital accounts vis-à-vis Europe. The dollar depreciates against

the euro, which enhances the effect of the monetary policy on output and employment. (The  $BP^*$  curve shifts down to the right and the ISXM curve shifts out.)

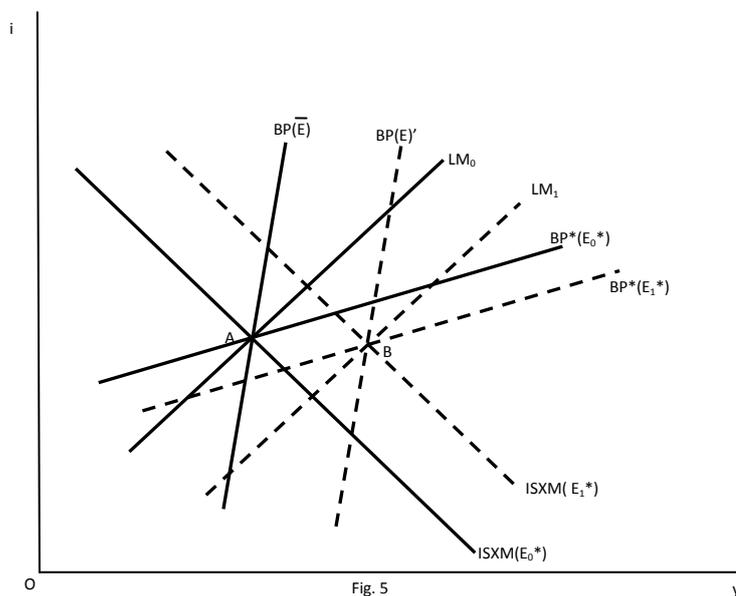


Fig. 5

The U.S. current account with China also moves into deficit and the bilateral autonomous financial account deteriorates as well. But this overall deterioration in the bilateral autonomous balance of payments is accommodated by dollar accumulation on the part of the Chinese central bank. The BP curve moves down to the right. The gap between the initial and new BP curves reflects the extent of the deficit in the autonomous balance of payments between the U.S. and China that must be financed by the ongoing inflow of official capital from China. At point B, a “permanent” payments deficit with China is financed by official Chinese accumulation of dollar-denominated securities.

#### 4.2 Fiscal Policy

A fiscal expansion in the U.S. shifts the ISXM curve to  $ISXM(G_1^*, E_0^*)$  in Figure 6, tending to raise output and interest rates. The dollar appreciates against the euro, given the assumed high capital mobility between the U.S. and Europe. The appreciation to  $E_1$  shifts the  $BP^*$  curve up and to the left and the ISXM curve moves back inward. These adjustments reflect a weakening of the effectiveness of the fiscal expansion.

With respect to China, the bilateral current account deteriorates and the financial account improves. The net effect is a deficit in the autonomous balance of payments with China. The central bank of China prevents the incipient appreciation of the yuan by intervening in the foreign exchange market. It then recycles the dollars acquired in the process back into circulation in the U.S. by

purchasing U.S. Treasury securities from the public. The imbalance in bilateral payments is made permanent by this move and China continues to accumulate claims against the United States. Once again, the automatic adjustment mechanism has been shut down and the ongoing payments deficit is financed by Chinese reserve accumulation.<sup>9</sup>

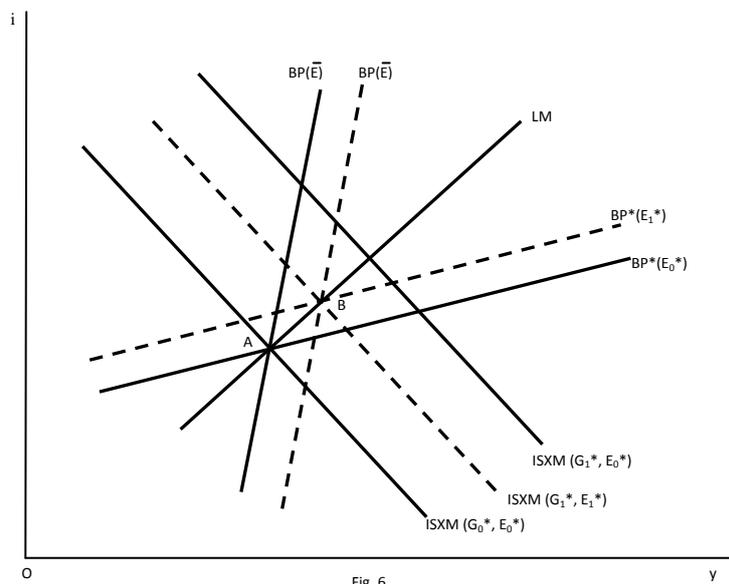


Fig. 6

## 5. Conclusion

In this mixed-regime model, the United States is neither a clear floater nor a full fixer, a condition which has ramifications for the effectiveness of monetary and fiscal policies in the context of cyclical stabilization. This paper has used a modified open-economy macro model to examine the implications. In an initial section, policy effectiveness is examined in the context of full flexibility of both exchange rates. The results are broadly consistent with the well-known benchmark model. However, high capital mobility between the U.S. and Europe, combined with low mobility between the U.S. and China, causes the two exchange rates to move in opposite directions in reaction to a fiscal expansion, with offsetting effects on policy effectiveness.

The paper next explores the case of a pegged yuan in the context of two scenarios. In the first, China recycles dollars absorbed in the process of exchange-market intervention by purchasing U.S. Treasury securities directly from the Fed, while in the second scenario the securities are purchased from the public. This allows China's pegging and recycling operations to "interfere" with the macro adjustment process within the United States. For example, even though the dollar is nominally free to fluctuate against the euro, the fact that China fixes the dollar-yuan rate "freezes" the dollar-euro rate. In another

example, China's purchases of U.S. Treasury securities from the public essentially shut down the automatic adjustment mechanism associated with fixed rates.

### Notes

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2. According to the IMF (2008), the U.S. operates an "independently floating" exchange-rate regime. The evidence shows that this is so both *de jure* and *de facto*. China's regime is classified as a "fixed peg," meaning no bands. For more on the ongoing debate over exchange-rate arrangements, see Levy-Yeyati and Sturzenegger (2005), Reinhart and Rogoff (2004) and Shambaugh (2004).

3. In the Bretton-Woods system, rates were fixed in a coordinated, consensual manner, with each country committed to the defense of the agreed-upon rates. In the present case, China fixes to the dollar unilaterally. While China is not the first country to have done so, it is the first country large enough to generate serious repercussions for the U.S.

4. We use this model as the benchmark model because it is well-known. It is the model found in most undergraduate and graduate textbooks and it is the paradigm widely used by contemporary policy makers. That does not always make it the best analytical tool. Alternative model choices would include the New Open Economy Macro Models as expounded by Obstfeld (2001), Obstfeld and Rogoff (1995), Lane (2001) and Corsetti (2007) and the portfolio-balance model (Frankel, 1993; Devereux and Sutherland, 2007).

5. Production networking and processing trade between China and the U.S. may reduce the response of the trade balance to changes in certain variables, including the exchange rate and domestic GDP (Arndt (2010)).

6. It is important to note that many countries in Asia fix their currencies to the dollar; others price their exports in dollars. Many are participants in international production networks that either feed end products to the United States or engage the U.S. in reciprocal components trade. These linkages have implications for exchange-rate and macro adjustment. (See, for example, Arndt and Huemer, 2007).

Suppose, for example, that China allows the yuan to float against the dollar, but that Singapore fixes its currency against the dollar. Then a yuan appreciation against the U.S. dollar is also a yuan appreciation against the Singapore dollar. The U.S. dollar price of end products from China rises, but the yuan price of components from Singapore falls and with it the cost of end-product exports to the United States. If Chinese value-added contained in Chinese exports is small, then dollar depreciation against the yuan has repercussions only for a small part of the price of end-products from China. The effect of exchange-rate changes on

the trade balance is reduced and with it the shift of BP due to a given exchange-rate shock.

7. We assume for simplicity that China pegs solely to the U.S. dollar and that it is a peg without bands. In reality, China is believed to operate a basket peg, with the dollar the dominant currency. China also has allowed the actual rate of the yuan to fluctuate. These departures from our simple peg will affect the magnitudes of various outcomes, but not the essential story. For further discussion of China's exchange-rate policy, see Frankel and Wei (2007).

8. In this section, we assume that sterilization is complete. A more realistic case would lie somewhere between this and the preceding scenario. See Obstfeld (1982) and Sarno and Taylor (2001), for example, for further discussion of the effectiveness of sterilization.

9. The fact that many of the components imported by China from third countries are incorporated into China's final-product exports implies that the "bilateral" current account deficit between the U.S. and the People's Republic is in reality a U.S. deficit with a multiplicity of countries. Indeed, only a relatively small part of the value of the trade imbalance between the U.S. and China is directly attributable to China as opposed to the countries that supply China with components and intermediate products. The importance of "processing" trade in China's overall trade is expertly examined in Xing (2011).

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