A Trade Model with An Optimal Exchange Rate Motivated by Current Discussion of A Chinese Renminbi Float *

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Abstract

We combine a model of combined inter-spatial and inter-temporal trade between countries recently used by Huang, Whalley and Zhang (2004) to analyze the merits of trade liberalization in services when goods trade is restricted with a model of foreign exchange rationing due to Clarete and Whalley (1991) in which there is a fixed exchange rate with a surrender requirement for foreign exchange generated by exports. In this model, when services remain unliberalized there is an optimal trade intervention, even in the small open price taking economy case. Given monetary policy and an endogenously determined premium value on foreign exchange, an optimal setting of the exchange rate can provide the optimal trade intervention. We suggest this model has relevance to the current situation in China where services remain unliberalized and tariff rates are bound in the WTO. Since there is an optimal exchange rate a move to a free Renminbi float can be welfare worsening. We use numerical simulation methods to explore the properties of the model, since it has no closed form solution. Our analysis provides an intellectual counter argument to those presently advocating a free Renminbi float for China.

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1 Introduction

This paper is motivated by current debate on financial liberalization in China, and specifically the issue of a Renminbi (RMB) float which China's OECD trading partners are now advocating given both the size of the Chinese trade surplus and their desire for improved access to Chinese markets. China has long maintained a fixed exchange rate with tight regulation of domestic banks, and strict limits on entry to the Chinese market for foreign financial institutions. In past, this has reflected a desire for macro stability, but the Chinese banking system also differs sharply from those in OECD countries with small but growing personal banking, and state owned banks acting in part as mechanisms for recapitalizing loss making state owned enterprises. Thus, part of what is at state in the debate on financial liberalization in China and the choice of exchange rate regime is the form and operation of the Chinese banking system and how this would change with a freely floating fully convertible Renminbi (see the discussion Zhang and Pan (2004) and Chang and Shao (2004)).

In seeking to contribute to this debate, this paper takes as its point of departure macro literature on the choice of exchange rate regime. While the choice between a fixed and flexible exchange rate regime has long been argued and debated in classical monetarist terms (that a fixed exchange rate implies accommodating monetary policy, and monetary policy determines the floating rate) as in Friedman's (1956) discussion, there is little literature that suggests that there may exist an optimal exchange rate which dominates a free float. Such a contention is clearly relevant to current policy debate in China, since with an optimal exchange rate a freely floating rate may be welfare worsening.

Here we use a recent model of combined inter-spatial and inter-temporal trade between countries due to Huang, Whalley and Zhang (2004), which we combine with a related model of spatial trade due to Clarete and Whalley (1991) in which there is a fixed exchange rate accompanied by a surrender requirement for foreign exchange generated by exporters. Huang, Whalley and Zhang (2004) earlier analyzed the merits of trade liberalization in services. In this model, in the presence of tariffs on inter-spatial trade free trade in services, even for a small open price taking economy, may not be welfare improving, and free trade in goods may not be Pareto optimal if services trade remains unliberalized.

In the model presented here, under either auctioning of foreign exchange received by the central bank among importers, or some non auctioned allocation mechanism with domestic trading in foreign exchange, there will be a premium value on foreign exchange which is endogenously determined and operates akin to a tariff on imports. Domestic monetary policy in such a model is non neutral, while trade liberalization (tariff reduction) merely changes the premium value on foreign exchange, in simple models where income effects among consumers are assumed away, leaving trade unchanged. Since monetary policy is non - neutral, when services remain unliberalized there is an optimal trade intervention, even in the small economy case. This occurs because given monetary policy and an endogenously determined premium value on foreign exchange, an optimal setting of the exchange rate can provide the optimal trade intervention. Under a freely floating exchange rate any departure from this optimal rate will typically inflict welfare losses.

We present the model, and illustrate possible outcomes using numerical simulation, and suggest it is relevant to the contemporary Chinese situation where services are unliberalized and tariffs are bound in the WTO. We would not pretend that this model realistically captures all of the relevant features of the financial and real sides of the Chinese economy, and hence may only be suggestive in its implications for current policy. Importantly, China is currently running a trade surplus rather than the balanced trade our model specifies, and concerns over potential capital flight under a free float are a factor in current debates and they are not captured here. But the implication that if services remain largely unliberalized (as in China today) and tariff rates are bound in the WTO a move to a free float may be welfare worsening seems both clear and relevant, and should be kept in mind by those currently advocating a free Renminbi float.

2 A Model of Spatial and Inter-temporal Trade with Exchange Rates and Non-Neutral Monetary Policy

We consider a world in which two types of trade are possible. One is inter-spatial trade between countries in commodities, and the other inter-temporal trade within countries facilitated by providers of intermediation services. To simplify things, we will further assume that intermediation services, when they are provided, are at zero cost to users of services, and also that such services can only be provided by foreign service providers. This is a gross simplification, but adopting it in a model with potentially both inter-temporal and inter-spatial trade means that we can consider autarky in services to be a case where no inter-temporal intermediation occurs, and free trade in services to be the case where full inter-temporal intermediation occurs. We thus also assume that if services remains unliberalized budget constraints within each period hold when we consider changes in exogenous exchange rates in the model. We do not claim that this is a realistic representation of contemporary China, but do suggest it is a useful analytical simplification.

Into this structure, we further inject a fixed exchange rate regime with resulting monetary non-neutralities. We assume domestic currency is needed to execute domestic transactions while foreign currency is needed for purchases of imports and is yielded by the sale of exports. In our formulation all foreign exchange earnings of exporters are surrendered to the central bank at the fixed exchange rate, while foreign exchange received by the bank is auctioned among importers at a premium to the official exchange rate. This premium value is endogenously determined given monetary policy, and operates akin to a tariff.

For simplicity, if we consider the 2 period ($t = 0, 1$), 1 country, 2 good ($l = 1, 2$) pure exchange international trade case of a small open price taking economy, the model can be presented as follows. The country has a single representative consumer, with endowments of the two goods in each period (E_l^t; $t = 0, 1$, $l = 1, 2$), and inter-temporal preferences written as

$$U = \sum_{t=0}^{1} \frac{1}{(1+\rho)^t} u^t(X_1^t, X_2^t) = u^0(X_1^0, X_2^0) + \frac{1}{1+\rho} u^1(X_1^1, X_2^1) \tag{1}$$

where ρ is inter-temporal discount factor and X_l^t denotes consumption of good l at date t.

If a time-additive Cobb-Douglas utility function of the form is used where $u^t(X_1^t, X_2^t) = [X_1^t]^{\alpha_1^t}[X_2^t]^{\alpha_2^t}$ for $t = 0, 1$, (1) can be represented more explicitly as

$$U = [X_1^0]^{\alpha_1^0}[X_2^0]^{\alpha_2^0} + \frac{1}{1+\rho}[X_1^1]^{\alpha_1^1}[X_2^1]^{\alpha_2^1} \tag{2}$$

where α_l^t is the share parameter for good l at date t ($\sum_{l=1}^{2} \alpha_l^t = 1$).

For good l in each period t, the exogenous world price is Π_l^t. We allow the country to impose tariffs at rate T_l^t on each imported good l (i.e. if $X_l^t \geq E_l^t$, then $T_l^t \geq 0$). Tariffs are set to equal zero for any export (i.e. if $X_l^t \leq E_l^t$, then $T_l^t = 0$). Internal (gross of tariff) prices for good l at date t are thus

$$P_l^t = \Pi_l^t (1 + T_l^t), \qquad t = 0, 1, \quad l = 1, 2. \tag{3}$$

These are also sellers prices of good l.

Tariff revenues collected in period t are

$$R^t = \sum_{l=1}^{2} \Pi_l^t T_l^t (X_l^t - E_l^t)^+, \qquad t = 0, 1 \tag{4}$$

where E_l^t denotes the initial endowment of good l, and the total income in period t is given by

$$I^t = \sum_{l=1}^{2} P_l^t E_l^t + R^t, \qquad t = 0, 1. \tag{5}$$

If we consider the case in which all goods are traded, the presence of rationed foreign exchange can be characterized as follows.

If we assume that the government fixes the exchange rate at e^t, and requires all foreign exchange earned by exporters to be surrendered to the Central Bank at the rate e^t, it then allocates rights to purchase available foreign exchange at the same rate e^t to importers. We will assume that exporters comply with this policy and fully meet the surrender requirement, even though there are obvious incentives for exporters to conceal foreign exchange and attempt to sell it on parallel (black) markets rather than surrender it at the lower fixed rate. The allocation process of foreign exchange among importers assumes that the government auctions (or sells) foreign exchange. In practice, allocation schemes actually followed are more complex than this involving priority allocation of various forms, but we abstract from these. But under such a simple auctioning scheme, if desired imports require more foreign exchange than the government offers for sale, the price of foreign exchange paid by importers will be bid up. This price will thus include a foreign exchange premium above the fixed rate e^t, which we designate as λ^t. This premium acts as a surcharge on foreign exchange bought by importers, and adjusts so as to clear the foreign exchange market.

In this formulation the net effect of foreign exchange rationing is akin to a general tariff on all imports, since the exchange rate received by exporters differs from the gross of premium value exchange rate paid by importers. Under an auctioning scheme, the foreign exchange premium accrues to the government, but if rights to purchase foreign exchange at the rate e^t were instead allocated by the government without charge, the premium would instead go directly to importers.

The world prices for the 2 goods are given as Π_l^t for $t = 0, 1$ and $l = 1, 2$. Domestic price (gross of tariff and gross of the foreign exchange premium for imports) for the 2 goods are again denoted as P_l^t for $t = 0, 1$ and $l = 1, 2$, and are defined below by (7).

The domestic demand for domestic currency (RMB) M_D^t at date t is given by the value of domestic demands in domestic currency, i.e.

$$M_D^t = \sum_{l=1}^{2} P_l^t X_l^t, \qquad t = 0, 1 \tag{6}$$

The domestic supply of RMB at date t is assumed set by the monetary authorities and is given by M_S^t.

Because of the foreign exchange premium, relative domestic prices of the 2 traded goods will now differ from world prices both due to the premium on foreign exchange and tariffs, depending upon whether the good is imported or exported. Domestic prices P_l^t are thus now given by

$$P_l^t = \begin{cases} e^t \Pi_l^t, & if\ X_l^t - W_l^t \leq 0 \\ (1 + \lambda^t) e^t \Pi_l^t, & if\ X_l^t - W_l^t \geq 0 \end{cases} \tag{7}$$

where $X_l^t - W_l^t$ denotes the net import of goods l, and λ^t is the premium value over the official exchange rate paid by purchasers of imports.

The demand for foreign currency (US dollars) N_D^t at date t is given by the value of import of goods

$$N_D^t = \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t]^+, \qquad t = 0, 1. \tag{8}$$

The supply of foreign currency (US dollars) N_S^t at date t is given by the value of export of goods

$$N_S^t = \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t]^-, \qquad t = 0, 1. \tag{9}$$

This formulation allows us to consider two types of equilibria. One of these is characterized by no provision of intermediation services by foreign services providers, and since we assume them to be the only potential service providers, no inter-temporal intermediation. In this equilibrium, period by period budget constraints apply for the economy, and we associate such an equilibrium with autarky in services trade. The other equilibrium is characterized by costless international flows of intermediation services (or free trade in services), and in this case combined period by period budget constraints hold. We assume, again for simplicity, that intertemporal intermediation only occurs within the national economy i.e. there is no intermediation between foreign and domestic residents, and the only role for foreign services providers is to facilitate intermediation within the price taking economy.

We also assume trade balance holds in each period, which implies that the value of imports goods is equal to the value of export and hence $N_D^t = N_S^t$ for $t = 0, 1$. Trade balance implies that

$$\sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t] = 0. \tag{10}$$

This also implies that total revenues accruing to sellers of rights to purchase foreign exchange at the rate e^t are

$$R^t = \lambda^t e^t \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t]^+, \qquad t = 0, 1 \tag{11}$$

These rents accrue either directly to the household sector as additional revenues of importers who are given allocations of foreign exchange by the government which they resell on premium markets, or indirectly as recycled government revenues.

Because anticipated revenues L^t from rights of access to foreign exchange affect commodity demands and are a component of income for at least one of the agents in the model, market demand functions have to be rewritten to reflect this. Both L^t and R^t are each endogenously determined, and $L^t = R^t$ only in equilibrium.

The budget constraint for the household sector includes initial holdings of money balances, and is given by

$$I^t = \sum_{l=1}^{2} P_l^t W_l^t + M_S^t + L^t, \qquad t = 0, 1 \tag{12}$$

We are able to consider two type of equilibria in this model for any arbitrarily specified fixed exchange rate, one with no trade in services (service autarky), and one with trade in services.

General Equilibrium with Service Trade Autarky (Period by Period Budget Constraints)

When there is service trade autarky no intermediation services are provided since we assume there are no domestic service providers. [1] This means that there is incompleteness in the

[1] See the discussion of barriers to trade in intermediation services in practice in the Chen and Schembri (2002), Francois and Schuknecht (2000), Kalirajan, McHuire, Nguyen and Schuele (2001), and Mattoo (1999).

coverage of markets in the sense that in service trade autarky intertemporal markets are missing. This enables us to appeal directly to literature on multi-commodity inter-temporal models of incomplete markets due to Radner(1972), Hart (1975), Duffie and Shafer (1985), Werner (1985), Duffie (1987), Geanakopolos (1990), Magill and Shafer (1991), and Magill and Quinzii (1996) in analyzing the effects of service liberalization in this model. In services trade autarky there is no inter-temporal trade, while with costless inter-temporal trade in services inter-temporal markets are complete. We use incomplete markets literature without the added complication of uncertainty; most of this literature is concerned with existence issues; our focus here is comparative statics.

Since the absence of trading across periods represents unliberalized trade in financial intermediation services, the total value of expenditures must satisfy the household budget constraint in each period, i.e.,

$$\sum_{l=1}^{2} P_l^t X_l^t + M_D^t = I^t, \qquad t = 0, 1 \tag{13}$$

that is,

$$\sum_{l=1}^{2} P_l^t X_l^t + M_D^t = \sum_{l=1}^{2} P_l^t W_l^t + M_S^t + L^t, \qquad t = 0, 1 \tag{14}$$

or

$$e^t \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t] + (M_D^t - M_S^t) + (R^t - L^t) = 0, \qquad t = 0, 1 \tag{15}$$

A country general equilibrium for the model in this case is given by values of (λ^t, L^t) which satisfy the conditions:

[1] $(X_l^t : t = 0, 1; l = 1, 2)$ solves

$$\begin{aligned} &max && U \\ &s.t. && \textstyle\sum_{l=1}^{2} P_l^t X_l^t + M_D^t = \sum_{l=1}^{2} P_l^t W_l^t + M_S^t + L^t, \qquad t = 0, 1 \end{aligned} \tag{16}$$

[2] For $t = 0, 1$,

$$e^t \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t] = 0 \qquad and \qquad R^t - L^t = 0 \qquad and \qquad M_D^t - M_S^t = 0 \tag{17}$$

General Equilibrium with Free Trade in Services (Across Period Budget Constraints)

If costlessly provided foreign supplied intermediation services are allowed in the model, then we can characterize a free trade in services equilibrium as a case where across period budget constraints hold rather than period by period budget constraints.

In this case, the total demand for foreign currency is $N_D = \sum_{t=0}^{1} \frac{N_D^t}{(1+r)^t}$. The total supply of foreign currency is $N_S = \sum_{t=0}^{1} \frac{N_S^t}{(1+r)^t}$. Trade balance implies that the value of imports equals the value of exports and $N_D = N_S$, i.e.

$$\sum_{t=0}^{1} \frac{1}{(1+r)^t} \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t] = \sum_{l=1}^{2} \Pi_l^0 [X_l^0 - W_l^0] + \frac{1}{1+r} \sum_{l=1}^{2} \Pi_l^1 [X_l^1 - W_l^1] = 0. \tag{18}$$

If two periods are considered for this model with trading which allowed across periods used to represent liberalized trade in financial intermediation services, the total value of expenditures must satisfy the household budget constraint in each period, i.e.,

$$\begin{cases} \sum_{l=1}^{2} P_l^0 X_l^0 + M_D^0 + F = I^0 \\ \sum_{l=1}^{2} P_l^1 X_l^1 + M_D^1 = I^1 + (1+r)F \end{cases} \tag{19}$$

where following the literature on incomplete markets F is the amount of credit allowed across periods by the Central Bank. In this case,

$$\begin{cases} \sum_{l=1}^{2} P_l^0 X_l^0 + M_D^0 + F = \sum_{l=1}^{2} P_l^0 W_l^0 + M_S^0 + L^0 \\ \sum_{l=1}^{2} P_l^1 X_l^1 + M_D^1 = \sum_{l=1}^{2} P_l^1 W_l^1 + M_S^1 + L^1 + (1+r)F \end{cases} \tag{20}$$

$$\begin{cases} e^0 \sum_{l=1}^{2} \Pi_l^0 [X_l^0 - W_l^0] + (M_D^0 - M_S^0) + (R^0 - L^0) + F = 0 \\ e^1 \sum_{l=1}^{2} \Pi_l^1 [X_l^1 - W_l^1] + (M_D^1 - M_S^1) + (R^1 - L^1) = (1+r)F \end{cases} \tag{21}$$

and

$$e^0 \sum_{l=1}^{2} \Pi_l^0 [X_l^0 - W_l^0] + \frac{1}{1+r} e^1 \sum_{l=1}^{2} \Pi_l^1 [X_l^1 - W_l^1] + (M_D - M_S) + (R - L) = 0 \tag{22}$$

where $M_D = M_D^0 + \frac{1}{1+r} M_D^1$ is total demand for domestic currency, $M_S = M_S^0 + \frac{1}{1+r} M_S^1$ is total supply for domestic currency, $R = R^0 + \frac{1}{1+r} R^1$ are total revenues across periods accruing to sellers of rights to purchase foreign exchange, and $L = L^0 + \frac{1}{1+r} L^1$ are anticipated revenues across periods from auctioning of foreign exchange.

A country general equilibrium in this case is given by values of (λ^t, L^t) which satisfy the conditions:

[1] $(X_l^t : t = 0, 1; l = 1, 2)$ solves

$$\begin{aligned} &max && U \\ &s.t. && \sum_{l=1}^{2} P_l^0 X_l^0 + M_D^0 + F = \sum_{l=1}^{2} P_l^0 W_l^0 + M_S^0 + L^0 \\ &&& \sum_{l=1}^{2} P_l^1 X_l^1 + M_D^1 = \sum_{l=1}^{2} P_l^1 W_l^1 + M_S^1 + L^1 + (1+r)F \end{aligned} \tag{23}$$

[2]

$$\sum_{t=0}^{1} \frac{1}{(1+r)^t} e^t \sum_{l=1}^{2} \Pi_l^t [X_l^t - W_l^t] = 0, \qquad R^t - L^t = 0 \qquad and \qquad M_D^t - M_S^t = 0 \; for \; t = 0, 1 \quad (24)$$

In this model when foreign exchange rationing is combined with the service and goods flow structure as set out above, if services trade remains unliberalized there is an optimal trade intervention even for a small open economy. In the case where period by period budget constraints apply, there will be optimal trade intervention and, for given monetary policy, an optimal exchange rate. If instead across period budget constraints apply (with free trade in services) there will be no optimal exchange rate. The implication is that if tariffs are bound under WTO / GATT and services remain unliberalized (as in China) either monetary or exchange rate policy provide instruments for achieving the optimal trade intervention. If monetary policy is given, an optimal exchange rate will exist, and any departure from this via a free float will impose welfare losses. The possibility of such outcomes in the model can be explored by numerical simulation in which fixed exchange rates are parametrically varied.

3 Some Numerical Simulation Results Indicating an Optimal Exchange Rate

We have used the structure set out in Section 2 to perform some numerical simulations for a representative economy which show how in the presence of given monetary policy (in the form of a setting of the money supply), WTO bound tariffs on goods flows, and service trade remaining unliberalized, there will be an optimal exchange rate. In such cases depending on the setting of the fixed exchange rate, welfare losses may occur with any move to a freely floating exchange rate, raising questions as to the desirability of a free Renminbi float in China. Losses will necessarily occur if the fixed exchange rate equals its optimal value.

In this simulations we perform, we assume for simplicity Cobb-Douglas preferences and consider a case where period by period budget constraints apply reflecting unliberalized services trade. The model parameter settings we use in our simulations are given in Table 1. For this parametrization, we take monetary policy as given and then compute equilibrium solutions for alternative settings of the exchange rate to explore the behaviour of the optimal exchange rate. Table 2 presents an equilibrium solution for this model, given the exchange rate and monetary policy in Table 1.

For the case where with no trading is allowed across periods $F = 0$, and the equilibrium is given in Table 2 (the model parametrization set out in Table 1). In this case when the exchange rate increases from 1.20 to 1.60, the foreign exchange premium value is eliminated (decreases from 1.00 to 0.00) in period 0 and from 2.00 to 0.50 in period 1. Utility increases from 47.140 to 50.000 in period 0 and from 43.984 to 50.000 in period 1, total utility increases from 87.126 to 95.455. Imports equals exports in each period and increase from 13.333 to 30.000 in period 0 and from 8.3333 to 25.0000 in period 1.

If instead, the domestic supply of currency (Renminbi) increases in period 0 from 150.00 to 240.00, the premium value in period 0 increases from 0.00 to 3.00 while in period 1 it is a constant at 0.7143. Utility in period 0 falls from 50.000 to 40.000, while utility in period 1 is a constant at 49.227. Total utility falls from 94.752 to 84.752. Imports equals exports in each period and falls from 30.00 to 0.00 in period 0 but remains a constant at 21.667 in period 1.

For the reference economy with trading allowed across periods $F > 0$, we can also compute a general equilibrium in Table 2 for the model parametrization set out in Table 1. If the exchange rate increases from 1.200 to 1.792, the interest rate falls from 0.180 to 0.078, the common premium value falls from 1.459 to 0.000 in both periods (and eliminated). Utility increases from 87.570 to 96.379, the amount deposited in Central Bank increases from 7.464 to 19.249. Imports increase from 7.113 to 24.631 in period 0 and from 15.670 to 41.946 in period 1. Exports increase from 13.333 to 35.369 in period 0 and from 8.333 to 30.369 in period 1.

Table 3 reports the optimal exchange rate for this model parameterization, along with the welfare costs which would follow with a move to a freely floating exchange rate under which the premium value on foreign exchange is eliminated. Utility first increases then decreases, which reaches its maximal value of 96.3851 when the exchange rate $e^0 = e^1 = 1.770$. Table 3 also reports the utility loss when a freely floating exchange rate occurs. In this case the loss is relative small, but this nonetheless establishes the presumption in favour of a fixed over a floating exchange rate in this case.

Table 4 reports the relationship between utility and domestic money supply changes, since changed monetary policy provides a substitute instrument for exchange rate policy in this model. Utility first increases then decreases which reaches its maximal value of 96.418 when the money supply M_S^0 equals 112.000. Results in Table 4 shows the utility loss when a freely floating exchange rate prevails. In this case once again the loss is relatively small, but these results again establish a presumption in favour of a fixed over a floating exchange rate in this case if monetary policy is not available as the instrument to achieve the optimal trade intervention.

Table 1. Parameters Values Used in 1 Country 2 Period 2 Good Numerical Simulation of An Optimal Exchange rate

1.1. Model Characteristics		
• Small Open Price Taking Economy		
• 1 Country 2 Period 2 Good		
• Cobb Douglas utility functions within the period		
1.2. Model Parameterization		
• Utility Inter-Temporal Discount Rate		
$\rho = 0.10$		
• Share Parameter in Preferences		
	$\alpha_1^0 = 0.50$	$\alpha_2^0 = 0.50$
	$\alpha_1^1 = 0.60$	$\alpha_2^1 = 0.40$
• Initial Endowments		
	$W_1^0 = 20$	$W_2^0 = 80$
	$W_1^1 = 25$	$W_2^1 = 75$
• World Prices		
	$\Pi_1^0 = 1.00$	$\Pi_2^0 = 1.00$
	$\Pi_1^1 = 1.00$	$\Pi_2^1 = 1.00$
• Initial Fixed Exchange Rate in Each Period		
$e^0 = e^1 = 1.50$		
• Domestic Supply of Renminbi in Each Period		
$M_S^0 = 160$ and $M_S^1 = 200$		

Table 2. General Equilibrium for the Model Parameterization Set Out in Table 1

Period by Period Budget Constraints	Across Period Budget Constraints
Interest Rate	
	$r = 0.116$
Exchange Rate Premium Value	
$\lambda^0 = 0.143$ and $\lambda^1 = 0.714$	$\lambda^0 = \lambda^1 = 0.413$
Domestic Prices	
$P_1^0 = 1.714$	$P_1^0 = 2.119$
$P_2^0 = 1.500$	$P_2^0 = 1.500$
$P_1^1 = 2.571$	$P_1^1 = 2.119$
$P_2^1 = 1.500$	$P_2^1 = 1.500$
Utility Levels in Each Period, and Across Periods	
$U^0 = 49.889$	$U^0 = 44.868$
$U^1 = 49.227$	$U^1 = 55.282$
$U = 94.641$	$U = 95.125$
Consumption	
$X_1^0 = 46.667$	$X_1^0 = 37.747$
$X_2^0 = 53.333$	$X_2^0 = 53.333$
$X_1^1 = 46.667$	$X_1^1 = 56.621$
$X_2^1 = 53.333$	$X_2^1 = 53.333$
Imports of Good 1	
$H_1^0 = 26.667$	$H_1^0 = 17.747$
$H_1^1 = 21.667$	$H_1^1 = 31.621$
Exports of Good 2	
$H_2^0 = 26.667$	$H_2^0 = 26.667$
$H_2^1 = 21.667$	$H_2^1 = 21.667$
Foreign Currency Demand	
$N_D^0 = 26.667$	$N_D^0 = 17.747$
$N_D^1 = 21.667$	$N_D^1 = 31.621$
	$N_D = 46.081$
Foreign Currency Supply	
$N_S^0 = 26.667$	$N_S^0 = 26.667$
$N_S^1 = 21.667$	$N_S^1 = 21.667$
	$N_S = 46.081$
Foreign Exchange Premium Revenues in Each Period	
$R^0 = 5.714$	$R^0 = 10.992$
$R^1 = 23.214$	$R^1 = 19.585$
	$R = 28.541$
Income in Each Period	
$I^0 = 320.000$	$I^0 = 333.379$
$I^1 = 400.000$	$I^1 = 385.069$
Money Deposit	
$F = 0.000$	$F = 13.379$

Table 3. Maximum Utility under An Optimal Exchanges Rate

	Endogenous $\lambda^0 = \lambda^1$ under An Optimal Exchange Rate	$\lambda^0 = \lambda^1 = 0$ under A Freely Float Exchange Rate
3.1. Model Characteristics		
• Small Open Price Taking Economy		
• 1 Country 2 Period 2 Good		
• Cobb Douglas utility functions within the period		
3.2. Model Parameterization		
• Utility Inter-Temporal Discount Rate	$\rho = 0.10$	
• Share Parameters in Preferences	$\alpha_1^0 = 0.50$ and $\alpha_2^0 = 0.50$, $\alpha_1^1 = 0.60$ and $\alpha_2^1 = 0.40$	
• Initial Endowments	$W_1^0 = 20$ and $W_2^0 = 80$, $W_1^1 = 25$ and $W_2^1 = 75$	
• World Prices	$\Pi_l^t = 1.00$ for $t = 0, 1$ and $l = 1, 2$	
• Exchange Rates	$e^0 = e^1 = 1.770$	$e^0 = e^1 = 1.792$
• Domestic Money Supply	$M_S^0 = 160$ and $M_S^1 = 200$	
3.3. Equilibrium		
• Interest Rate	$r = 0.080$	$r = 0.078$
• Exchange Rate Premium Value	$\lambda^0 = \lambda^1 = 0.023$	$\lambda^0 = \lambda^1 = 0.000$
• Domestic Prices	$P_1^t = 1.810$	$P_1^t = 1.792$
	$P_2^t = 1.770$	$P_2^t = 1.792$
• Utility Value	$U = 96.385$	$U = 96.379$
• Consumption	$X_1^0 = 44.192$	$X_1^0 = 44.631$
	$X_2^0 = 45.188$	$X_2^0 = 44.631$
	$X_1^1 = 66.287$	$X_1^1 = 66.946$
	$X_2^1 = 45.188$	$X_2^1 = 44.631$
• Imports	$H_1^0 = 24.192$	$H_1^0 = 24.631$
	$H_1^1 = 41.287$	$H_1^1 = 41.946$
• Exports	$H_2^0 = 34.812$	$H_2^0 = 35.369$
	$H_2^1 = 29.812$	$H_2^1 = 30.369$
• Foreign Currency Demand	$N_D^0 = 24.192$	$N_D^0 = 24.631$
	$N_D^1 = 41.287$	$N_D^1 = 41.946$
	$N_D = 62.404$	$N_D = 63.539$
• Foreign Currency Supply	$N_S^0 = 34.812$	$N_S^0 = 35.369$
	$N_S^1 = 29.812$	$N_S^1 = 30.369$
	$N_S = 62.404$	$N_S = 63.539$
• Revenue from Foreign Exchange Premium	$R^0 = 0.966$	$R^0 = 0.000$
	$R^1 = 1.648$	$R^1 = 0.000$
	$R = 2.491$	$R = 0.000$
• Home hold Income	$I^0 = 338.802$	$I^0 = 339.249$
	$I^1 = 379.684$	$I^1 = 379.249$
• Monetary Deposits	$F = 18.802$	$F = 19.249$

Table 4. Maximum Utility under Optimal Domestic Monetary Policy

	Endogenous $\lambda^0 = \lambda^1$ under An Optimal Exchange Rate	$\lambda^0 = \lambda^1 = 0$ under A Freely Float Exchange Rate
4.1. Model Characteristics		
• Small Open Price Taking Economy		
• 1 Country 2 Period 2 Good		
• Cobb Douglas utility functions within the period		
4.2. Model Parameterization		
• Utility Inter-Temporal Discount Rate	$\rho = 0.10$	
• Share Parameters in Preferences	$\alpha_1^0 = 0.50$ and $\alpha_2^0 = 0.50$, $\alpha_1^1 = 0.60$ and $\alpha_2^1 = 0.40$	
• Initial Endowments	$W_1^0 = 20$ and $W_2^0 = 80$, $W_1^1 = 25$ and $W_2^1 = 75$	
• World Prices	$\Pi_l^t = 1.00$ for $t = 0, 1$ and $l = 1, 2$	
• Exchange Rates	$e^0 = e^1 = 1.50$	
• Domestic Monetary Supply	$M_S^0 = 112.000$	$M_S^0 = 103.621$
	$M_S^1 = 200.000$	$M_S^1 = 200.000$
4.3. Equilibrium		
• Interest Rate	$r = 0.083$	$r = 0.078$
• Exchange Rate Premium Value	$\lambda^0 = \lambda^1 = 0.051$	$\lambda^0 = \lambda^1 = 0.000$
• Domestic Prices	$P_1^t = 1.577$	$P_1^t = 1.500$
	$P_2^t = 1.500$	$P_2^t = 1.500$
• Utility Value	$U = 96.418$	$U = 96.379$
• Consumption	$X_1^0 = 35.509$	$X_1^0 = 34.540$
	$X_2^0 = 37.333$	$X_2^0 = 34.540$
	$X_1^1 = 76.091$	$X_1^1 = 80.000$
	$X_2^1 = 53.333$	$X_2^1 = 53.333$
• Imports	$H_1^0 = 15.509$	$H_1^0 = 14.540$
	$H_1^1 = 51.091$	$H_1^1 = 55.000$
• Exports	$H_2^0 = 42.667$	$H_2^0 = 45.460$
	$H_2^1 = 21.667$	$H_2^1 = 21.667$
• Foreign Currency Demand	$N_D^0 = 15.509$	$N_D^0 = 14.540$
	$N_D^1 = 51.091$	$N_D^1 = 55.000$
	$N_D = 62.664$	$N_D = 65.557$
• Foreign Currency Supply	$N_S^0 = 42.667$	$N_S^0 = 45.460$
	$N_S^1 = 21.667$	$N_S^1 = 21.667$
	$N_S = 62.664$	$N_S = 65.557$
• Revenue from Foreign Exchange Premium	$R^0 = 1.195$	$R^0 = 0.000$
	$R^1 = 3.937$	$R^1 = 0.000$
	$R = 4.828$	$R = 0.000$
• Home hold Income	$I^0 = 264.736$	$I^0 = 253.621$
	$I^1 = 355.863$	$I^1 = 350.000$
• Monetary Deposits	$F = 40.736$	$F = 46.379$

4 Concluding Remarks

This paper presents a model of international trade with both inter-temporal and spatial trade motivatedly by current debate on both Renminbi revaluation and a possible Renminbi free float in China. In this model if inter-temporal trade is restricted by service regulation and tariff rates are bound in the WTO, even for a small open price taking economy free trade in goods will typically not be the best policy. A fixed exchange rate policy with a surrender requirement on exporters and rationing (or auctioning) of foreign exchange among importers can be a welfare improving intervention compared to a free floating exchange rate. This analysis seems relavant to the present debate, in China where services unliberalized until 2007 when the terms of China's WTO accession apply (see Whalley (2003)) and tariff rates bound under China's WTO accession terms.

While this analysis may not be fully realistic of the situation in economies such as China under international pressure to liberalize their exchange rate regime, it provides possible intellectual coherence to a position that China's best policy may not be to move to a free float. This runs counter to accepted international conventional wisdom.

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