Currency Manipulation versus Current Account Manipulation

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Abstract

It is said that a country's currency peg can become currency manipulation representing protracted government intervention in the foreign exchange market that gives it unfair competitive advantage in international trade yet prevents effective balance of payments in its trade partners. Regarding this widespread fallacy, this paper explains why currency peg is not currency manipulation even when it keeps a country's currency undervalued. We clarify that 1) government is inherently a major player in the financial market and hence "no protracted intervention" is a meaningless guideline for designating currency manipulation; 2) exchange rate flexibility is neither a sufficient nor a necessary condition for fixing current account imbalance and hence currency peg would not prevent effective current account adjustments; and 3) as far as causing "unfair" trade advantage is concerned, currency peg is less guilty than the attempt to prevent or fix current account imbalance; and obligating a country to adjust its currency to accommodate its trade partners' current account management would unfairly impair this country's trade advantage. (E52 F31 F32)

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1. Introduction

Section 3004 of the United States Omnibus Trade and Competitiveness Act of 1988 (H.R. 3) stipulates that "the Secretary of the Treasury shall analyze on an annual basis the exchange rate policies of foreign countries, in consultation with the International Monetary Fund, and consider whether countries manipulate the rate of exchange between their currency and the United States dollar for purposes of preventing effective balance of payments adjustments or gaining unfair competitive advantage in international trade."

According to the Article IV of Agreement of International Monetary Fund (IMF), a country should "avoid manipulating exchange rates or the international monetary system in order to prevent effective balance of payments adjustment or to gain an unfair competitive advantage over other members". Specifically, IMF advises member countries to avoid "protracted, large-scale intervention in one direction in the exchange market" (Goldstein, 2004). Based on these IMF codes of conduct, the U.S. Treasury deems the authorities of an economy manipulating the exchange rate "if they intentionally act to set the exchange rate at levels, or ranges, to prevent effective balance of payments adjustments or gain unfair competitive advantage in international trade such that for a protracted period the exchange rate differs significantly from the rate that would have prevailed in the absence of action by the authorities."[2] In sum, "no protracted intervention", "no current account imbalance", and "no unfair trade advantage" are three

[2] See the Treasury's "Report To The Committees On Appropriations on Clarification Of Statutory Provisions Addressing Currency Manipulation" for details.

major guidelines for designating currency manipulation.

Entering the new millennium China has been accused of currency manipulation through pegging its currency (RMB) to the U.S. dollar (USD).[3] It is a common view that the RMB-USD peg has gained China unfair trade advantage yet caused large current account deficits and substantial manufacturing job losses in the United States.[4]

Notwithstanding considering China's currency peg distortionary, the U.S. Treasury has not found China meeting the "technical requirements" for designating currency manipulation yet (Snow, 2005). However, the U.S. legislators appeared to be convinced that China's currency peg is nothing but manipulation and have proposed legislations to either force China to stop it or protect the U.S. against it.[5]

In late July 2005, China revaluated its currency by 2% against the U.S. dollar and announced its intention to switch the RMB-USD peg to a trade-weighted currency basket peg. This "baby step" was welcomed by the U.S. policymakers but has not satisfied them

[3] While China is the main target of the currency manipulation accusation, Hong Kong, Japan, Korea, Malaysia, Singapore and Taiwan have also faced similar charges. For narrative convenience and clarity, we treat China as a representative currency manipulator; and our analysis applies to other alleged currency manipulators as well.

[4] For a few samples of this widespread view, see "Is China Playing by the Rules? Free Trade, Fair Trade, and WTO Compliance", Hearing before the Congressional-Executive Commission on China (September 24, 2003); "China's Industrial, Investment and Exchange Rate Policies: Impact on the United States", Hearing before the U.S.-China Economic and Security Review Commission (September 25, 2003); "China's Exchange Rate Regime and Its Effects on the U.S. Economy", Hearing before the Subcommittee on Domestic and International Monetary Policy, Trade and Technology of Committee on Financial Services (October 1, 2003); "The Report to the Congress on International Economic and Exchange Rate Policies", Hearing before the U.S. Senate Committee on Banking, Housing, and Urban Affairs (May 26, 2005); and "U.S.-China Economic Relations", Hearing before the U.S. Senate Committee on Finance (June 23, 2005).

[5] H.R. 3058 "Currency Harmonization Initiative through Neutralization Action Act of 2003" requires "the Secretary of the Treasury to analyze and report on the exchange rate policies of the People's Republic of China, and to require that additional tariffs be imposed on products of that country on the basis of the rate of manipulation by that country of the rate of exchange between the currency of that country and the United States dollar." The Schumer-Graham Bill introduced by Senators Charles Schumer (D-NY) and Lindsey Graham (R-SC) in 2005 threatens 27.5% countervailing tariffs against China's currency "manipulation".

yet.[6] Should there are no "larger steps in the future", China will most likely face the manipulation accusation again.

While currency peg has been a legitimate exchange rate regime for years,[7] China's large foreign reserve accumulation since the end of last century fits the description of "protracted large-scale intervention in one direction"; and the concurrently growing U.S. current account deficit seems to be the consequence of this intervention preventing "effective balance of payment adjustments".[8] Therefore, it seems obvious that China needs to adopt a more flexible exchange rate regime or at least substantially revaluate its currency; and failing to do so will be currency manipulation (Bergsten, 2004; Goldstein, 2004, 2005).

Not everyone agrees to the currency manipulation charge. Some authors claim that China's overall current account surpluses are relatively small and hence do not indicate misaligned currency value; and its unusually large reserve accumulation is mainly caused by speculative capital inflows and its control over capital outflows (Yang and Bajeux-Besnainou, 2004). Some authors argue that China should not abandon its currency peg that has been crucial to the stability of both its own and the world economy

[6] In the Senate Hearing on "The Federal Reserve's Second Monetary Policy Report to Congress for 2005", Senator Charles Schumer (D-NY), one of the sponsors of the Schumer-Graham Bill, had the following comments on China's new exchange rate regime. "This is a good first step, albeit a baby step. It is smaller than we had hoped, but to paraphrase the Chinese philosophers, a trip of a thousand miles can well begin with the first baby step. The most significant thing about this move is that the Chinese in effect have conceded that pegging their currency is bad for China, for the world economy, and for the U.S., and we are glad they have come to that understanding. If there are not larger steps in the future, we will not have accomplished very much. But after years of inaction, this step is welcome."

[7] The IMF does not prohibit a member country from adopting a fixed exchange rate regime. Indeed, for nearly three decades after World War II major nations in the world have tried to maintain a global fixed exchange rate regime called the Bretton Woods system; and recently many European countries have moved one step further to adopt a unified currency called Euro.

[8] China's foreign reserves have increased from 150 billion USD at the end of 1999 to 600 billion USD at the end of 2004; and the U.S. current account deficit increased from 300 billion USD in 1999 to 670 billion USD in 2004.

(McKinnon, 2003a,b; Mundell, 2004); and some suggest that China should revaluate its currency and move towards a more flexible exchange rate regime for its own benefits but not because currency peg is illegal currency manipulation (Eichengreen, 2004; Frankel, 2004; McCallum, 2004).

However, supporting the currency manipulation accusation or not, most participants in the RMB debates agree that China's persistent current account surpluses and substantial foreign reserve accumulation are evidence that the RMB has been undervalued. Then, why is a country artificially keeping its currency undervalued not manipulating it?

We are aware of no direct answers to this question, which is nevertheless the most powerful argument supporting the currency manipulation charge. Suffice it to say that until this question is clarified, the U.S. policymakers will continue believing that countervailing tariffs against currency peg are not protectionism but a legitimate measure to "level the playing field" in international trade.

This paper is to clarify why currency peg is not currency manipulation even when it keeps a country's currency undervalued. In the next section we first disabuse a fallacy on government "intervention" in the foreign exchange market and explain why "protracted government intervention" is a meaningless indicator of currency manipulation. Then in section 3 we analytically show that exchange rate flexibility is neither a sufficient nor a necessary condition for fixing currency account imbalance, which clarifies that currency peg does not "prevent effective balance of payments adjustments". Indeed, we argue that

currency peg tends to be helpful in fixing current account imbalance. In this section we also clarify that currency peg does not give a country unfair trade advantage; rather, obliging a country to revaluate its currency to help fix its trade partners' current account imbalance is "current account manipulation" that could unfairly impair this country's trade advantage. In section 4 we explore intellectual causes of such a widespread fallacy regarding currency manipulation. We conclude the paper in section 5.

2. Government "intervention" in the foreign exchange market: a clarification

China's large reserve accumulation since the new millennium unambiguously reflects the Chinese authorities' "protracted, large-scale intervention in one direction in the exchange market", which undoubtedly has caused the exchange rate to differ "from the rate that would have prevailed in the absence of action by the authorities." However, such "intervention" is not currency manipulation. Indeed, the whole idea of government "intervening" in the foreign exchange market is a fallacy we intend to clarify in the following.

According to the basic welfare theorem, prices determined by free market mechanism are efficient, while those under the influence of government tend to be distorted. Based on this free market doctrine, no currency manipulation is to let the market determine currency value.

However, while government can or should generally leave the goods market to the "invisible hand", it has to be a major player in the financial market. Indeed, a major task

of the Federal Reserve in the United States is to influence the Fed Funds Rate through open market operations in the treasury securities market.

If systematically intervening in the determination of interest rate (as a price between the same currency at two different times) is legitimate, why is intervention in the determination of exchange rate (as a price between two different kinds of currencies) "manipulation"? If the Federal Reserve has liberty to accumulate treasury securities for maintaining its interest rate target, what is wrong with the People's Bank of China doing the same thing for maintaining its exchange rate target?

Remark 2.1 *In the modern economy based on fiat money, the belief that there exists a purely market-based exchange rate free from government intervention is an illusion. Government, as the ultimate supplier of money, would affect the exchange rate, directly or indirectly.*

Indeed, in the recent RMB controversies, a case can be made that it is the United States who has been "manipulating" its currency. Although the U.S. has not directly intervened in the foreign exchange market, the interest rate cuts initiated by the Federal Reserves since 2000, which reduced the Fed Funds Rate from above 6% in 2000 to only 1% at the end of 2003, are effectively a "protracted, large scale intervention in one direction" that puts depreciating pressure on the dollar. Consequently, the cheap U.S. money flowing into China for higher returns becomes the foreign reserves of the Chinese government

who has been the trustee of the country's foreign assets. What such large reserve accumulation reflects is no more China's currency "manipulation" for preventing RMB appreciation than the U.S. "manipulation" to facilitate USD depreciation.

As pointed out by McCallum (2004), "exchange rate policy and monetary policy are not two independent entities"; and "in an economy without direct controls on foreign transactions, the two amount to virtually the same thing". The U.S. policymakers do not always agree to the Federal Reserve's monetary policy, yet they have not suggested that the Fed should let the market determine the interest rate. Likewise, governments' exchange rate policies are not always appropriate, yet "no intervention" is not the solution.

Remark 2.2 *"No protracted intervention" is a pointless guideline for designating currency manipulation. When the exchange rate is right, government's effort to maintain it, however protracted, is not currency manipulation. When the exchange rate is wrong, government's inaction would nevertheless be manipulation.*

3. Exchange rate and current account: a general equilibrium analysis

In general, the currency of a country with persistent current account surpluses (or deficits) is considered undervalued (or overvalued).[9] Based on this notion, China's currency peg

[9] While the U.S. policymakers are mainly concerned about the impact of China's currency manipulation on its current account, balance of payments, which includes both current and capital (or financial) account, is another often-used indicator of exchange rate misalignment (Goldstein, 2004). However, our clarification in the last section implies that

is deemed inappropriate because it seems to keep RMB at an undervalued level that sustains its current account surpluses yet causes excessive deficits in the United States.

However, an under-appreciated point is that correcting exchange rate misalignments does not necessarily entail exchange rate adjustments. Since by definition exchange rate is misaligned when current account is imbalanced, fixing the imbalance would automatically correct the misalignment. The key is whether fixing current account imbalance must require adjusting the exchange rate; in other words, whether exchange rate flexibility is a necessary condition for current account adjustments.

Indeed, whether exchange rate flexibility is a sufficient condition for fixing current account imbalance is also questionable. It is true that other things being equal, currency depreciation tends to improve a country's current account through reducing its terms of trade. However, other things can hardly remain equal when the exchange rate is changed; *e.g.*, dollar depreciation would tend to generate inflation pressure that forces the Federal Reserve to raise the interest rate. Therefore, a general equilibrium perspective is needed to examine whether exchange rate is an effective instrument for fixing current account imbalance.

Although exchange rate adjustments may be neither a sufficient nor a necessary condition for fixing current account imbalance, they could be helpful in that respect. Indeed, exchange rate seems to be the most favorite tool for fixing current account

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capital account (or financial account) imbalance is not an appropriate indicator of exchange rate misalignment—more discussion on this point can be found in section 4.

imbalance. Its legitimacy has been taken for granted to such an extent that when there exists current account imbalance, fixed exchange rate becomes currency manipulation for unfair trade advantage. This popular view is nevertheless a fallacy.

In the following we will use a general equilibrium model to show that 1) exchange rate alone is not an effective instrument for fixing current account imbalance; *i.e.*, exchange rate flexibility is not a sufficient condition for current account adjustments; 2) neither is exchange rate flexibility a necessary condition for current account adjustments; and 3) fixed exchange rate does not provide unfair trade advantage; rather, obligating a surplus country to revaluate its currency could unfairly impair its trade advantage.

3.1 The model

Similar to many works on the RMB controversies (*e.g.*, Frankel, 2004), we use the Mundell-Fleming framework to model the determination of exchange rate and current account. We use a two-country model, which allows us to examine the issue from a global perspective that considers not only the home country's policy targets but also those of the foreign country. It should be noted that since trade balance is the dominant component of current account and the focus of the RMB controversies, in this model we consider only trade balance instead of the entire current account that also includes other payments and receipts.

The model contains two countries and four goods. Q_{1x} and Q_{1n} are tradable and

non-tradable goods produced in country 1, while Q_{2m} and Q_{2n} are their respective counterparts in country 2. Note that country 1 and 2 represent the United States and those accused currency manipulators in the context of the RMB controversies.

For simplicity, assume labor (L) is the only input in the production functions:

$$Q_{ij} = \alpha_{ij} L_{ij}, \tag{1}$$

where the parameter $\alpha > 0$ measures labor productivity; and the subscripts $i = 1, 2$ and $j = x, m, n$ identify countries and goods respectively.

Suppose labor income absorbs the entire production revenue,[10] *i.e.*,

$$W_i \, L_{ij} = P_{ij} \, Q_{ij}, \tag{2}$$

where P_{ij} is the price of good *j* in country *i* (in terms of its currency); and W_i is the wage rate in country *i*, which is identical in the tradable and non-tradable sectors.

Suppose consumption is Cobb-Douglas in both countries; then the value of country *i*'s consumption of good *j* is a fixed proportion of its total consumption, *i.e.*,

$$P_{ij} \, C_{ij} = \theta_{ij} Y_i(i_i, s_i), \tag{3}$$

where C_{ij} represents country *i*'s consumption of good *j*; Y_i denotes country *i*'s aggregate demand that is a function of the interest rate (as a monetary policy instrument) and subject to the exogenous demand shock s_i ($\partial Y_i / i_i < 0$ and $\partial Y_i / \hat{s}_i > 0$); and θ_{ij} is a parameter measuring country *i*'s consumption preference over good *j* ($\sum_j \theta_{ij} = 1$ meaning that country *i*'s aggregate demand is equal to its total consumption

[10] It would make no intrinsic difference to assume that the labor income is less than 100 percent yet a constant share of the production revenue.

expenditure).[11]

The goods market equilibrium conditions are

$$C_{1n} = Q_{1n} \tag{4}$$

$$C_{1x} + C_{2x} = Q_{1x} \tag{5}$$

$$C_{2n} = Q_{2n} \tag{6}$$

$$C_{1m} + C_{2m} = Q_{2m} \tag{7}$$

$$P_{2x} = eP_{1x} \tag{8}$$

$$P_{2m} = eP_{1m} \tag{9}$$

$$L_{1x} + L_{1n} = \overline{L}_1 \tag{10}$$

$$L_{2m} + L_{2n} = \overline{L}_2 \tag{11}$$

$$(1+i_1)(1+\dot{e}/e) = 1+i_2 \tag{12}$$

Equations (4) and (5) are the market clearing conditions for the tradable and non-tradable sectors in country 1; and equation (6) and (7) are the similar conditions in country 2. Equations (8) and (9) are the law of one price for the two tradable goods Q_x and Q_m, where e denotes the exchange rate.[12] Equation (10) and (11) are the labor market clearing conditions in the two countries. Equation (12) represents the interest parity under free capital mobility.

Regarding the internal balance, suppose the two countries target their domestic inflation rates defined respectively by

[11] The sum of θ's would be less than 1 if the investment component of aggregate demand is considered. Since that would not gain us extra insights, we do not consider the investment component for simplicity.

[12] Suppose country 1 and 2 are the United States and China respectively, then e = 8.3 yuan/dollar under China's currency peg.

$$\pi_1 \equiv (P_{1x}C_{1x} + P_{1m}C_{1m} + P_{1n}C_{1n})(\overline{P}_{1x}C_{1x} + \overline{P}_{1m}C_{1m} + \overline{P}_{1n}C_{1n})^{-1} - 1 \tag{13}$$

and

$$\pi_2 \equiv (P_{2x}C_{2x} + P_{2m}C_{2m} + P_{2n}C_{2n})(\overline{P}_{2x}C_{2x} + \overline{P}_{2m}C_{2m} + \overline{P}_{2n}C_{2n})^{-1} - 1 \tag{14}$$

where π_i is the inflation rate in country *i*; and $\overline{P}_{ij}$ are the benchmark base price of good *j* in country *i*. According to this definition, country *i* would have zero inflation if the value of its total consumption under the current prices (P_{ij}) is the same as it would be under the base prices ($\overline{P}_{ij}$).

The last equation in the model defines country 1's current account balance as

$$CA \equiv P_{1x}C_{2x} - P_{1m}C_{1m}. \tag{15}$$

In Appendix A.1 and A.2 we present more details of this model and show that it can be reduced to the following 6 equations.

$$P_{1x} = \frac{1-\theta_{1m}}{\alpha_{1x}\overline{L}_1} Y_1(i_1, s_1) + \frac{\theta_{2x}}{\alpha_{1x}\overline{L}_1 e} Y_2(i_2, s_2) \tag{16}$$

$$P_{2m} = \frac{e\theta_{1m}}{\alpha_{2m}\overline{L}_2} Y_1(i_1, s_1) + \frac{1-\theta_{2x}}{\alpha_{2m}\overline{L}_2} Y_2(i_2, s_2) \tag{17}$$

$$P_{1x} = (1+\overline{\pi}_1)\left(\theta_{1x}\overline{P}_{1x} + \overline{P}_{1m}\theta_{1m}\frac{eP_{1x}}{P_{2m}} + \overline{P}_{1n}\frac{\alpha_{1n}\theta_{1n}}{\alpha_{1x}}\right) \tag{18}$$

$$P_{2m} = (1+\overline{\pi}_2)\left(\theta_{2m}\overline{P}_{2m} + \overline{P}_{2x}\theta_{2x}\frac{P_{2m}}{eP_{1x}} + \overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}}\right) \tag{19}$$

$$(1+i_1)(1+\dot{e}/e) = 1+i_2 \tag{20}$$

$$CA = \frac{\theta_{2x}Y_2(i_2, s_2)}{e} - \theta_{1m}Y_1(i_1, s_1) \tag{21}$$

Equation (16), derived from equations (1)-(11), is a necessary condition for goods and labor market equilibrium in country 1; equation (17) represents the corresponding

condition for country 2. Equation (18), derived based on equation (13), represents a necessary condition for country 1 to achieve its inflation target $\overline{\pi}_1$ as the goal of its internal balance; and equation (19) is a necessary condition for country 2 to achieve $\overline{\pi}_2$. Equation (20), identical to equation (12), represents the interest parity under free capital mobility, which implies identical interest rates in the two countries (*i.e.* $i_1 = i_2$) when the exchange rate is in equilibrium (*i.e.*, $\dot{e} = 0$). Equation (21), derived based on equation (15), provides a macroeconomic perspective of current account determination.

These 6 equations simultaneously determine the equilibrium of the world economy; based on which we first examine whether flexible exchange rate is a sufficient condition for country 1 to use exchange rate as an instrument to fix its current account imbalance.

Solving our deceptively simple model turns out to be extremely tedious in algebra. For clarity we place most of the mathematical details in the appendix and focus on discussing intuitions behind the results in the text.

3.2 Flexible exchange rate as an instrument for current account adjustments

According to equation (21),

$$\partial CA / \partial e = -\theta_{2x} Y_2 e^{-2} < 0,$$

which implies that given the aggregate demands Y_1 and Y_2, country 1 can improve its current account through currency depreciation (*i.e.*, a decrease in e).[13] However, since

[13] Intuitively, given country 2's aggregate demand and hence its expenditure on imported goods, country 1's currency depreciation would increase the value of its export (in terms of its own currency) to country 2 and hence improve its current account.

the exchange rate *e* appears in all the 6 equations from (16) to (21), its change is unlikely to have no impacts on Y_1 and Y_2. Therefore, a general equilibrium perspective is needed to examine whether exchange rate is an effective instrument for fixing current account imbalance.

Suppose initially the world economy is in an equilibrium described by

$$\Gamma^* \equiv \{ i_1^*, i_2^*; \bar{\pi}_1, \bar{\pi}_2, e^*, CA^* \},$$

i.e., under the interest rates i_1^* and i_2^*, both countries achieve their inflation targets $\bar{\pi}_1$ and $\bar{\pi}_2$, with the corresponding equilibrium exchange rate at e^* and current account at CA^*. Note that $i_1^* = i_2^*$ since the expected exchange rate movement is equal to zero at equilibrium (*i.e.*, $\dot{e}^* = 0$).

Then, suppose a positive aggregate demand shock occurs in country 1 (*i.e.*, $ds_1 > 0$) and shifts the world economy to a new situation described by

$$\hat{\Gamma} = \{ \hat{i}_1, \hat{i}_2; \bar{\pi}_1, \bar{\pi}_2, \hat{e}, \hat{CA} \},$$

where $\hat{i}_1 = \hat{i}_2 > i_1^* = i_2^*$ (*i.e.*, a higher world interest rate), $\hat{e} > e^*$ (an appreciation in country 1's currency), and $\hat{CA} < CA^*$ (*i.e.*, a deterioration of country 1's current account).[14]

Intuitively, the positive demand shock generates inflation pressure that forces country 1's government to raise i_1, which will induce the appreciation of country 1's currency. The inflation pressure as well as the interest rate hike in country 1 will be transmitted to

[14] We assume that both country 1 and 2's consumption of imported goods is relatively small compared to their domestic consumption, which is not unrealistic. Under this assumption, we show in Appendix that, a positive demand shock in country 1 would drive up the interest rate (see inequality A.50 in Appendix A.3.2), appreciate its currency (see inequality A.68 in Appendix A.3.5), and deteriorate its current account (see inequality A.57 in Appendix A.3.2).

country 2 through the goods and asset markets, and force country 2's government to raise i_2. The resulting decrease in country 2's aggregate demand helps accommodate country 1's expanding demand, which explains the current account deterioration.

In the situation of $\hat{\Gamma}$, suppose country 1's government is uncomfortable with its current account balance $\hat{CA}$ and wishes to improve it back to CA^*. Will currency depreciation be an effective instrument to achieve this goal? The answer is negative.

Suppose country 1 is able to depreciate its currency from $\hat{e}$ to $\tilde{e}$. As this depreciation generates inflation pressure in country 1 by increasing its import price, country 1's monetary authorities will have to increase the interest rate i_1. According to equation (21), both the currency depreciation (*i.e.*, a lowered e) and the interest rate hike (*i.e.*, a higher i_1) would help improve country 1's current account. The impact of country 1's policy is not limited to itself. Both the decreases in e and Y_1 will generate deflation pressure in country 2 and force it to cut the interest rate i_2. This interest rate cut would stimulate country 2's aggregate demand Y_2, which according to equation (21) also helps improve country 1's current account. Therefore, currency depreciation from $\hat{e}$ to $\tilde{e}$ seems to be able to move the world economy from $\hat{\Gamma}$ to

$$\tilde{\Gamma} = \{ \tilde{i}_1, \tilde{i}_2; \bar{\pi}_1, \bar{\pi}_2, \tilde{e}, CA^* \}$$

under which country 1 achieves the goal of increasing its current account from $\hat{CA}$ back to CA^*.

Unfortunately, this desirable situation of $\tilde{\Gamma}$ is not in equilibrium. As discussed above, the exchange rate decline from $\hat{e}$ to $\tilde{e}$ will cause an interest disparity

(*i.e.*, $\tilde{i}_1 > \tilde{i}_2$) by driving up country 1's interest rate yet pushing down country 2's. This disparity will generate appreciating pressure to push the exchange rate back to the level of $\hat{e}$ and foil country 1's attempt to fixed current account imbalance through currency depreciation.

Country 1 should not blame country 2 for cutting its interest rate to hinder the currency depreciation crucial for fixing its current account imbalance; the latter merely tries to maintain its internal balance. Indeed, country 1's own interest rate hike for its own internal balance is also a force against the depreciation. The key is that flexible exchange rate is an endogenous variable not supposed to be an effective instrument to influence current account.

Remark 3.1 *The exchange rate is not an effective instrument for fixing current account imbalance because monetary policies used by countries to maintain their internal balance have already indirectly determined it.*

This should not be surprising; it reflects the spirit of the well-known "incompatible trinity". That is, free capital mobility does not allow a country to independently target both its inflation rate and the exchange rate through monetary policy. Here from a global perspective, two instruments (*i.e.*, country 1 and 2's interest rates i_1 and i_2) are not enough to achieve three independent targets (*i.e.*, their domestic inflation rates $\bar{\pi}_1$ and $\bar{\pi}_2$ and the exchange rate e). Therefore,

Remark 3.2 *To the disappointment of those who count on currency depreciation to fix current account imbalance, flexible exchange rate is not a sufficient condition for current account adjustments.*

3.3 Fixed exchange rate as a hindrance to current account adjustments

The impotence of flexible exchange rate in fixing current account imbalance has not acquitted currency peg of the manipulation charge yet, since fixing current account imbalance could be a mission impossible without exchange rate flexibility. However, is flexible exchange rate a necessary condition for current account adjustments?

To answer this question, we examine whether and how country 1 can fix its current account imbalance under flexible exchange rate and currency peg respectively.

Current account management under flexible exchange rate

Recall that under flexible exchange rate, a positive demand shock in country 1 can shift the world economy from Γ^* to $\hat{\Gamma}$, causing country 1's current account to deteriorate from CA^* to $C\hat{A}$. Therefore, conversely when the world economy is in the situation of $\hat{\Gamma}$, country 1's government can initiate a negative demand shock through fiscal tightening to shift the world economy from $\hat{\Gamma}$ to Γ^* and hence improve its current account from $C\hat{A}$ to CA^*.

Intuitively, as the fiscal tightening reduces its aggregate demand, country 1's

monetary authorities have to cut the interest rate to maintain its internal balance. The resulting interest disparity will cause country 1's currency to depreciate.[15] As the depreciation makes country 1's production cheaper yet country 2's more expensive, the world demand on country 2's production will shrink. Consequently, country 2 will cut its interest rate to generate more demand on domestic goods, which at the same time also induces more demand on country 1's exports. Eventually, the country 1's fiscal tightening can shift the world economy from $\hat{\Gamma}$ to Γ^* with an increase in country 1's current account (*i.e.*, $CA^* > C\hat{A}$), a decline in the world interest rate ($i^* < \hat{i}$), and a depreciation in country 1's currency ($e^* < \hat{e}$). In sum,

Remark 3.3 *Under flexible exchange rate, fiscal tightening is an effective instrument for fixing current account imbalance, which tends to be accompanied by currency depreciation.*

Although fixing current account imbalance through fiscal tightening tends to cause currency depreciation, it could be misleading to credit the depreciation as the "cause" of the adjustment. Indeed, currency depreciation is merely one of the many factors (*e.g.* decline in the interest rates as another) that facilitate current account improvement driven by fiscal tightening.

[15] Since country 1's fiscal tightening will reduce its import demand, country 2 may also react with interest rate cuts, which nevertheless tend to be relatively small.

However, what if country 2 adopts a fixed exchange rate regime? Will fiscal tightening still be able to fix country 1's current account imbalance under country 2's currency peg?

Current account management under currency peg

In the situation of $\hat{\Gamma}$, suppose country 1 attempts to use fiscal tightening to improve its current account from $\hat{CA}$ to CA^*, while country 2 commits to keeping the exchange rate fixed at $\hat{e}$ and hence loses its monetary independence. Thus, in the simultaneous system (16)-(21), the exchange rate becomes exogenous, while country 2's inflation rate π_2 is endogenized. Under this situation, we show in Appendix A.4.1 (see equations A.77 and A.78) that

$$\frac{dCA}{ds_1} < 0$$

and

$$\frac{d\pi_2}{ds_1} < 0 ,$$

which indicates that under the fixed exchange rate, fiscal tightening (*i.e.* $ds_1 < 0$) can still help country 1 to fix its current account imbalance (*i.e.* $dCA > 0$), but would cause higher inflation in country 2 (*i.e.*, $d\pi_2 > 0$) who prioritizes its exchange rate stability over inflation stability.

Remark 3.4 *Currency peg does not hinder current account adjustments. Currency peg*

fixes only the nominal exchange rate, while current account adjustments depend on the terms of trade that can be adjusted through price variations in the goods markets.

The situation becomes more complicated if country 2 wishes to target both its inflation rate and the exchange rate. Two targets take two instruments. While country 2 loses its monetary independence because of the currency peg, fiscal policy can help it keep domestic inflation rate under control. Under this situation, we show in Appendix A.4.2 that

$$\frac{dCA}{ds_1} = 0 \ ,$$

which indicates that fiscal tightening in country 1 will not be able to help it fix its current account imbalance when country 2 targets both its inflation rate and the exchange rate.

Intuitively, when country 2 sacrifices its monetary independence for currency peg, fiscal tightening allows country 1 to adopt expansionary monetary policy to stimulate the aggregate demand in country 2, which is the key mechanism for fixing its current account imbalance. However, this mechanism breaks down when country 2 uses fiscal policy to influence its domestic demand.

However, even under this situation, fixing current account imbalance is still not impossible: Country 1 has an option to sacrifice its inflation target for its goal of external balance. When country 1 quits targeting inflation for current account management, the interest rate i_1 becomes exogenous while its inflation rate π_1 is endogenized in the

simultaneous system (16)-(21). Thus, country 1 can use the interest rate to influence the current account. In Appendix A.4.2 (equations A.81 and A.82) we show that

$$\frac{dCA}{di_1} > 0$$

and

$$\frac{d\pi_1}{di_1} < 0 \ ,$$

which indicates that monetary tightening can help country 1 fix current account imbalance but would lead to below-target inflation.

Intuitively, under currency peg, monetary tightening in country 1 (*i.e.*, $di_1 > 0$) will induce similar tightening in country 2, which will have negative impacts on both countries' aggregate demands. However, while country 2 will use fiscal expansion to counteract this impact to maintain its inflation target, country 1 can choose not to do so and hence improve its current account (*i.e.*, $dCA > 0$).

In sum, as long as country 1 adopts appropriate policies, country 2's currency peg would not prevent it from fixing its current account imbalance. Therefore,

Remark 3.5 *Exchange rate flexibility is not a necessary condition for current account adjustments.*

Indeed, currency peg can actually facilitate current account adjustments. As discussed above, inducing aggregate demand expansion in country 2 is the key to reducing country

1's current account deficits. Under flexible exchange rate, since country 2's monetary authorities do not "intervene" in the foreign exchange market, the transmission mechanism is mainly through the goods market: Currency depreciation puts deflation pressure in country 2's goods market and forces country 2 to cut its interest rate to stimulate the aggregate demand. One problem of this mechanism is that the exchange rate may not affect the terms of trade effectively because of low exchange rate passthrough; and another problem is that price adjustments in the goods market tend to be slow.

In contrast, the transmission mechanism under fixed exchange rate would be more straightforward: When fiscal tightening forces country 1 to cut its interest rate to fight the resulting deflation pressure, country 2 has to cut its as well in order to maintain the interest parity that it has to respect under the currency peg.

Since this transition mechanism through the asset market tends to work more effectively and swiftly than the one through the goods market, country 1 would find a country 2 with currency peg more supportive to its effort in fixing current account than one without.

Theoretically, country 1 may have to sacrifice its inflation stability for fixing its current account imbalance when country 2 uses both monetary and fiscal policies to target both its inflation rate and the exchange rate. Yet in reality the chance for country 1 to be in this situation tends to be slim because from country 2's point of view, fighting inflation pressure from abroad with exchange rate adjustments tends to be more convenient than resorting to fiscal tightening. Indeed, one major rationale for China to

increase the flexibility of its exchange rate is to shelter it from foreign shocks (Frankel, 2004).

3.4 Currency manipulation versus current account manipulation

Our foregoing analysis has cleared the charge that a country's currency peg that keeps its currency undervalued is currency manipulation because it prevents effective current account adjustments in its trade partners. In the following we will examine another charge against currency peg. That is, currency peg that keeps a country's currency undervalued gives it "unfair" competitive advantage in international trade. We are aware of no serious examination of this popular assertion; observers either take it for granted or simply dismiss it. However, its validity is crucial: Were it true, countervailing measures against currency peg would be justified; otherwise, they are disguised protectionism.

A measure of competitive advantage in international trade

In our model, trade advantage can be measured by the terms of trade defined as

$$TOT \equiv \frac{eP_{1x}}{P_{2m}}. \tag{22}$$

The greater the TOT is, the cheaper and hence the more competitive is the country 2's tradable goods (Q_{2m}); and the more expensive and hence the less competitive is country 1's tradable goods (Q_{1x}).

According to equation (22), it seems obvious that currency peg provides unfair trade

advantage when it keeps a country's currency undervalued: When country 2's currency is pegged at an undervalued level, the exchange rate *e* would be higher than what it should have been under flexible exchange rate, which will inflate the TOT and hence "unfairly" increase country 2's trade advantage. However, this plausible argument neglects the impact of country 2's currency peg on its domestic price level. As mentioned in Remark 3.4, currency peg only fixes the nominal exchange rate, while the terms of trade can be adjusted via price variations in the goods markets.

To examine how currency peg affects the terms of trade, we assume a positive productivity shock occurring in country 2's tradable sector (*i.e.*, $d\alpha_{2m} > 0$) and compare how the terms of trade would respond to this shock in three scenarios

No manipulations: a benchmark scenario

Solving equations (1) and (2) simultaneously and using equation (22), we obtain

$$TOT = \frac{eW_1\alpha_{2m}}{W_2\alpha_{1x}},$$

which indicates that given the wage rates in country 1 and 2, country 2's productivity hike in the tradable sector (i.e., $d\alpha_{2m} > 0$) will increase its trade advantage through raising country 1's terms of trade (*i.e.*, $dTOT > 0$). This is not surprising; a country's productivity hike in its tradable sector is supposed to be one of the most legitimate sources of its competitive advantage in international trade. However, since the productivity hike tends to affect the wage rates through the Balassa-Samuelson effect,

this partial equilibrium result is merely illustrative; a general equilibrium analysis is needed.

We first consider a benchmark scenario under which both countries use monetary policy to target their domestic inflations only and do not directly intervene in the determination of the exchange rate or the current account. Based on the simultaneous system (16)-(21), we show in Appendix A.3.1 (equation A.46) that under this benchmark situation

$$dTOT^{BM} = \Phi_1 d\alpha_{2m}, \tag{23}$$

where $\Phi_i > 0$ are summarizing notations whose expressions are given in the appendix. We also show in Appendix A.3.3 (equation A.58) that it is possible that

$$dCA = -\Phi_2 d\alpha_{2m}, \tag{24}$$

and in Appendix A.3.4 (equation A.63) that it is possible that

$$de = -\Phi_3 d\alpha_{2m}. \tag{25}$$

These results indicate that without foreign exchange or current account intervention, a positive productivity shock in country 2's tradable sector ($d\alpha_{2m} > 0$) would increase its trade advantage by increasing country 1's terms of trade (i.e. $dTOT > 0$), and could depreciate country 1's currency ($de < 0$) and worsen its current account ($dCA < 0$).[16] We

[16] Intuitively, the productivity increase in country 2's tradable sector would increase the supply capacity of its tradable goods relative to country 1's tradable goods, which explains its positive impact on country 1's terms of trade. According to equation (22), the adjustment in the terms of trade can be accomplished by a decline in the price of country 2's tradable goods (i.e., P_{2m}) and/or an increase in the price of country 1's tradable goods (i.e., P_{1x}). However, since both countries target their inflation rates, the term of trade adjustment tends to also entail a change in the nominal exchange rate. The extra supply due to the productivity hike in country 2 tends to cause a decline in the world interest rate to generate more aggregate demands in both countries to accommodate this supply increase. Since the extra supply belongs to country 2 only, the increase in country 1's aggregate demand tends to increases its current account deficit.

take this case as the benchmark scenario to examine how currency peg affects competitive advantage in international trade in the next scenario and how current account management affects trade advantage in the third scenario.

Currency manipulation and trade advantage

In the second scenario we consider a situation where country 1 uses its monetary policy to target its domestic inflation, while country 2 uses its to target the exchange rate.

When the exchange rate is fixed (*i.e.*, $de = 0$), country 2's tradable productivity hike would not be able to reduce the exchange rate *e* as it would under the flexible exchange rate. However, as a result, country 2's price level will be higher. While the former will further increase country 2's trade advantage, the latter represents an opposite force. Our initial conjecture was that these two forces would offset each other so that the impact of the productivity shock on the terms of trade would be the same with or without the currency peg. It turns out that this conjecture is inaccurate.

In Appendix A.5 we show that when country 2 sacrifices its monetary independence for targeting the exchange rate (*i.e.*, in the simultaneous system (16)-(21), *e* becomes exogenous while π_2 becomes endogenous), a productivity shock in country 2's tradable sector will have the following impact on country 1's terms of trade:

$$dTOT = \Phi_4 d\alpha_{2m} + \Phi_5 de. \tag{26}$$

Recall that equation (25) measures how the exchange rate would have changed by the productivity shock under the no-manipulation benchmark situation. Thus, substituting it

into equation (26), we obtain the benchmark impact of the productivity hike on the terms of trade under the situation with neither exchange rate nor current account intervention:

$$dTOT^{BM} = (\Phi_4 - \Phi_3\Phi_5)d\alpha_{2m}. \tag{27}$$

According to equation (26), when country 1 pegs its currency (*i.e.*, $de = 0$), the terms-of-trade impact would be

$$dTOT^{EX} = \Phi_4 d\alpha_{2m}. \tag{28}$$

A comparison between equations (27) and (28) indicates that

$$dTOT^{EX} > dTOT^{BM}; \tag{29}$$

i.e., country 2's productivity shock would have a greater impact on country 1's terms of trade under the fixed exchange rate than in the no-manipulation benchmark scenario. Therefore,

Remark 3.6 *A country's positive productivity shock in its tradable sector can increase its competitive advantage in international trade by a greater extent under currency peg than under flexible exchange rate.*

Such extra trade advantage is due to a wealth effect. The productivity shock in country 2 represents a deflationary force that will reduce the world interest rate so as to stimulate the aggregate demands in both countries. Each country's contribution to fighting this deflation pressure mainly depends on the interest elasticity of its aggregate demand. However, whether price adjustments in international trade are accomplished directly

through price variations in goods markets or indirectly via exchange rate adjustments also matters. Since the higher domestic price level in country 2 under the currency peg will cause a wealth effect that negatively affects its aggregate demand, its aggregate demand expansion would be smaller under the currency peg than when the exchange rate is flexible; and that of country 1 would be greater. Since own goods tend to dominate foreign goods in both countries' consumption portfolios, country 2's domestic prices will be lower under the currency peg than the flexible exchange rate; and those of country 1 would be higher. This explains why country 1 would have a higher terms of trade when country 2 pegs its currency.

Current account manipulation and trade advantage

According to equation (24), even when country 2 does not peg its currency, the productivity hike in country 2's tradable sector would still cause current account imbalance in country 1. Thus, country 1's authorities need to intervene to avoid this situation.

In the following we consider a scenario where country 1 uses monetary policy to target its domestic inflation and fiscal policy to manage its current account, while country 2 merely uses monetary policy to target its domestic inflation and let the exchange rate float.

We show in Appendix A.6 that under this situation, the impact of the productivity shock in country 2's tradable sector on country 1's terms of trade would be

$$dTOT = -\Phi_6 dCA + \Phi_7 d\alpha_{2m}. \quad (30)$$

Recall that equation (24) measures how country 1's current account would have changed by the productivity shock in the no-manipulation benchmark scenario. Thus, substituting it into equation (30), we obtain the benchmark impact of the productivity hike on the terms of trade:

$$dTOT^{BM} = (\Phi_2\Phi_6 + \Phi_7)d\alpha_{2m}. \quad (31)$$

On the other hand, when country 1 manages to avoid current account imbalance by keeping $dCA = 0$, the impact of the productivity shock on the terms of trade would be

$$dTOT^{CA} = \Phi_7 d\alpha_{2m} \quad (32).$$

A comparison between equations (31) and (32) indicates that

$$dTOT^{BM} > dTOT^{CA} \quad (33)$$

which implies that country 2 would gain less trade advantage from its productivity hike if country 1 managed to avoid the current account imbalance caused by the increased productivity. Less competitive advantage for country 2 means relatively more competitive advantage for country 1. Therefore,

Remark 3.7 *Currency account "manipulation" that fixes or prevents current account imbalance can gain a country extra trade advantage.*

Currency manipulation versus current account manipulation

Combining inequalities (29) and (33), we obtain

$$dTOT^{EX} > dTOT^{BM} > dTOT^{CA}, \tag{34}$$

which implies that while country 2 can gain extra competitive advantage in international trade from pegging its currency, country 1 can also gain extra trade advantage through targeting its current account balance. The question is whether such extra advantages are "unfair".

It is inconceivable that a country would try to enhance its export competitiveness by pegging its currency. Indeed, currency peg is a macroeconomic policy for creating a more stable market mechanism to improve microeconomic efficiency. While a country's currency peg may gain it extra trade advantage through the wealth effect, it is not the result of its interference with trade flows or price adjustments in international trade but the consequence of higher inflation. Thus, we do not see any *a priori* reason to deem such extra trade advantage unfair.

Current account management is also a macroeconomic policy for preventing potential economic instability in the future; and we are aware of no country claiming that it intentionally uses current account policy to enhance its competitiveness in international trade. However, while the legitimacy of preventing or fixing current account imbalance is often taken for granted, its implications to international trade are seldom discussed. Indeed, forbidding current account imbalance is to guarantee that a country's tradable sector (as a whole) will not lose its world market share from international competition because for every bit of domestic market yielded, "no imbalance" implies that there will be an equal amount of gain in the foreign market. Therefore, in the sense that current

account management represents interference with international trade (notwithstanding for a legitimate cause), any extra competitiveness a country gains from targeting its current account would reflect unfair trade advantage. Ironically, under the no-imbalance rule, this country's trade partners would be obliged to adjust their currencies to accommodate the current account "manipulation" that unfairly impair their trade advantage or otherwise be guilty of currency "manipulation".

In sum,

Remark 3.8 *A country's currency peg does not provide it with unfair trade advantage. Rather, a country can gain unfair trade advantage through preventing or fixing current account imbalance. Therefore, as far as causing unfair trade advantage is concerned, currency peg is less a manipulation than the attempt to prevent or fix current account imbalance.*

4. Discussion

John Maynard Keynes' conviction that "the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas" still stands;[17] currency manipulation would not have become such a prevalent and forceful charge had the

[17] In concluding his General Theory, Keynes shared his following insights: "Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas."

plaintiffs not genuinely believed that currency peg unfairly impairs their interests. Yet the question is the encroachment of what ideas is responsible for such a widespread fallacy regarding currency manipulation.

Dogmatically endorsing the free-market doctrine is the number one factor behind the false accusation of currency manipulation. Currency peg is a natural suspect of manipulation because it entails government "intervention" in the foreign exchange market. Those against currency "manipulation" often believe that they are on a moral high ground defending the sacrosanct free market mechanism. Yet they actually miss the point that a purely market-based and government-free exchange rate does not exist. As the ultimate supplier of money, government has to be part of the mechanism determining the exchange rate, directly or indirectly.

Persistent balance of payments surplus or large foreign reserves accumulation is often viewed as evidence of currency manipulation because they manifest government's presence in the foreign exchange market. However, compared to the Chinese government holding a large amount of treasury securities by itself, what would be the difference had it given money to its citizens and allowed them to purchase the U.S. treasury securities instead? According to the rule of no protracted intervention, the United States would have been guilty of currency manipulation had the Federal Reserves conducted its open market operations in the foreign exchange market during its monetary expansion in the early 2000s. However, what is effectively different as it actually injected the cheap money through the treasury markets?

The free-market doctrine is still valid; the key is to respect government's "freedom" in choosing monetary policy instruments. Blessed with its mature financial system, sophisticated central banking institutions, and special status in the international financial system, the United States does not have to use the exchange rate as a monetary policy instrument. However, this should not prohibit other countries from using it.

Misunderstanding the concept of exchange rate misalignment is another factor behind the false accusation of currency manipulation. Economics theory declares that a country with persistent current account surpluses has an undervalued currency. This seems to automatically convict a surplus country guilty of currency manipulation by pegging its currency. After all, why is a country artificially keeping its currency undervalued not manipulating it? The answer is actually straightforward, as long as one correctly understands the concept of exchange rate misalignment. In short, currency peg is not manipulation even when it keeps the currency misaligned because currency peg does not cause the misalignment; current account imbalance does. A fixed exchange rate can never trigger current account imbalance. Yet when current account imbalance occurs for other reasons such as tax cuts, government expenditure expansion, or both, the fixed exchange rate would become misaligned by definition. A natural way to correct such misalignments is to fix the current account imbalance by counteracting its original causes. A wishful thinking is the other way around, *i.e.*, to fix current account imbalance by correcting exchange rate misalignments. However, as discussed above, exchange rate is not an effective instrument for fixing current account imbalance.

Misunderstanding the concept of exchange rate misalignment is also responsible for the misperception that currency peg would prevent effective current account adjustments. Indeed, our analysis has shown that flexible exchange rate is not a necessary condition for current account adjustments. Economics theory declares that exchange rate is misaligned when current account is imbalanced, yet that means the misalignment of the *real* exchange rate, which is determined jointly by the domestic price level of the surplus country, that of the deficit country, and the nominal exchange rate between their currencies. Thus, currency peg *per se*, which fixes only the nominal exchange rate, is not able to prevent correction of real exchange rate misalignment. Even when a surplus country pegs its currency and targets its inflation rate simultaneously, its trade partner can still fix its current account imbalance by sacrificing its own inflation target. It is true that the deficit country may find this solution difficult because of its wage or other domestic nominal rigidities. However, it is not reasonable for it to blame its own current account imbalance on a nominal rigidity (*i.e.*, currency peg) in another country while taking for granted its own rigidities that are no less guilty.

At the end of the day, those who blame currency peg for current account imbalance should ponder upon the following question: If flexible exchange rate is really a necessary condition for current account adjustments, why current account imbalance can occur under a fixed exchange rate in the first place?

The most ironic fallacy in the RMB controversies is the claim that currency peg gives a surplus country unfair trade advantage by keeping its currency undervalued. A

country can indeed gain more trade advantage from a productivity hike in its tradable sector under a fixed exchange rate than under a flexible one. However, such extra advantage is due to a wealth effect and not *a priori* unfair. On the contrary, obliging a country to adjust its exchange rate to help fix its trade partners' current account imbalance is to ask it to accommodate their trade intervention that would unfairly impair its competitive advantage. Correcting current account imbalance may be necessary from macroeconomic stability. However, a microeconomic implication of the no-imbalance rule is to protect a country's overall trade performance from international competition.

IMF has recently been criticized for being "asleep at the wheel" on "its most fundamental responsibility" (*i.e.*, exchange rate surveillance) so as to let global imbalance (*i.e.*, the U.S. current account deficits) out of control (Adams, 2005; Goldstein and Mussa, 2005). While our analysis supports the IMF's cautiousness in joining the anti-currency-manipulation movement, a more fundamental question is whether the attention on external imbalance has been misguided.

A major concern over the persistent and large current account deficit in the U.S. is that its reversal could jeopardize not only its own economic stability but also that of the entire world. It is a widespread concern that such reversals could be triggered by foreign investors switching from USD-denominated assets to other assets (Blanchard et al., 2005; Edwards, 2005). However, the practical relevance of such reversals can be significantly reduced by the presence of governments in the foreign exchange markets. As long as monetary authorities in major nations prioritize their responsibility for maintaining global

financial stability over the profitability of their foreign reserve portfolios, they are well capable of neutralizing any shock caused by portfolio adjustments in the private sector. Indeed, such shocks may not occur in the first place when well-functioned international monetary coordination helps establish the private sector's confidence in global financial stability.

A large amount of U.S. treasury securities being held by foreigners is not a threat to global economic stability.[18] The real threat is the massive U.S. public debts that may have to be inflated away. The right way for the U.S. to address this issue is to defuse its ticking "debt bomb" through increasing public and/or private savings. Its current account imbalance is merely a superficial symptom of the more fundamental debt problem; and trying to fix the imbalance through dollar depreciation will not solve the problem but could cause unnecessary economic instability.

5. Conclusions

While much effort has been spent in saving the Bretton Woods system to no avail in the early 1970s, several Asian countries have been accused of currency manipulation for trying to maintain a "revived Bretton Woods system" (Dooley et al., 2003) in the early 2000s. While the IMF was originally established to maintain exchange rate stability so as to prevent competitive depreciation, it has recently been criticized for allowing exchange

[18] In the era of globalization, U.S. investors are not necessarily more loyal to dollar-denominated assets than foreign investors. Indeed, foreign government holders could be less likely than U.S. investors to run against the U.S. assets since they are more concerned about financial and economic stability than profitability.

rate stability to prevent exchange rate depreciation. More ironically, winning the battle against currency manipulation will not fix the U.S. current account imbalance; yet if the United States goes directly to tackle the root problem that its excessive external imbalance reflects, the battle would not be necessary.

To summarize, currency peg is not currency manipulation. As long as the U.S. maintains its good performance in inflation control, many countries will continue to find it attractive to peg their currencies to the U.S. dollar. As for China, before a sound financial system is established, currency peg will still be a convenient way to outsource financial services.

Current account or balance of payments should no longer be treated the way it was when money supply depended on the supply of gold or other real species. With its foreign debts denominated in its own currency, the United States especially has no reason to worry about balance of payments crises. If the United States believes that its excessive current account imbalance reflects that its future macroeconomic stability is in jeopardy, it should cure the disease but not attack the symptom.

In the era of globalization, international policy coordination is unavoidable. However, such coordination can only be successful through cooperation; and false accusation based on bad economics would be counterproductive.

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Appendix

A.1 The model

Country 1's production of its tradable goods:

$$Q_{1x} = \alpha_{1x} L_{1x}, \tag{A.1}$$

$$W_1 L_{1x} = P_{1x} Q_{1x}, \tag{A.2}$$

Country 1's production of its non-tradable goods:

$$Q_{1n} = \alpha_{1n} L_{1n}, \tag{A.3}$$

$$W_1 L_{1n} = P_{1n} Q_{1n}, \tag{A.4}$$

Country 2's production of its tradable goods:

$$Q_{2m} = \alpha_{2m} L_{2m}, \tag{A.5}$$

$$W_2 L_{2m} = P_{2m} Q_{2m}, \tag{A.6}$$

Country 2's production of its non-tradable good:

$$Q_{2n} = \alpha_{2n} L_{2n}, \tag{A.7}$$

$$W_2 L_{2n} = P_{2n} Q_{2n}, \tag{A.8}$$

Country 1's consumption of goods Q_{1x}, Q_{2m}, and Q_{1n}:

$$P_{1x} C_{1x} = \theta_{1x} Y_1(\bar{i}_1, \dot{s}_1), \tag{A.9}$$

$$P_{1m} C_{1m} = \theta_{1m} Y_1(\bar{i}_1, \dot{s}_1), \tag{A.10}$$

$$P_{1n} C_{1n} = \theta_{1n} Y_1(\bar{i}_1, \dot{s}_1) = (1 - \theta_{1x} - \theta_{1m}) Y_1(\bar{i}_1, \dot{s}_1), \tag{A.11}$$

Country 2's consumption of goods Q_{1x}, Q_{2m}, and Q_{2n}:

$$P_{2x} C_{2x} = \theta_{2x} Y_2(\bar{i}_2, \dot{s}_2), \tag{A.12}$$

$$P_{2m} C_{2m} = \theta_{2m} Y_2(\bar{i}_2, \dot{s}_2), \tag{A.13}$$

$$P_{2n} C_{2n} = \theta_{2n} Y_2(\bar{i}_2, \dot{s}_2) = (1 - \theta_{2x} - \theta_{2m}) Y_2(\bar{i}_2, \dot{s}_2), \tag{A.14}$$

Goods market clearing conditions:

$$C_{1n} = Q_{1n} \tag{A.15}$$

$$C_{1x} + C_{2x} = Q_{1x} \tag{A.16}$$

$$C_{2n} = Q_{2n} \tag{A.17}$$

$$C_{1m} + C_{2m} = Q_{2m} \tag{A.18}$$

$$P_{2x} = e P_{1x} \tag{A.19}$$

$$P_{2m} = e P_{1m} \tag{A.20}$$

Labor market clearing conditions:

$$L_{1x} + L_{1n} = \bar{L}_1 \tag{A.21}$$

$$L_{2m} + L_{2n} = \overline{L}_2 \tag{A.22}$$

Uncovered interest parity:

$$(1+i_1)(1+\dot{e}/e) = 1+i_2 \tag{A.23}$$

Definitions of inflations and current account:

$$\pi_1 \equiv (P_{1x}C_{1x} + P_{1m}C_{1m} + P_{1n}C_{1n})(\overline{P}_{1x}C_{1x} + \overline{P}_{1m}C_{1m} + \overline{P}_{1n}C_{1n})^{-1} - 1 \tag{A.24}$$

$$\pi_2 \equiv (P_{2x}C_{2x} + P_{2m}C_{2m} + P_{2n}C_{2n})(\overline{P}_{2x}C_{2x} + \overline{P}_{2m}C_{2m} + \overline{P}_{2n}C_{2n})^{-1} - 1 \tag{A.25}$$

$$CA \equiv P_{1x}C_{2x} - P_{1m}C_{1m}\,. \tag{A.26}$$

Endogenous variables:

Country 1: C_{1x}, C_{1m}, C_{1n}, Q_{1x}, Q_{1n}, L_{1x}, L_{1n}, P_{1x}, P_{1m}, P_{1n}, W_1

Country 2: C_{2x}, C_{2m}, C_{2n}, Q_{2m}, Q_{2n}, L_{2m}, L_{2n}, P_{2x}, P_{2m}, P_{2n}, W_2

Policy targets:

Internal balance: $\overline{\pi}_1$, $\overline{\pi}_2$

External balance: *CA*, *e*

Policy instruments:

Monetary policy: i_1, i_2

Fiscal policy: s_1, s_2

A.2 Simplifying the model

Substituting equation (A.1) into (A.2) and (A.3) into (A.4) then combining the two results, we obtain

$$P_{1x}\alpha_{1x} = P_{1n}\alpha_{1n}, \tag{A.27}$$

Substituting equations (A.1), (A.9), and (A.12) into (A.16), we obtain

$$\frac{\theta_{1x}Y_1(\bar{i}_1, \dot{s}_1)}{P_{1x}} + \frac{\theta_{2x}Y_2(\bar{i}_2, \dot{s}_2)}{P_{2x}} = \alpha_{1x}L_{1x} \tag{A.28}$$

Substituting equation (A.15) into (A.3), then substituting the result into (A.11), then rearranging, we obtain

$$\alpha_{1x}L_{1n} = \frac{\alpha_{1x}(1-\theta_{1x}-\theta_{1m})Y_1(\bar{i}_1, \dot{s}_1)}{P_{1n}\alpha_{1n}} \tag{A.29}$$

Combining equations (A.28) and (A.29), we obtain

$$\frac{\theta_{1x}Y_1(\bar{i}_1, \dot{s}_1)}{P_{1x}} + \frac{\theta_{2x}Y_2(\bar{i}_2, \dot{s}_2)}{P_{2x}} + \frac{\alpha_{1x}(1-\theta_{1x}-\theta_{1m})Y_1(\bar{i}_1, \dot{s}_1)}{P_{1n}\alpha_{1n}} = \alpha_{1x}(L_{1x}+L_{1n}) \tag{A.30}$$

Substituting equations (A.19), (A.21) and (A.27) into (A.30) and rearranging, we obtain the first equation in the simplifying model:

$$P_{1x} = \frac{1-\theta_{1m}}{\alpha_{1x}\bar{L}_1}Y_1(i_1, s_1) + \frac{\theta_{2x}}{\alpha_{1x}\bar{L}_1 e}Y_2(i_2, s_2) \tag{16}$$

Symmetrically, we can derive the second equation in the simplifying model:

$$P_{2m} = \frac{e\theta_{1m}}{\alpha_{2m}\bar{L}_2}Y_1(i_1, s_1) + \frac{1-\theta_{2x}}{\alpha_{2m}\bar{L}_2}Y_2(i_2, s_2) \tag{17}$$

Combining (A.9) – (A.11), substituting in (A.24), then rearranging, we obtain

$$Y_1 = (1+\pi_1)(\bar{P}_{1x}C_{1x} + \bar{P}_{1m}C_{1m} + \bar{P}_{1n}C_{1n}) \tag{A.31}$$

Substituting (A.9) into (A.31) and rearranging, we obtain

$$P_{1x} = (1+\pi_1)\left(\theta_{1x}\bar{P}_{1x} + \bar{P}_{1m}\frac{\theta_{1x}C_{1m}}{C_{1x}} + \bar{P}_{1n}\frac{\theta_{1x}C_{1n}}{C_{1x}}\right) \tag{A.31}$$

Using (A.9), (A.10), (A.11) and (A.31), we obtain

$$P_{1x} = (1+\pi_1)\left(\theta_{1x}\overline{P}_{1x} + \overline{P}_{1m}\frac{\theta_{1m}P_{1x}}{P_{1m}} + \overline{P}_{1n}\frac{\theta_{1n}P_{1x}}{P_{1n}}\right) \tag{A.32}$$

Substituting (A.20) and (A.27) into (A.32), we obtain the third equation in the simplifying model:

$$P_{1x} = (1+\pi_1)\left(\theta_{1x}\overline{P}_{1x} + \overline{P}_{1m}\theta_{1m}\frac{eP_{1x}}{P_{2m}} + \overline{P}_{1n}\frac{\alpha_{1n}\theta_{1n}}{\alpha_{1x}}\right) \tag{18}$$

Symmetrically we can obtain the fourth equation in the simplifying model:

$$P_{2m} = (1+\overline{\pi}_2)\left(\theta_{2m}\overline{P}_{2m} + \overline{P}_{2x}\theta_{2x}\frac{P_{2m}}{eP_{1x}} + \overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}}\right) \tag{19}$$

The fifth equation in the simplifying model is identical equation (A.23):

$$(1+i_1)(1+\dot{e}/e) = 1+i_2 \tag{20}$$

Substituting (A.10), (A.12), and (A.19) into (A.26), we obtain the last equation in the simplifying model:

$$CA = \frac{\theta_{2x}Y_2(i_2,s_2)}{e} - \theta_{1m}Y_1(i_1,s_1) \tag{21}$$

A.3 Flexible exchange rate

Under flexible exchange rate, P_{1x}, P_{2m}, i_1, i_2, CA, and e are endogenous variables in the 6-equantion simplifying model. We will examine how a demand shock in country 1 (ds_1) or a productivity shock in country 2 ($d\alpha_{2m}$) affects these endogenous variables.

Before we proceed, note that countries 1 and 2's interest rates are equal at equilibrium; and we will use i to denote the world interest rate in the following analysis for simplicity.

Solving equation (16) and (17) simultaneously, we obtain

$$P_{1x}\left[\alpha_{1x}\overline{L}_1(1-\theta_{2x})-\frac{P_{2m}}{eP_{1x}}\alpha_{2m}\overline{L}_2\theta_{2x}\right]=(1-\theta_{2x}-\theta_{1m})Y_1(i_1,s_1) \tag{A.33}$$

and

$$P_{2m}\left[(1-\theta_{1m})\alpha_{2m}\overline{L}_2-\frac{eP_{1x}}{P_{2m}}\alpha_{1x}\overline{L}_1\theta_{1m}\right]=(1-\theta_{2x}-\theta_{1m})Y_2(i_2,s_2) \tag{A.34}$$

Total differentiating (A.33) and (A.34), we obtain

$$\omega_1 dP_{1x}+\omega_2 d\left(\frac{eP_{1x}}{P_{2m}}\right)=(1-\theta_{2x}-\theta_{1m})Y_{1i}di+(1-\theta_{2x}-\theta_{1m})Y_{1s}ds_1 \tag{A.33'}$$

$$\omega_3 dP_{2m}-\omega_4 d\left(\frac{eP_{1x}}{P_{2m}}\right)=(1-\theta_{2x}-\theta_{1m})Y_{2i}di-P_{2m}(1-\theta_{1m})\overline{L}_2 d\alpha_{2m} \tag{A.34'}$$

where

$$\omega_1\equiv\left[\alpha_{1x}\overline{L}_1(1-\theta_{2x})-\frac{P_{2m}}{eP_{1x}}\alpha_{2m}\overline{L}_2\theta_{2x}\right]>0 \tag{A.35}$$

$$\omega_2\equiv P_{1x}\left[\left(\frac{P_{2m}}{eP_{1x}}\right)^2\alpha_{2m}\overline{L}_2\theta_{2x}\right]>0 \tag{A.36}$$

$$\omega_3\equiv\left[(1-\theta_{1m})\alpha_{2m}\overline{L}_2-\frac{eP_{1x}}{P_{2m}}\alpha_{1x}\overline{L}_1\theta_{1m}\right]>0 \tag{A.37}$$

$$\omega_4\equiv P_{2m}\alpha_{1x}\overline{L}_1\theta_{1m}>0 \tag{A.38}$$

Assume that

$$\theta_{2x}+\theta_{1m}<1; \tag{A.39}$$

i.e., the proportion of imports in total consumption is small in both countries, which is not unrealistic.

According to equation (A.33), (A.34) and (39), it is not difficult to verify inequalities

(A.35) and (A.37) respectively. Inequalities (A.36) and (A.38) are obvious.

Total differentiating equations (18) and (19), we obtain

$$dP_{1x} = (1+\overline{\pi}_1)\overline{P}_{1m}\theta_{1m}d\left(\frac{eP_{1x}}{P_{2m}}\right) \tag{18'}$$

and

$$dP_{2m} = (1+\overline{\pi}_2)\left(-\overline{P}_{2x}\theta_{2x}\left(\frac{P_{2m}}{eP_{1x}}\right)^2 d\left(\frac{eP_{1x}}{P_{2m}}\right) - \overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}^2}d\alpha_{2m}\right) \tag{19'}$$

Substituting equations (18') and (19') into (A.33') and (A.34') respectively, we obtain

$$\left[\omega_1(1+\overline{\pi}_1)\overline{P}_{1m}\theta_{1m}+\omega_2\right]d\left(\frac{eP_{1x}}{P_{2m}}\right) = (1-\theta_{2x}-\theta_{1m})Y_{1i}di + (1-\theta_{2x}-\theta_{1m})Y_{1s}ds_1 \tag{A.40}$$

and

$$\begin{aligned}&\left(-\omega_3(1+\overline{\pi}_2)\overline{P}_{2x}\theta_{2x}\left(\frac{P_{2m}}{eP_{1x}}\right)^2-\omega_4\right)d\left(\frac{eP_{1x}}{P_{2m}}\right)\\ &=(1-\theta_{2x}-\theta_{1m})Y_{2i}di+\left[\omega_3(1+\overline{\pi}_2)\overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}^2}-P_{2m}(1-\theta_{1m})\overline{L}_2\right]d\alpha_{2m}\end{aligned} \tag{A.41}$$

Solving equations (A.40) and (A.41) together, we obtain

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) = (\omega_5 ds_1 + \omega_6 d\alpha_{2m})\omega_7^{-1} \tag{A.42}$$

where

$$\omega_5 \equiv -(1-\theta_{2x}-\theta_{1m})Y_{1s}Y_{2i} > 0 \tag{A.43}$$

$$\omega_6 \equiv \left[\overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}^2}\omega_3(1+\overline{\pi}_2)-P_{2m}(1-\theta_{1m})\overline{L}_2\right]Y_{1i} > 0 \tag{A.44}$$

$$\omega_7 \equiv -\left\{\left[\omega_3(1+\overline{\pi}_2)\overline{P}_{2x}\theta_{2x}\left(\frac{P_{2m}}{eP_{1x}}\right)^2+\omega_4\right]Y_{1i}+\left[\omega_1(1+\overline{\pi}_1)\overline{P}_{1m}\theta_{1m}+\omega_2\right]Y_{2i}\right\} > 0 \tag{A.45}$$

Since $Y_{1s} > 0$, $Y_{2i} < 0$, and $\theta_{2x} + \theta_{1m} < 1$ according to inequality (39), it is not difficult to verify inequality (A.43).

Substituting equation (19) into (A.44), we obtain

$$\omega_6 \equiv \frac{1}{\alpha_{2m}}\left[P_{2m}\omega_3 - \omega_3\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m} + \overline{P}_{2x}\theta_{2x}\frac{P_{2m}}{eP_{1x}} \right) - P_{2m}\alpha_{2m}\left(1-\theta_{1m}\right)\overline{L}_2 \right] Y_{1i},$$

which, after substituting in equation (A.37) and rearrangement, we obtain

$$\omega_6 \equiv -\frac{1}{\alpha_{2m}}\left[eP_{1x}\alpha_{1x}\overline{L}_1\theta_{1m} + \omega_3\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m} + \overline{P}_{2x}\theta_{2x}\frac{P_{2m}}{eP_{1x}} \right) \right] Y_{1i} > 0, \qquad \text{(A.44')}$$

Since $Y_{1i} < 0$ and $\omega_3 > 0$ according to inequality (A.37), it is not difficult to verify inequality (A.44') or equivalently (A.44).

Since $Y_{1i} < 0$, $Y_{2i} < 0$, and $\omega_i > 0$ (i = 1, 2, 3, 4) according to inequalities (A.35) – (A.38), it is not difficult to verify inequality (A.45).

A.3.1 Impact of country 2's tradable productivity shock on country 1's terms of trade

According to inequality (A.42), the impact of the productivity shock $d\alpha_{2m}$ on country 1's terms of trade can be measured by

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) = \omega_7^{-1}\omega_6 d\alpha_{2m}, \qquad \text{(A.46)}$$

that is,

$$dTOT^{BM} = \Phi_1 d\alpha_{2m} \qquad \text{(A.46')}$$

where $\Phi_1 = \omega_7^{-1}\omega_6 > 0$. This inequality implies that under flexible exchange rate, a positive productivity shock in country 2's tradable sector tends to increase country 1's

terms of trade.

A.3.2 Impact of country 1's demand shock on its interest rate and current account

Let $d\alpha_{2m} = 0$ and solve equations (A.40) and (A.41) together; we obtain

$$\left[\omega_9\left(1-\theta_{2x}-\theta_{1m}\right)Y_{1i} + \omega_8\left(1-\theta_{2x}-\theta_{1m}\right)Y_{2i}\right]di = -\omega_9\left(1-\theta_{2x}-\theta_{1m}\right)Y_{1s}ds_1 \tag{A.47}$$

where

$$\omega_8 \equiv \left[\omega_1\left(1+\bar{\pi}_1\right)\overline{P}_{1m}\theta_{1m} + \omega_2\right] > 0 \tag{A.48}$$

$$\omega_9 \equiv \left(\omega_3\left(1+\bar{\pi}_2\right)\overline{P}_{2x}\theta_{2x}\left(\frac{P_{2m}}{eP_{1x}}\right)^2 + \omega_4 \right) > 0 \tag{A.49}$$

Since $\omega_i > 0$ (i = 1, 2, 3, 4) according to inequalities (A.35) – (A.38), it is not difficult to verify inequalities (A.48) and (A.49). Then, since $Y_{1s} > 0$, $Y_{1i} < 0$ and $Y_{2i} < 0$, according to equation (A.47),

$$\frac{di}{ds_1} = -\omega_9\left(1-\theta_{2x}-\theta_{1m}\right)Y_{1s}\left[\omega_9\left(1-\theta_{2x}-\theta_{1m}\right)Y_{1i} + \omega_8\left(1-\theta_{2x}-\theta_{1m}\right)Y_{2i}\right]^{-1} > 0, \tag{A.50}$$

which implies that under flexible exchange rate, a positive demand shock in country 1 tends to increase the world interest rate.

Substituting equations (33) and (34) into (21), we obtain

$$CA = \frac{P_{1x}\left(\alpha_{2m}\overline{L}_2\frac{P_{2m}}{eP_{1x}} - \alpha_{1x}\overline{L}_1\theta_{1m}\right)}{1-\theta_{2x}-\theta_{1m}} \tag{A.51}$$

which, after total differentiation, gives,

$$dCA = \frac{CA}{P_{1x}} dP_{1x} + \frac{P_{1x}\left[-\alpha_{2m}\overline{L}_2 \left(\frac{P_{2m}}{eP_{1x}} \right)^2 d\left(\frac{eP_{1x}}{P_{2m}} \right) + \overline{L}_2 \frac{P_{2m}}{eP_{1x}} d\alpha_{2m} \right]}{1-\theta_{2x}-\theta_{1m}} \tag{A.52}$$

Substituting equation (18') into (A.52) and rearranging, we obtain

$$dCA = -\omega_{10} d\left(\frac{eP_{1x}}{P_{2m}} \right) + \omega_{11} d\alpha_{2m}, \tag{A.53}$$

where

$$\omega_{10} \equiv -\frac{CA}{P_{1x}}\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m} + \left(1-\theta_{2x}-\theta_{1m}\right)^{-1} P_{1x}\alpha_{2m}\overline{L}_2 \left(\frac{P_{2m}}{eP_{1x}} \right)^2 > 0 \tag{A.54}$$

$$\omega_{11} \equiv \left(1-\theta_{2x}-\theta_{1m}\right)^{-1} P_{1x}\overline{L}_2 \frac{P_{2m}}{eP_{1x}} > 0 . \tag{A.55}$$

Note $CA \le 0$ since we consider a situation where country 1 has current account deficits. Then, according to inequality (A.39), it is not difficult to verify inequalities (A.54) and (A.55).

Substituting equation (A.42) into (A.53), we obtain

$$dCA = -\omega_{10}\omega_7^{-1}\omega_5 ds_1 - \left(\omega_{10}\omega_7^{-1}\omega_6 - \omega_{11}\right) d\alpha_{2m}, \tag{A.56}$$

which, according to inequalities (A.43), (A.45), and (A.54), implies that

$$\frac{dCA}{ds_1} = -\omega_{10}\omega_7^{-1}\omega_5 < 0 \tag{A.57}$$

which implies that under flexible exchange rate, a positive demand shock in country 1 will enlarge its current account deficit.

A.3.3 Impact of country 2's productivity shock on country 1's current account

According to equation (A.56), the impact of a productivity shock in country 2's tradable

sector on country 1's current account can be measured by

$$dCA = -\Phi_2 d\alpha_{2m}, \tag{A.58}$$

where $\Phi_2 \equiv \omega_7^{-1}\left(\omega_{10}\omega_6 - \omega_7\omega_{11}\right)$ has an ambiguous sign. According to equations (A.36), (A.37), (A.38), (A.44'), (A.45), (A.54), and (A.55),

$$\Phi_2 \equiv \omega_{12} + \omega_{13} - \omega_{14} - \omega_{15},$$

where, supposing $CA \le 0$,

$$\omega_{12} \equiv \frac{CA\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}}{\alpha_{2m}P_{1x}}\left[\omega_3\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m} + \frac{\overline{P}_{2x}\theta_{2x}P_{2m}}{eP_{1x}}\right) + eP_{1x}\alpha_{1x}\overline{L}_1\theta_{1m}\right]Y_{1i} > 0 \tag{A.59}$$

$$\omega_{13} \equiv -\omega_3\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m}\right)\left(1-\theta_{2x}-\theta_{1m}\right)^{-1}P_{1x}\overline{L}_2\left(\frac{P_{2m}}{eP_{1x}}\right)^2 Y_{1i} > 0 \tag{A.60}$$

$$\omega_{14} \equiv -\omega_1\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\left(1-\theta_{2x}-\theta_{1m}\right)^{-1}P_{1x}\overline{L}_2\frac{P_{2m}}{eP_{1x}}Y_{2i} > 0 \tag{A.61}$$

$$\omega_{15} \equiv -\omega_2\left(1-\theta_{2x}-\theta_{1m}\right)^{-1}P_{1x}\overline{L}_2\frac{P_{2m}}{eP_{1x}}Y_{2i} > 0\,. \tag{A.62}$$

According to equations (A.59), the larger country 1's current account deficit is, the more likely that the productivity hike in country 2 would further aggravate the deficit. According equations (A.59) and (A.60), the smoother is country 1's monetary transmission, which in the model here is measured by the sensitivity of its aggregate demand to a change in the interest rate (i.e., Y_{1i}), the more likely that the productivity hike in country 2 would negatively affect its current account. Conversely according to equation (A.61) – (A.62), the less smooth is country 2's monetary transmission (measured by Y_{2i}), the more likely that country 2's productivity hike would have a negative impact on country 1's current account.

A.3.4 Impact of country 2's productivity shock on the exchange rate

Total differentiating equations (18) and (19), we obtain

$$\left[\left(1+\overline{\pi}_1\right)^{-1}-\overline{P}_{1m}\theta_{1m}\frac{e}{P_{2m}}\right]dP_{1x}+\overline{P}_{1m}\theta_{1m}\frac{eP_{1x}}{P_{2m}^2}dP_{2m}=\overline{P}_{1m}\theta_{1m}\frac{P_{1x}}{P_{2m}}de \tag{18"}$$

$$\overline{P}_{2x}\theta_{2x}\frac{eP_{2m}}{\left(eP_{1x}\right)^2}dP_{1x}+\left[\left(1+\overline{\pi}_2\right)^{-1}-\frac{\overline{P}_{2x}\theta_{2x}}{eP_{1x}}\right]dP_{2m}=-\left(\overline{P}_{2x}\theta_{2x}\frac{P_{1x}P_{2m}}{\left(eP_{1x}\right)^2}de+\overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}^2}d\alpha_{2m}\right) \tag{19"}$$

Solving these two equations together, we obtain

$$de=-\left[\left(1+\overline{\pi}_2\right)\frac{e\overline{P}_{2n}\alpha_{2n}\theta_{2n}}{P_{2m}\alpha_{2m}^2}\right]d\alpha_{2m}+\left[\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{P_{1x}}{P_{2m}}\right]^{-1}\left[1-\left(1+\overline{\pi}_2\right)\frac{\overline{P}_{2x}\theta_{2x}}{eP_{1x}}-\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{e}{P_{2m}}\right]dP_{1x}$$

which, substituting in equation (18'), becomes

$$de=-\Phi_3 d\alpha_{2m} \tag{A.63}$$

where

$$\Phi_3=\omega_{16}-\omega_{17} \tag{A.64}$$

$$\omega_{16}\equiv\left(1+\overline{\pi}_2\right)\left(\frac{e\overline{P}_{2n}\alpha_{2n}\theta_{2n}}{P_{2m}\alpha_{2m}^2}\right)>0 \tag{A.65}$$

$$\omega_{17}\equiv\omega_7^{-1}\omega_6\left(\frac{P_{1x}}{P_{2m}}\right)^{-1}\left(1-\frac{\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}e}{P_{2m}}-\frac{\left(1+\overline{\pi}_2\right)\overline{P}_{2x}\theta_{2x}}{eP_{1x}}\right). \tag{A.66}$$

The sign of ω_{17} is undetermined yet most likely positive since the sum of its last two terms, which represent the proportion of imported goods in total consumption for countries 1 and 2 respectively, is not likely to be greater than unity. Thus, the sign of Φ_1 is ambiguous, which implies that similar to the case of current account, the impact of country 2's productivity hike in the tradable sector on the exchange rate is ambiguous.

A.3.5 Impact of country 1's demand shock on the exchange rate

Let $d\alpha_{2m} = 0$; then according to equation (A.42),

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) = \omega_7^{-1}\omega_5 ds_1 , \tag{A.42'}$$

which, according to equations (A.43) and (A.45), indicates that country 1's demand shock has a positive impact on its terms of trade.

Letting $d\alpha_{2m} = 0$ and solving equations (18") and (19") simultaneously, we obtain

$$de = \left[\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{P_{1x}}{P_{2m}}\right]^{-1}\left[1-\left(1+\overline{\pi}_2\right)\frac{\overline{P}_{2x}\theta_{2x}}{eP_{1x}}-\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{e}{P_{2m}}\right]dP_{1x},$$

which, substituting in equations (18'), becomes

$$de = \frac{P_{2m}}{P_{1x}}\left[1-\left(1+\overline{\pi}_2\right)\frac{\overline{P}_{2x}\theta_{2x}}{eP_{1x}}-\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{e}{P_{2m}}\right]d\left(\frac{eP_{1x}}{P_{2m}}\right),$$

which, substituting in equation (A.42'), becomes

$$de = \frac{P_{2m}}{P_{1x}}\left[1-\left(1+\overline{\pi}_2\right)\frac{\overline{P}_{2x}\theta_{2x}}{eP_{1x}}-\left(1+\overline{\pi}_1\right)\overline{P}_{1m}\theta_{1m}\frac{e}{P_{2m}}\right]\omega_7^{-1}\omega_5 ds_1 \tag{A.67}$$

As just mentioned, the term in the bracket on the right hand side of equation (A.67) tends to be positive under normal situation. Hence the coefficient of ds_1 in equation (A.67) is positive, i.e.,

$$\frac{de}{ds_1} > 0 , \tag{A.68}$$

which implies that under flexible exchange rate, a positive demand shock in country 1 can appreciate its currency, while fiscal tightening tends to depreciate it.

A.4 Currency peg

A.4.1 Impact of fiscal tightening under currency peg without inflation target

When country 2 sacrifices its inflation targeting for currency peg, P_{1x}, P_{2m}, i_1, i_2, CA, and π_2 are endogenous variables in the 6-equantion simplifying model; and the exchange rate *e* becomes exogenous.

Modifying equation (16), we obtain

$$\frac{eP_{1x}}{P_{2m}} = \frac{1-\theta_{1m}}{\alpha_{1x}\bar{L}_1}\frac{e}{P_{2m}}Y_1(i_1, s_1) + \frac{\theta_{2x}}{\alpha_{1x}\bar{L}_1 P_{2m}}Y_2(i_2, s_2),$$

which, after total differentiation, we obtain

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) + \omega_{18}dP_{2m} + \omega_{19}di = \frac{(1-\theta_{1m})Y_1}{P_{2m}\alpha_{1x}\bar{L}_1}de + \frac{(1-\theta_{1m})e}{P_{2m}\alpha_{1x}\bar{L}_1}Y_{1s}ds_1 \tag{A.69}$$

where

$$\omega_{18} \equiv \frac{eP_{1x}}{P_{2m}^2} > 0$$

$$\omega_{19} \equiv -\left[\frac{(1-\theta_{1m})e}{P_{2m}\alpha_{1x}\bar{L}_1}Y_{1i} + \frac{\theta_{2x}}{\alpha_{1x}\bar{L}_1 P_{2m}}Y_{2i}\right] > 0$$

Total differentiating equation (17), we obtain

$$dP_{2m} + \omega_{20}di = \frac{\theta_{1m}Y_1}{\alpha_{2m}\bar{L}_2}de + \frac{e\theta_{1m}}{\alpha_{2m}\bar{L}_2}Y_{1s}ds_1 - \frac{P_{2m}}{\alpha_{2m}}d\alpha_{2m} \tag{A.70}$$

where

$$\omega_{20} \equiv -\left(\frac{e\theta_{1m}}{\alpha_{2m}\bar{L}_2}Y_{1i} + \frac{1-\theta_{2x}}{\alpha_{2m}\bar{L}_2}Y_{2i}\right) > 0$$

Modifying equation (18), we obtain

$$\left(\frac{eP_{1x}}{P_{2m}}\right)\frac{P_{2m}}{e}=(1+\pi_1)\left(\theta_{1x}\overline{P}_{1x}+\overline{P}_{1m}\theta_{1m}\frac{eP_{1x}}{P_{2m}}+\overline{P}_{1n}\frac{\alpha_{1n}\theta_{1n}}{\alpha_{1x}}\right), \tag{18'''}$$

which, after total differentiation, becomes

$$\omega_{21}d\left(\frac{eP_{1x}}{P_{2m}}\right)+\left(\frac{P_{1x}}{P_{2m}}\right)dP_{2m}=\left(\frac{P_{1x}}{e}\right)de \tag{A.71},$$

where

$$\omega_{21}\equiv\left[\frac{P_{2m}}{e}-(1+\pi_1)\overline{P}_{1m}\theta_{1m}\right]>0$$

The signs of ω_{18}, ω_{19}, and ω_{20} are obvious, while that of ω_{21} would be not difficult to verify according to equation (18)

Solving equations (A.69) – (A.71) simultaneously, we obtain

$$d\left(\frac{eP_{1x}}{P_{2m}}\right)=\omega_{22}(\omega_{23}de+\omega_{24}ds_1+\omega_{25}d\alpha_{2m}), \tag{A.72}$$

where

$$\omega_{22}\equiv\left[\frac{e(1+\pi_1)\overline{P}_{1m}\theta_{1m}}{P_{2m}}+\omega_{19}(\omega_{20})^{-1}\omega_{21}\left(\frac{P_{2m}}{P_{1x}}\right)\right]^{-1}>0$$

$$\omega_{23}\equiv-(\omega_{20})^{-1}Y_2\left(\frac{1-\theta_{1m}-\theta_{2x}}{P_{2m}\alpha_{1x}\overline{L}_1e\alpha_{2m}\overline{L}_2}\right)Y_{1i}>0$$

$$\omega_{24}\equiv-(\omega_{20})^{-1}\left(\frac{(1-\theta_{1m}-\theta_{1x})e}{P_{2m}\alpha_{1x}\overline{L}_1\alpha_{2m}\overline{L}_2}\right)Y_{2i}>0$$

$$\omega_{25}\equiv\omega_{19}(\omega_{20})^{-1}\frac{P_{2m}}{\alpha_{2m}}>0.$$

According to inequality (A.39), the signs of ω_{23} and ω_{24} are easily verified, while the signs of ω_{22} and ω_{25} are obvious.

Let $de = 0$ and $d\alpha_{2m} = 0$; then equation (A.72) implies that

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) = \omega_{22}\omega_{24}ds_1, \tag{A.73}$$

which, according to equation (A.71), gives

$$dP_{2m} = -\omega_{26}ds_1, \tag{A.74}$$

where

$$\omega_{26} \equiv \frac{P_{2m}}{P_{1x}}\omega_{21}\omega_{22}\omega_{24} > 0.$$

Modifying equation (A.51), we obtain

$$CA = \frac{\frac{P_{2m}}{e}\left(\alpha_{2m}\overline{L}_2 - \frac{eP_{1x}}{P_{2m}}\alpha_{1x}\overline{L}_1\theta_{1m}\right)}{1-\theta_{2x}-\theta_{1m}} \tag{A.51'}$$

which, after total differentiation, becomes

$$dCA = \frac{eCA}{P_{2m}}d\left(\frac{P_{2m}}{e}\right) - \frac{P_{2m}\alpha_{1x}\overline{L}_1\theta_{1m}}{e\left(1-\theta_{2x}-\theta_{1m}\right)}d\left(\frac{eP_{1x}}{P_{2m}}\right) \tag{A.75}$$

Total differentiating equation (18'''), we obtain

$$d\left(\frac{P_{2m}}{e}\right) = \left(\frac{P_{2m}}{eP_{1x}}\right)\left[\left(1+\pi_1\right)\overline{P}_{1m}\theta_{1m} - \frac{P_{2m}}{e}\right]d\left(\frac{eP_{1x}}{P_{2m}}\right),$$

which, substituting in equation (A.75), gives

$$dCA = -\omega_{27}d\left(\frac{eP_{1x}}{P_{2m}}\right) \tag{A.76}$$

where

$$\omega_{27} \equiv \left[-\frac{eCA}{P_{2m}}\left(\frac{P_{2m}}{eP_{1x}}\right)\left(1+\pi_1\right)\overline{P}_{1m}\theta_{1m} + \frac{P_{2m}^2\left(\alpha_{2m}\overline{L}_2\right)}{e^2P_{1x}\left(1-\theta_{2x}-\theta_{1m}\right)}\right] > 0$$

Since we consider the situation where country 1 has current account imbalance (i.e.,

$CA \le 0$), the sign of ω_{27} is obvious.

Substituting equation (A.73) into (A.76), we obtain

$$dCA = -\omega_{27}\omega_{22}\omega_{24}ds_1, \tag{A.77}$$

which implies that

$$\frac{dCA}{ds_1} < 0,$$

which indicates that country 1's fiscal tightening (i.e. $ds_1 < 0$) is still able to fix current account imbalance when country 2 pegs its currency but does not target its inflation.

Total differentiating equation (19), we obtain

$$d\overline{\pi}_2 = \frac{1+\overline{\pi}_2}{P_{2m}}dP_{2m} - \frac{(1+\overline{\pi}_2)^2 P_{2m}\overline{P}_{2x}\theta_{2x}}{e_2 P_{1x}^2} d\left(\frac{eP_{1x}}{P_{2m}}\right)$$

which, substituting equations (A.73) and (A.74), gives

$$d\overline{\pi}_2 = -\omega_{28}ds_1 \tag{A.78}$$

where

$$\omega_{28} \equiv \left[\frac{1+\overline{\pi}_2}{P_{2m}}\omega_{26}ds_1 + \frac{(1+\overline{\pi}_2)^2 P_{2m}\overline{P}_{2x}\theta_{2x}}{e_2 P_{1x}^2}\omega_{22}\omega_{24}\right] > 0.$$

Inequality (A.78) implies that when country 1 uses fiscal tightening to fix its current account imbalance, country 2's currency peg would cause its own higher inflation.

A.4.2 Impacts of fiscal tightening under currency peg plus inflation target

Suppose country 1 uses monetary policy and fiscal policy to target both its domestic inflation and current account, while country 2 uses them to target both its inflation and

exchange rate. Under this situation, according to equation (18) and (19), the fixed exchange rate implies that both P_{1x} and P_{2m} need to be fixed too in order to let both countries achieve their inflation targets. According to equation (16) and (17), fixed P_{1x} and P_{2m} requires both fixed Y_1 and Y_2, which, according to equation (21), requires fixed CA. In sum, when both countries target their inflations, currency peg will anchor current account; and country 1's fiscal tightening would not be able to fix its current account imbalance.

Suppose country 2 uses both monetary policy and fiscal policy to target both its inflation and exchange rate, while country 1 sacrifices its inflation targeting in order to improve its current account. Under this situation, we will show that country 1 can use the interest rate as an instrument to improve it current account.

Modifying equation (19) into

$$\frac{P_{2m}}{eP_{1x}}\left[\left(eP_{1x}\right)-\left(1+\overline{\pi}_2\right)\left(\overline{P}_{2x}\theta_{2x}\right)\right]=\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m}+\overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}}\right),$$

which, after total differentiation, becomes

$$d\left(\frac{eP_{1x}}{P_{2m}}\right)=\omega_{29}dP_{1x}, \tag{A.79}$$

where

$$\omega_{29}\equiv e\left(1+\overline{\pi}_2\right)^{-1}\left(\theta_{2m}\overline{P}_{2m}+\overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}}\right)^{-1}>0 \tag{A.79'}$$

Substituting equation (A.79) into (A.33'), we obtain

$$dP_{1x}=-\omega_{30}di, \tag{A.80}$$

where

$$\omega_{30} \equiv -\left[\omega_1 + \omega_2\omega_{29}\right]^{-1}\left(1-\theta_{2x}-\theta_{1m}\right)Y_{1i} > 0$$

Substituting equations (A.79) and (A.80) into (A.52), we obtain

$$dCA = \omega_{31}di \tag{A.81}$$

where

$$\omega_{31} \equiv \left[-\frac{CA\,\omega_{30}}{P_{1x}} + \frac{P_{1x}\alpha_{2m}\overline{L}_2\omega_{29}\omega_{30}}{1-\theta_{2x}-\theta_{1m}}\left(\frac{P_{2m}}{eP_{1x}}\right)^2\right] > 0$$

Equations (A.81) implies that even when country 2 targets both its inflation rate and exchange rate, country 1 can still fix its current account imbalance through increasing its own interest rate.

Total differentiating equation (18), we obtain

$$d\pi_1 = \frac{\left(1+\pi_1\right)}{P_{1x}}\left[dP_{1x} - \left(1+\pi_1\right)\overline{P}_{1m}\theta_{1m}d\left(\frac{eP_{1x}}{P_{2m}}\right)\right],$$

which, substituting in equations (A.79), A(79'), and (A.80) , gives

$$d\pi_1 = -\omega_{32}di\,, \tag{A.82}$$

where

$$\omega_{32} \equiv \frac{\left(1+\pi_1\right)}{eP_{1x}}\omega_{29}\left[\left(1+\overline{\pi}_2\right)\left(\theta_{2m}\overline{P}_{2m} + \overline{P}_{2n}\frac{\alpha_{2n}\theta_{2n}}{\alpha_{2m}}\right) - \left(1+\pi_1\right)\overline{P}_{1m}\theta_{1m}e\right]\omega_{30}\,. \tag{A.82'}$$

The first term in the bracket on the right hand side of equation (A.82') gauges the proportion of country 2's domestic consumption in its total consumption, while the second term gauges the proportion of country 1's import consumption in its total consumption. Since the former tends to be greater than the latter, under a normal situation,

the sign of ω_{32} would be positive (i.e., $\omega_{32} > 0$), which, according to equation (A.82), implies that by sacrificing its inflation targeting for fixing its current account imbalance, country 1 has to bear with below-target inflation.

A.5 Currency manipulation

According to equation (A.72)

$$dTOT = \Phi_4 d\alpha_{2m} + \Phi_5 de \tag{A.83}$$

where $\Phi_4 \equiv \omega_{22}\omega_{25}$ and $\Phi_5 \equiv \omega_{22}\omega_{23}$. Since $\Phi_5 > 0$, country 2's currency peg will provide it with extra trade advantage by keeping its currency from appreciating (i.e., $de < 0$).

A.6 Current account manipulation

According to equation (A.53),

$$d\left(\frac{eP_{1x}}{P_{2m}}\right) = -\Phi_6 dCA + \Phi_7 d\alpha_{2m}, \tag{A.84}$$

where $\Phi_6 \equiv \omega_{10}^{-1}$ and $\Phi_7 \equiv \omega_{10}^{-1}\omega_{11}$. Since $\Phi_6 > 0$, equation (A.84) implies that country 1 can gain extra trade advantage from preventing or fixing its current account imbalance.