RIETI Discussion Paper Series 06-E-024

Chinese Exchange Rate Regimes and the Optimal Basket Weights for the Rest of East Asia

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Chinese Exchange Rate Regimes and the Optimal Basket Weights for the Rest of East Asia[1]

April, 2006

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Abstract

China has recently announced its intention to fundamentally reform its currency regime in the future. This paper studies how the country's choice of its exchange rate regime interacts with the rest of East Asia's choice. For that purpose, I build a four country new open economy macroeconomic model that consists of East Asia, China, Japan and the US. It is assumed that both East Asia and China peg their respective currencies to certain weighted averages of the Japanese yen and the US dollar. Each side takes the other's choice as given and chooses its own basket weight. The game is characterized by strategic complementarity. It is shown that the currency in which the traded goods prices are quoted plays an important role. The paper considers two alternative cases, the standard producer currency pricing (PCP) case and the vehicle currency pricing (VCP) case in which all the prices of traded goods are preset in the units of US dollars. In the PCP case, trade volume is the important determinant of the equilibrium basket weights, and the balances of trade are inconsequential. However, in the VCP case, trade balances between the four economies are shown to play an important role. Under VCP, and starting from realistic initial trade balances, the equilibrium basket weights far exceed what are implied by Japan's presence in international trade.

[1] Key Words: Exchange Rate Regime, Currency Basket, Strategic Interaction, New Open Economy Macroeconomics, Vehicle Currency Pricing. JEL Codes: F41, F33.

[2] I would like to thank participants of the RIETI study group on basket exchange rate regimes for their helpful comments.

1 Introduction

China has recently announced its intention to fundamentally reform its currency regime in the future. This paper studies how China's choice of its exchange rate regime affects the rest of East Asia's choice, and vice versa. For that purpose, I build a four country new open economy macroeconomic model that consists of East Asia, China, Japan and the US. It is assumed that both East Asia and China peg their respective currencies to a basket of the Japanese yen and the US dollars. I consider a game between the two economies in which each side takes the other's choice as given and chooses its own basket weights so as to minimize influences of foreign (Japanese and US) shocks to its own current account. This game exhibits strategic complementary.

The paper derives the Nash equilibrium of this game under various alternative setups. It is shown that the currency in which traded goods' prices are quoted plays an important role. The paper considers two alternative cases, the standard producer currency pricing (PCP) case and the vehicle currency pricing (VCP) case in which all the prices of traded goods are preset in the units of US dollars. In the PCP case, trade volume is the important determinant of the equilibrium basket weights, and the balances of trade are inconsequential. However, in the VCP case, trade balances between the four economies are shown to play an important role. Under VCP, and starting from realistic initial trade balances, the equilibrium basket weights far exceed what are implied by Japan's presence in international trade. The paper also investigates how this tendency is altered when the industrial structure becomes more similar between East Asia and China.

The rest of the report is organized as follows. Section 2 describes the basic theoretical framework. Section 3 presents the model more formally, while section 4 explains the details of the numerical simulation. The results of numerical simulations are presented in section 5, and intuitions behind those results are discussed in section 6. Section 7 concludes.

2 Overview of the model

The model considered in this paper builds on the framework of Corsetti et al. (2000). Their model in turn is based on a two country equilibrium model of Obstfeld and Rogoff (1995 and 1996). In Obstfeld and Rogoff's "redux" model, each country produces one type of goods (which consists of many varieties). In each country, there are households who live for infinite number of periods, who are both consumers and monopolistically competitive producers at the same time. They decide today's consumption and supply of labor, which is the sole input into production, so as to maximize their life-time utility, taking into account the intertemporal budget constraint. Unlike the international real business cycle models (see, for example, Backus, Kehoe and Kydland (1992), this model is characterized by nominal rigidity: nominal prices are assumed to be set in advance, and stay unchanged during one period. This means that a pure monetary expansion could have real effects and could change the utility level of the locals and foreigners.

Corsetti et. al. (2000) develop a three country version of the Obstfeld-Rogoff model. In their model, each country is specialized in the production of just one type of products (each of which consists of many varieties) and those goods are traded internationally. Consumers live for infinite periods and maximize their life time utility. They do not face any borrowing constraint. Their preferences are assumed to be "symmetric" across countries, in the sense that consumers in any country spend the same fraction of their expenditure on goods produced in a particular country. Firms are monopolistically competitive and set nominal prices one period in advance.

Shioji (2001) develops a modified version of this model and analyzes the welfare effect of a Japanese monetary expansion on Asia. He finds that the overall welfare effect was positive. Shioji (2002) generalizes this model by incorporating home bias in consumer preference and a fraction of agents that are myopic (that is, they simply maximize their periodic utility each period). He finds that the welfare implication of the previous paper is weakened but remains qualitatively similar. Shioji (2005) relaxes the assumption that each country specializes in production of just one type of product. Instead, it is assumed that there are three types of goods that are produced in all three countries (called Asia, Japan and the US): they are called "high-tech tradables", "low-tech tradables", and "non-tradables". Using this model, he studies Asia's choice of the optimal basket weights (between the Japanese yen and the US dollars) under the typical "producer currency pricing" case and a more typical case in which prices of tradable goods are fixed in the short run in the units of the US dollars.

The model in this paper consists of four "countries", East Asia, China, Japan, and the US. Japan and the US specialize in production of "J goods" and "U goods", respectively. East Asia and China, on the other hand, both produce both of "A1 goods" and "A2 goods".

This model is simulated numerically to derive the responses of East Asia and China's current accounts to monetary shocks that originate from either the US or Japan. It is assumed that both Japan and the US are under the flexible exchange rate regime, while both East Asia and China adopt basket pegs. First, taking China's choice of basket weights as given, I compute the responses of East Asia' current account. I will investigate under which values of basket weights for East Asia its current account is most stabilized. This exercise will be repeated under various values of China's basket weights. This will enable me to derive a reaction function of East Asia to China's choice. Next, I take East Asia's choice as given and derive China's reaction function. By studying the features of those reaction functions, we will be able to uncover what kind of strategic interaction exists between the two economies.

This simulation exercise will be conducted under various setups. They differ in the assumptions concerning the pricing behaviors regarding traded goods, initial trade balance between the four countries, and the industrial structures of East Asia and China.

In terms of pricing behaviors, I consider two alternative cases. The first is the standard producer currency pricing (PCP) case, in which the prices of traded goods remain constant in the short run in the units of the exporter country's currency. The second is called the vehicle currency pricing (VCP) case, which means that their prices are preset in the units of US dollars.

As for initial trade balances, I start from the standard assumption that, prior to the arrival of shocks, trade was completely balanced between the four countries. This assumption, however, is not particularly realistic when it comes to the relationship between the East Asian countries and the US. In reality, the US is running large trade deficits against each of East Asia, China, and Japan. To take this fact into consideration, I will consider an alternative case in which the initial conditions reflect the reality described above.

I also consider two alternative assumptions regarding the industrial structures of East Asia and China. In the benchmark case, East Asia largely specialized in production of A1 goods, while China's production is mostly devoted to A2 goods. Hence their industrial structure is very different from each other. In recent years, however, mainly due to the advancement of the machinery sector in China, its trade structure is becoming increasingly similar to that of East Asia. To see the effect of such structural changes, in an alternative case, it is assumed that both East Asia and China produce mostly A2 goods, and the production of A1 goods is at a very low level. Hence, in this case, the two economies are quite similar in their industrial structure.

3 The Model

The world consists of four "countries"; US (denoted by U), Japan (denoted by J), China (denoted by C) and East Asia (denoted by E). Each country is inhabited by a continuum of households. The numbers of households in those countries are all constant, and are denoted by γ_U, γ_J, γ_C, and γ_E, respectively. Time is discrete and households live for infinite periods of time. There is free flow of goods and bonds between the countries.

3-1 Type of Goods

Goods are classified into four "types". They are all tradables. First, there are two types of "OECD goods", called "U goods" (denoted by subscript U) and "J goods" (denoted by subscript J). They are produced exclusively by the US and Japan, respectively. Second, there are two types of "Asian goods", called "A1 goods" and "A2 goods". Both of them are produced by both Chinese and East Asian producers. Those four types of goods are imperfect substitutes. Each type of goods consists of many "brands", that are imperfect substitutes between each other. Each household specializes in production of just one brand of goods, over which it has a monopoly right to produce. This means that the number of brands produced is always equal to the number of households.

There is no investment and all the goods are final consumer goods. We make an assumption on the utility function so that all the households decide to consume all brands of goods available to them, that is, all brands of tradable goods as well as all non-tradable goods produced in the country they live in.

3-2 Households

In each period, each household obtains utility from consuming a bundle of consumer goods. It derives disutility from working to produce its own brand of consumer goods. It also derives utility from holding real money balance. The one-period utility of the household x, that produces type k goods (k=U, J, A1, or A2) in country j in period t is assumed to take the following form:

$$u_t^{jk}(x) = \ln C_t^{jk}(x) - \frac{\kappa^{jk}}{2}\left(Y_t^{jk}(x)\right)^2 + \chi \cdot \ln\left(\frac{M_t^{jk}(x)}{P_t^j}\right) \quad (1)$$

The first part represents utility from consumption. The variable $C_t^{jk}(x)$ is a bundle of consumer goods (or the "composite consumption index") consumed by this household in period t. The exact definition of this index will be specified later. The second part represents the disutility of work. The variable $Y_t^{jk}(x)$ is the amount of output produced by this household in period t, using labor as the sole input. The parameter κ (which is assumed to be positive) describes how work effort is related to output: when its value is high, it means that productivity is low (more work effort is needed to produce the same amount of output). The third part corresponds to the utility from money holding, where $M_t^{jk}(x)$ is the amount of cash held by this household, denoted in the unit of the local currency, while P_t^j is the average price level of country j, to be specified exactly later. The parameter χ is assumed to be positive. The periodic budget constraint takes the following form:

$$\frac{E_t^j B_{t+1}^{jk}(x)}{P_t^j} + \frac{M_t^{jk}(x)}{P_t^j} + C_t^{jk}(x) = (1+i_t)\frac{E_t^j B_t^{jk}(x)}{P_t^j} + \frac{M_{t-1}^{jk}(x)}{P_t^j} + \frac{SR_t^{jk}(x)}{P_t^j} - \frac{T_t^{jk}(x)}{P_t^j} \quad (2)$$

In the above, E_t^j is the exchange rate of country j (j=U, J, C, or E) in period t. We shall take the US dollar as the numeraire so that E_t^U =1. The other exchange rates are defined as the value of a US dollar in the units of local currency, so an increase in this variable means a depreciation of the local currency against the US dollars. $B_{t+1}^{jk}(x)$ is the amount of bond held by this household at the end of period t. The bonds are denominated in US dollars. The nominal interest rate that accrues to holding this bond between periods t-1 and t is denoted by i_t, and this is also measured in US dollars. The assumption of free financial capital mobility implies that this value will always be the same across the countries. $SR_t^{jk}(x)$ is the revenue from sales of the goods produced by this household, defined in the units of the local currency. In a flexible price equilibrium (long run), law of one price holds, and the sales revenue is equal to the price of this brand of goods charged by this monopolistically competitive household (which will be denoted by $P_t^{jk}(x)$), times the quantity of the goods sold world-wide ($SR_t^{jk}(x) = P_t^{jk}(x) \cdot Y_t^{jk}(x)$). In a fixed price equilibrium (short run), the domestic price is fixed, while sales prices abroad vary depending on the pass-through rate between the seller's country and the buyer's country. Finally, $T_t^{jk}(x)$ is lump sum tax imposed by the government, also defined in the units of the local currency.

Also, note that, as a producer, each household faces a downward sloping demand curve, as different brands of goods are assumed to be imperfect substitutes. Later, we shall specify exactly how those varieties of goods enter into each household's utility. For the moment, it suffices to know that, in a flexible price equilibrium (long run), each household faces the demand curve of the following kind:

$$Y_t^{jk}(x) = P_t^{jk}(x)^{-\theta_x} \cdot Z_t^{jk} \quad , (3)$$

where θ_x is a sector-specific constant larger than one, whose role in the utility function will be spelled out later. And Z_t^{jk} is some variable that is beyond the control of each household.

Households are forward looking and maximize the following life time utility:

$$U_t^{jk}(x) = \sum_{s=0}^{\infty} \beta^s u_{t+s}^{jk}(x) \quad , \ (4)$$

(where β is the subjective discount factor) subject to the periodic budget constraint and a non-Ponzi game condition.

3-3 Equilibrium conditions

Here, I will discuss equilibrium conditions for the households as a whole. For example, define the average consumption of households producing type k goods in country j in period t as the integral of $C_t^{jk}(x)$ over all x. Denote such a variable as C_t^{jk}. Define Y_t^{jk}, M_t^{jk}, and B_t^{jk}, in analogous ways for output, money holdings, and bond holdings, respectively. Then, by the assumption of symmetry within each household group, we obtain

$$C_t^{jk} = C_t^{jk}(x), \quad Y_t^{jk} = Y_t^{jk}(x), \quad M_t^{jk} = M_t^{jk}(x), \quad B_t^{jk} = B_t^{jk}(x), \qquad (5)$$

for all j, k and t.

In equilibrium, the following three conditions that are derived from individual forward looking household's optimization conditions have to be satisfied at the aggregate level. First, the following Euler equation has to be satisfied:

$$\frac{C_{t+1}^{jk}}{C_t^{jk}} = \beta\left(1+i_{t+1}\right)\frac{P_t^j / E_t^j}{P_{t+1}^j / E_{t+1}^j} \quad \text{(for all t, j, and k).} \qquad (6)$$

Second, the following "money demand" relationship has to be satisfied:

$$\frac{M_t^{jk}}{P_t^j} = \chi C_t^{jk} \frac{(1+i_{t+1})E_{t+1}^j}{(1+i_{t+1})E_{t+1}^j - E_t^j} \quad \text{(for all t, j, and k). (7)}$$

The previous two conditions have to be satisfied at all times. When prices are flexible, the following optimality condition for the consumption-leisure choice will have to be met as well:

$$\frac{P_{j,t}^{jk}}{P_t^j} = \frac{\theta \cdot \kappa^{jk}}{\theta - 1} C_t^{jk} \cdot Y_t^{jk} \qquad \text{(for all t, j, and k)}, (8)$$

where $P_{j,t}^{jk}$ is the average price index for the type k goods produced and sold in country j by households in country j (which will be equal to individual price $P_t^{jk}(x)$, by symmetry).

3-4 Equilibrium conditions (government)

Next, the government's budget constraint has to be satisfied in equilibrium. In this paper, it is assumed that the government's only role is to print money and to distribute it across households in a lump sum fashion. This implies:

$$M_t^j - M_{t-1}^j + T_t^j = 0 \qquad \text{(for all t and j)}, \qquad (9)$$

where M_t^j and T_t^j are money supply and transfer, respectively, in country j in period t. I assume that the government supplies the same amounts of money and transfers to households within the same category, i.e., those who produce the same type of goods and have the same utility function. Then, writing such money supply and transfers per capita to households producing type k goods as M_t^{jk} and T_t^{jk}, and the population of households producing type k goods in country j as π^{jk}, we can write

$$M_t^j = \sum_k \pi^{jk} M_t^{jk} \qquad (10)$$

and

$$T_t^j = \sum_k \pi^{jk} T_t^{jk} \quad . \quad (11)$$

3-5 Equilibrium conditions (resource constraint)

The aggregate resource constraint for country j can be written as:

$$E_t^j (B_{t+1}^j - B_t^j) = SR_t^j + i_t E_t^j B_t^j - P_t^j C_t^j \qquad \text{(for all t and j)}, \qquad (12)$$

where B_t^j, SR_t^j, and C_t^j are aggregate bond holding, sales revenue, and consumption, respectively. That is,

$$B_t^j = \sum_k \pi^{jk} B_t^{jk} \quad , \qquad (13)$$

$$SR_t^j = \sum_k \pi^{jk} SR_t^{jk} \qquad (14)$$

(where SR_t^{jk} is sales revenue for households producing type k goods in country j),

and $C_t^j = \sum_k \pi^{jk} C_t^{jk}$. (15)

The world wide net supply of bonds has to be equal to zero:

$$B_t^U + B_t^J + B_t^C + B_t^E = 0 \quad \text{(for all t).} \qquad (16)$$

The amount of output produced by each type of household has to equal the demand for the good. That is,

$$Y_t^j(x) = D_{U,t}^j(x) + D_{J,t}^j(x) + D_{C,t}^j(x) + D_{E,t}^j(x) \quad \text{(for all x, t and j),} \qquad (17)$$

where $D_{U,t}^j(x)$, $D_{J,t}^j(x)$, $D_{C,t}^j(x)$ and $D_{E,t}^j(x)$ are demand for output produced by household x in country j that come from the US, Japan, China, and East Asia, respectively. Those demands will be specified in detail later.

3-6 Composite consumption indices

Now I move on to specify contents of each consumption index. In this section, time subscript t is omitted for the sake of exposition. The overall consumption index, $C^{jk}(x)$, is assumed to take the following form:

$$C^{jk}(x) = \left[\omega_{UJ}^{j\ 1/\varepsilon} \left(C_{UJ}^{jk}(x)\right)^{(\varepsilon-1)/\varepsilon} + \omega_A^{j\,1/\varepsilon} \left(C_A^{jk}(x)\right)^{(\varepsilon-1)/\varepsilon} \right]^{\varepsilon/(\varepsilon-1)}, \qquad (18)$$

where $C_{UJ}^{jk}(x)$ is itself a composite consumption index of U goods and J goods, and $C_A^{jk}(x)$ is an index for A1 and A2 goods. The parameter ε is the elasticity of substitution between tradable goods as a whole and non-tradable goods, and ω 's are the expenditure share parameters. In turn,

$$C_{UJ}^{jk}(x) = \left[\omega_U^{j\,1/\psi} \left(C_U^{jk}(x)\right)^{(\psi-1)/\psi} + \omega_J^{j\,1/\psi} \left(C_J^{jk}(x)\right)^{(\psi-1)/\psi} \right]^{\psi/(\psi-1)}, \qquad (19a)$$

and

$$C_A^{jk}(x) = \left[\omega_{A1}^{j\ 1/\phi} \left(C_{A1}^{jk}(x)\right)^{(\phi-1)/\phi} + \omega_{A2}^{j\ 1/\phi} \left(C_{A2}^{jk}(x)\right)^{(\phi-1)/\phi} \right]^{\phi/(\phi-1)}. \qquad (19b)$$

Each of the above indices are themselves composite consumption indices. For example, in the case of A1 goods,

$$C_{A1}^{jk}(x) = \left[\omega_{A1,C}^{j\ \ 1/\theta_{A1}} \cdot C_{A1,C}^{jk}(x) + \omega_{A1,E}^{j\ \ 1/\theta_{A1}} \cdot C_{A1,E}^{jk}(x) \right]^{\theta_{A1}/(\theta_{A1}-1)} \qquad (20)$$

where θ_{A1} is the elasticity of substitution between brands within type A1 goods, and

$$C_{A1,i}^{jk}(x) = {\omega_{A1,i}^{j}}^{-1/\theta_{A1}} \cdot \sum_{z_{A1,i}} \left(C_{A1}^{jk}(z_{A1,i}, x) \right)^{(\theta_{A1}-1)/\theta_{A1}} \tag{21}$$

where summation inside the brackets is taken over all the A1 brands produced in country i.

3-7 Price indices and demand functions

The above definitions of consumption indices allow us to appropriately define composite price indices. Also, we can derive demand functions that each household faces as a producer of goods.

3-8 Long run vs. Short run equilibrium, and pricing regimes

In the long run, all the prices are assumed to be flexible and that all the markets clear. In such a case, the contemporaneous optimality conditions between consumption and leisure are satisfied for all the households: that is, equation (8) is satisfied. In the short run, prices are rigid in the sense that will be specified below, and output becomes demand-determined. As a consequence, equation (8) no longer holds.

In the short run, the nominal prices of domestically produced goods are assumed to be rigid (that is, the same as their values in the previous period) in the units of the domestic currency. As for the goods traded internationally, in the bench mark case, we assume producer currency pricing (PCP). In this case, the traded goods prices are preset in the units of the currency of the country in which they are produced, and remain unchanged in the short run. In the alternative case of vehicle currency pricing (VCP), their prices are predetermined in the units of US dollars.

4 Description of the Numerical Exercise

4-1 Dynamics of the Model

In the following analysis, it is assumed that the world economy starts from a flexible price equilibrium with constant money supply. All the countries are in the steady state in which all the variables remain constant over time. In the benchmark case, it is assumed that all households had zero foreign bonds or debts at the outset. This implies, by the nature of steady state, that trade is balanced for each of the four countries. In the numerical simulation, I will also choose the parameter values in such a way that exports and imports are practically equal for each of the bilateral trade pairs. In the alternative case, I will allow for the possibility that there were accumulated assets and debts in the initial steady state, and, as a consequence, trade is not necessarily balanced for each country.

Starting from the steady state of either nature mentioned above, money supply of either the US or Japan increases permanently. As East Asia and China are assumed to peg their currencies to a certain basket of the US dollar and the Japanese yen, their money supply is also likely to change as endogenous responses to the shock[3]. In the short run, there is price rigidity of one kind or the other, as described in the

[3] As stated, population is heterogeneous within East Asia and China, where there are two groups of households producing different types of goods. In this case, how money supply is distributed between the two household groups could have real influences on the policy effects. In this paper, it is assumed that, in each

previous section. As a consequence, the world economy deviates from the long run equilibrium. Output becomes demand determined. After one period, prices become fully flexible. The world economy arrives at a new flexible price equilibrium, which is likely to be different from the old one. In fact, the world economy will automatically jump to the new long run equilibrium immediately. This is the beauty of the approach of Corsetti, et.al. (2000): it converts an infinite period model into a virtual two period model, and researchers have to worry about only the "short run" (period 1) and the "long run" (period 2 onwards).

The effects of the policy change are analyzed by computing percentage deviations of the new equilibrium from the original steady state, by way of log-linear approximation[4]. As it is difficult to obtain analytical results, I report results from numerical exercises in the next section.

4-2 Calibration

The model is calibrated to fit characteristics of data for the US, Japan, China and East Asia on production and relative productivity. Data for Asia is computed by aggregating values for Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, and Thailand (Taiwan is omitted due to missing data). The actual numbers employed are summarized in Tables 1-5.

Population

World population is normalized to equal 1, and each country's population is chosen to match its actual share (among the four economies) in the number of persons employed, as is shown in Table 1[5].

Productivity

The productivity parameters in the last row of Table 1 are chosen to match observed GDP per worker.

Subjective Discount Factor and the Utility Weight on Money

As is shown in Table 2, I set the subjective discount factor at $\beta = 0.9$. The parameter for money in the utility, χ , is somewhat arbitrarily set at 1.

Elasticities

Assumptions on the elasticities of substitution are summarized in Table 2. All the elasticities are set to be equal to 2, with the exception of the within-type elasticities between A1 as well as A2 goods, which are set to be equal to 5.

Exchange rate regimes

It is assumed that both Japan and the US are under flexible exchange rate regimes. China and East Asia, on the other hand, employ basket peg regimes in which their nominal exchange rates are fixed against weighted averages of the Japanese yen and the US dollars.

Pricing regimes

As stated earlier, two cases are considered. In both cases, prices of domestically produced and consumed goods are assumed to be constant in the short run. In the "PCP" case, prices of traded goods are constant

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period, initial money supply is (re-)distributed to each household in such a way that it is proportional to average per household nominal expenditure of the producer group that the household belongs to during that period. This way, monetary policy will not have real effects through a redistributive channel.

[4] As initial bond holdings are assumed to be zero in the benchmark case, we cannot take their log linear approximations around the initial values. For those variables, their deviations from the initial values are defined as changes in their values from their initial values as ratios to the initial GDP.

[5] Total numbers of workers are estimated by information from the *Key Indicators* web site of thEast Asian Development Bank.

in the short run in the units of the producer country's currency. In the "VCP" case, they are preset in the units of US dollars.

Sectoral allocation of workers, or industrial strucure

As was stated earlier, two alternative assumptions will be made. In the "Distinct" case, 99% of Chinese workers will be working in A1 sector, while the corresponding number will be 1%. In the "Similar" case, both ratios will be 1%.

Utility Weights and Initial Surpluses

In principle, the values of the expenditure share parameters, ω's, are chosen to match the actual expenditure patterns of the four economies. However, in the data, the East Asian countries enjoy sustained trade surpluses, while the US runs trade deficits. To isolate their consequences, I will first abstract from their presence in the benchmark case called the "balanced" case, and later compare the results with a more realistic case called the "unbalanced" case, in which the presence of initial surpluses and deficits is allowed. Table 3A summarizes the parameters used in the "balanced" case. In the table, each row represents a buyer country, and each of the first four columns show the values of expenditure share parameters applicable to goods sold by each of the four countries. The last column represents the buyer country's initial deficit (% of initial total absorption). The expenditure share parameter in the (i,j) entry of the table (where each of i and j represents a country) for this case[6] is computed by the following procedure. First, "expenditure by i on goods from j" is computed by the formula: ((actual expenditure by i on goods from j) + (actual expenditure on goods from i by j))/2. Note this implies that (hypothetical) "expenditure by i from j" and "expenditure by j from i" will be equal, by construction. This reflects the notion of bilateral trade balance. Then the share parameter (i,j) is set to be equal to this hypothetical expenditure divided by GDP of i. Moreover, as the last column of Table 3A shows, the initial trade surplus is restricted to be zero. This is ensured by restricting the initial bond holding of each household in each country to be zero[7]. Of course, as the elasticity of substitution between the goods in the model deviates from 1 in the model (see Table 2), and the countries are asymmetric (as in Table 1), the bilateral trade in the steady state will not be exactly balanced in the resulting steady state. However, as a numerical matter, the steady state bilateral trade in this "balanced" case turned out to be very close to actually being balanced.

In contrast, the parameter values in the "unbalanced" case, summarized in Table 3B in the same manner as in Table 3A, are more straightforward reflection of the actual pattern seen in the data. The expenditure share parameter in the (i,j) entry is set to be equal to the observed expenditure by country i on goods from j divided by i's total absorption (GDP minus net exports). As shown in the last column, East Asia, China and Japan are supposed to be running trade surplus in the initial steady state, while the US alone is running deficit. This is ensured by appropriately choosing the values for initial bond holdings. An unavoidable consequence is that we have to assume a negative bond holding for a country with initial

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[6] For example, the parameter for the "share of expenditure 'by East Asia' 'from US'" corresponds to, using the model notations, ω_{UJ}^{E} times ω_{U}^{E}.

[7] This can be seen from equation (2). If bond holding is zero on both sides of the equation, and money supply is constant over time (which implies no monetary transfers, from (9)), nominal consumption expenditure and sales revenue will be equal for every household.

surplus and a positive bond holding for a country with initial deficit, from equation (2) and by the requirement of a steady state. This is the cost we have to pay to make the initial trade patterns of the model realistic, but it is still an uncomfortable implication, especially given the actual large accumulated foreign debt of the US. One way to reconcile this assumption with the reality might be to think of "bonds" in the model including non-pecuniary assets in foreign countries, such as political influences, military presence, and the ability to collect segniorage as an issuer of a currency used internationally.

I have not discussed expenditure shares between goods A1 and A2 produced in East Asia and China. The parameter values for those shares are chosen so that the share parameter for each type of good will be equal to the share of its producers in total population times the country-wide share parameter for each producer country.

Table 1: Parameter values for the calibration exercise (A)

Population and Productivity

	East Asia	China	Japan	US
Population	0.171	0.649	0.057	0.122
Productivity (square root of $1/\kappa$)	1	0.3	15	15

Table 2: Parameter values for the calibration exercise (B)

Preference parameters

Preference parameters:	
Discount factor (β)	0.9
Utility weight on money (χ)	1
Elasticities:	
Between (U,J) and (A1, A2)	2
Between U and J	2
Between A1 and A2	2
Within U and Within J	2
Within A1	5
Within A2	5

Table 3: Parameter values for the calibration exercise (C)

Sectoral allocation of population in East Asia and China

	Percent of total population, in the order of (A1, A2)	
	East Asia	China
"Distinct" case	99, 1	1, 99
"Similar" case	99, 1	99, 1

Table 4: Parameter values for the calibration exercise (D)

Expenditure share parameters and initial surpluses.

A. "Balanced" case

	Expenditure share parameters				Initial trade surplus (% of absorption)
	from E. Asia	from China	from Japan	from US	
by E.Asia	75.48%	5.64%	8.74%	10.15%	0.00%
by China	4.49%	85.03%	4.71%	5.76%	0.00%
by Japan	1.79%	1.21%	94.77%	2.23%	0.00%
by US	1.02%	0.73%	1.10%	97.15%	0.00%

B. "Unbalanced" case

	Expenditure share parameters				Initial trade surplus (% of absorption)
	from E. Asia	from China	from Japan	from US	
by E.Asia	76.96%	4.30%	10.49%	8.25%	5.81%
by China	5.92%	86.10%	5.17%	2.81%	3.05%
by Japan	1.58%	1.16%	95.81%	1.46%	2.31%
by US	1.23%	1.09%	1.47%	96.21%	-2.00%

Table 5: Summary of the benchmark case and the alternative cases

	Pricing regime	Sectoral population shares	Share parameters and surpluses
benchmark	PCP	"distinct"	"balanced"
alternative	VCP	"similar"	"unbalanced"

4-3 Steady State of the Model

I first derive values of various shares and ratios in the initial steady state. By comparing those with actual statistics, we can study how closely the model replicates the actual patterns of production and spending. As the pricing regime has no consequence on the steady state allocation, we will be considering four types of steady states, depending on whether the sectoral allocation of workers is "distinct" or "similar", and on whether expenditure shares are "balanced" or "unbalanced". To save space, in Table 6, I show only the cases of "distinct and balanced" and "distinct and unbalanced". "Similar" cases are practically identical to those cases. Comparing the table with Table 4 shows that the steady state features are largely determined by the choices of expenditure share parameters and initial surpluses.

Table 6: Steady state expenditures and surpluses of the model.

A. "Distinct, Balanced" case

	Calibrated expenditure shares				Initial trade surplus (% of absorption)
	from E. Asia	from China	from Japan	from US	
by E.Asia	76.60%	5.49%	8.22%	9.72%	0.00%
by China	4.69%	85.10%	4.53%	5.64%	0.00%
by Japan	1.93%	1.26%	94.60%	2.27%	0.00%
by US	1.08%	0.75%	1.08%	97.10%	0.00%

B. "Distinct, Unbalanced" case

	Calibrated expenditure shares				Initial trade surplus (% of absorption)
	from E. Asia	from China	from Japan	from US	
by E.Asia	78.17%	4.47%	9.55%	7.81%	4.93%
by China	5.85%	86.99%	4.59%	2.59%	6.48%
by Japan	1.76%	1.31%	95.45%	1.51%	1.65%
by US	1.32%	1.19%	1.41%	96.07%	-2.07%

5 Main findings

In this section I report the simulation results. In Figures 1-4, the horizontal axis corresponds to the basket weight of China, and the vertical axis represents that of East Asia. Values on the axes are the weights of the Japanese yen. Hence, if the value is zero, it means a complete peg to the US dollar, and, if it is one, this means a complete peg to the Japanese yen. The two curves in the figures are the reaction curves of East Asia and China. The solid curve is the optimal choice of East Asia given China's choice. As stated earlier, "optimal" here is defined as the weight that minimizes the sum of the squared responses of the country's current account to the US and Japanese monetary policy shocks (defined as increases in their respective money supply) of equal sizes. The dashed curve is the optimal choice of China given East Asia's choice. The intersection between the two curves is the Nash equilibrium.

Figure 1 shows the case in which industrial structure is "distinct" between East Asia and China, and trade is "balanced". In all of Figures 1-4, Panel A corresponds to the "PCP" case (hence Figure 1A represents the benchmark case of this paper's analysis), while panel B shows the result for the "VCP" case. According to Figure 1A, this game between East Asia and China is characterized by strategic complementarity. By applying the usual stability argument, the Nash equilibrium is stable. The same features will emerge in all the panels of Figures 1-4. The intuition is the following. Consider East Asia, which takes China's choice as given. When China employs a complete US dollar peg, the share of the "dollar area" in overall trade for East Asia is high. East Asia itself thus has a strong incentive to stabilize the value of its currency against the US dollars. It still does not wish to employ a complete US dollar peg, as Japan accounts for some fraction of its trade (about 35% in the simulation). As China increases the Japanese yen's weight in its basket, East Asia also wishes to increase the yen's weight in its own basket, for it is as if the fraction of trade with the "yen area" increases. Even if China employs a complete yen peg, however, East Asia wishes to retain some weight on US dollars, because it trades with the US as well. As a result, the reaction curve is upward sloping with a positive intercept and has a slope less than one. A similar argument applies to China. The Nash equilibrium is obtained when the weight of the Japanese yen is slightly less than half for both countries, as can be seen in Figure 1A.

The situation is quite similar in Figure 1B, in which the pricing regime is now "VCP" but everything else is the same. The equilibrium weights become slightly higher.

Figure 2 corresponds to the case in which trade is "unbalanced" but the industrial structure is "distinct". Figure 2A, the "PCP" case, is quite similar to the "balanced" case. However, in Figure 2B, the "VCP" case, both reaction curves shift outward compared to Figure 1B, and the equilibrium weights of the yen are much higher, exceeding 70%. Hence, the presence of initial trade imbalance is largely irrelevant under "PCP", but it influences the result enormously under "VCP".

In Figure 3, initial trade is back to the "balanced" case but now the industrial structure is "similar" between East Asia and China. The slopes of the reaction curves suggest that the optimal weight for one country becomes more sensitive to the choice of the other in this case. Intuitively, as the competition between the two countries becomes severer, each of them has a greater incentive to stabilize the value of its currency against the other. The Nash equilibrium itself does not change greatly from Figure 1. It should be noted, however, that the equilibrium values are more sensitive to slight shifts in the reaction curves in this case.

Figure 4 shows the result for the case opposite to the benchmark: initial trade is "unbalanced" and industrial structure is "similar". Figure 4A shows that, once again, under the "PCP" case, the equilibrium weights are largely unaffected. However, according to Figure 4B, in the "VCP" case, both reaction curves shift outward, and the equilibrium weights are much higher. Comparing this figure with Figure 2B, the "unbalanced" but "distinct" case, East Asia's equilibrium weight is higher while that of China is slightly lower.

6 Intuition

Although the intuition is relatively straightforward in the "PCP" case, in which trade volumes play the decisive role, mechanisms behind the results for the "VCP" case require some further investigation. The following thought experiment is useful. Suppose, for simplicity, that China employs either the complete US dollar peg (thus it is a part of the "dollar area") or the complete Japanese yen peg (in this case it is a part of the "yen area"). On the other hand, East Asia attaches the weight equal to a*100% to the Japanese yen and (1-a)*100% to the US dollar. Suppose that the yen depreciated against the US dollar by 1%. What happens to the prices of traded goods sold in each country, expressed in the units of that country's currency? Table 7A summarizes the "PCP" case. In this case, as a becomes larger, East Asia can sell its products at lower prices in both the yen the dollar areas, while the local prices of the imported goods are higher. This case is contrasted with the "VCP" case summarized in Table 7B. In this case, as all the imported goods come into a local market with their dollar prices fixed, the only thing that matters is what happens to the importer country's exchange rate against the US dollar. Hence, in East Asia, imported goods prices rise uniformly as the yen's weight increases in its basket, that is, as its currency is depreciated against the US dollar. In Japan, prices of all the imports rise by 1%, wherever they are from. And this holds no matter what happens to East Asia's basket weight of the Japanese yen, as the goods coming from East Asia are always priced in US dollars. In contrast, in the US, prices of all the imports are unchanged, because they are all priced in US dollars.

Table 7: Response of the prices of traded goods in the market in which they are sold (in the units of that country's currency) to a one percent depreciation of the yen against the dollar (in %)

A. PCP case

		Goods exported from		
		East Asia	Yen Area	Dollar Area
Local market	East Asia	---	-(1-a)	a
	Yen Area	1-a	---	1
	Dollar Area	-a	-1	---

B. VCP case

		Goods exported from		
		East Asia	Yen Area	Dollar Area
Local market	East Asia	---	a	a
	Yen Area	1	---	1
	Dollar Area	0	0	---

As a further thought experiment, assume that the price elasticities of imports are all constant and that they are equal across all the goods and the markets. Denote this elasticity by e. Also denote the initial exports from East Asia to the yen area and to the dollar area by E¥ and E$, respectively, and its initial imports from those areas by I¥ and I$, respectively. Then, under "PCP", East Asia's trade balance changes by e times the following amount:

$$\left\{-(1-a)E_{¥}+aE_{\$}\right\}-\left\{(1-a)I_{¥}-aI_{\$}\right\} \qquad (22)$$

Equating this to zero, and denoting the resulting weight as $a*_{PCP}$,we obtain:

$$a*_{PCP}=\frac{E_{¥}+I_{¥}}{\left(E_{¥}+I_{¥}\right)+\left(E_{\$}+I_{\$}\right)}=\frac{T_{¥}}{T_{¥}+T_{\$}}, \qquad (23)$$

where $T_{¥}\equiv E_{¥}+I_{¥}$ and $T_{\$}\equiv E_{\$}+I_{\$}$.

This is the "trade volume weighted" basket weight. Under "VCP", East Asia's trade balance changes by e times the following amount:

$$\left\{-1\cdot E_{¥}+0\cdot E_{\$}\right\}-\left\{aI_{¥}+aI_{\$}\right\} \qquad (24)$$

and thus, equating this to zero, and denoting the resulting weight as a^*_{VCP} yields:

$$a^*_{VCP}=\frac{E_{¥}}{I_{¥}+I_{\$}}. \qquad (25)$$

Note that, in this case, exports to the dollar area disappear from the right hand side. Also, comparison between equations (23) and (25) reveals that an increase in imports from Japan increases the yen's "optimal" weight under "PCP", but decreases it under "VCP", holding other things equal. The above results imply two things. First, when bilateral trade is balanced in every direction (that is, E¥=I¥ and E\$=I\$), both "PCP" and "VCP" give the same weight: that is, the pricing regime does not matter. Second, when there is initial trade imbalance, it does not affect a^*_{PCP} as long as trade volumes (T¥ and T\$) are unchanged. This is not so under "VCP". Note that equation (25) can be rewritten as

$$a^*_{VCP}=\frac{\frac{E_{¥}}{T_{¥}}T_{¥}}{\left(1-\frac{E_{¥}}{T_{¥}}\right)T_{¥}+\left(1-\frac{E_{\$}}{T_{\$}}\right)T_{\$}}, \qquad (27)$$

Thus, holding trade volumes (T¥ and T\$) constant, a*VCP is increasing in trade surpluses against both the yen area and the dollar area. As East Asia runs a trade surplus against the US (while trade against Japan is closer to being balanced) in the more realistic "unbalanced" case of the numerical analysis, its optimal weight of the yen is likely to be higher than under the "balanced" case. By the same argument, the optimal weight of the yen for China tends to be higher under the "unbalanced" case than under the "balanced" case. Those are the basic reasons why the reaction curves for both countries shift outward when we move from Figure 1B to Figure 2B, or from Figure 3B to Figure 4B, while the same tendency is not observed under the "PCP" case.

As a more subtle issue, the expressions in (27) suggest that the slopes of the reactions curves in the "VCP" case depend on the bilateral trade balance between East Asia and China. In the "unbalanced" case of the numerical simulation, East Asia runs an initial trade surplus against China. In Figures 2B and 4B, as China increases its basket weight on the yen, it is as if East Asia's surplus against the dollar area shrinks while its surplus against the yen area increases. Comparing Figures 2B with 1B, or 4B with 3B, we learn that the presence of this effect makes East Asia's reaction to China's strategy more sensitive. The opposite can be said of China: in the "unbalanced" case, its reaction to East Asia's choice becomes weaker.

7 Conclusions

This paper has utilized a new open economy macroeconomic model to analyze the strategic interaction between China and East Asia in their choices of basket weights. The game is characterized by strategic complementarity. When the assumptions on the pricing regime and initial trade imbalances are combined with each other, they alter the equilibrium values greatly. In the realistic case in which the prices of traded goods are preset in the units of US dollars, and Asian countries run large trade surpluses against the US, the equilibrium basket weights of the yen tend to be much higher than otherwise.

This model can be used to predict the future course of the exchange rate regimes in overall East Asia. For example, it is widely expected that Japan's trade surplus is going to shrink in the near future due to the quickly aging population. If this happens, the analysis in the paper suggests that the equilibrium basket weights on the Japanese yen are likely to be even higher.

This paper focused exclusively on the positive aspects of the game between East Asia and China. Future work needs to consider the normative aspects as well. Also, more detailed investigations on the roles of industrial structure need to be conducted.

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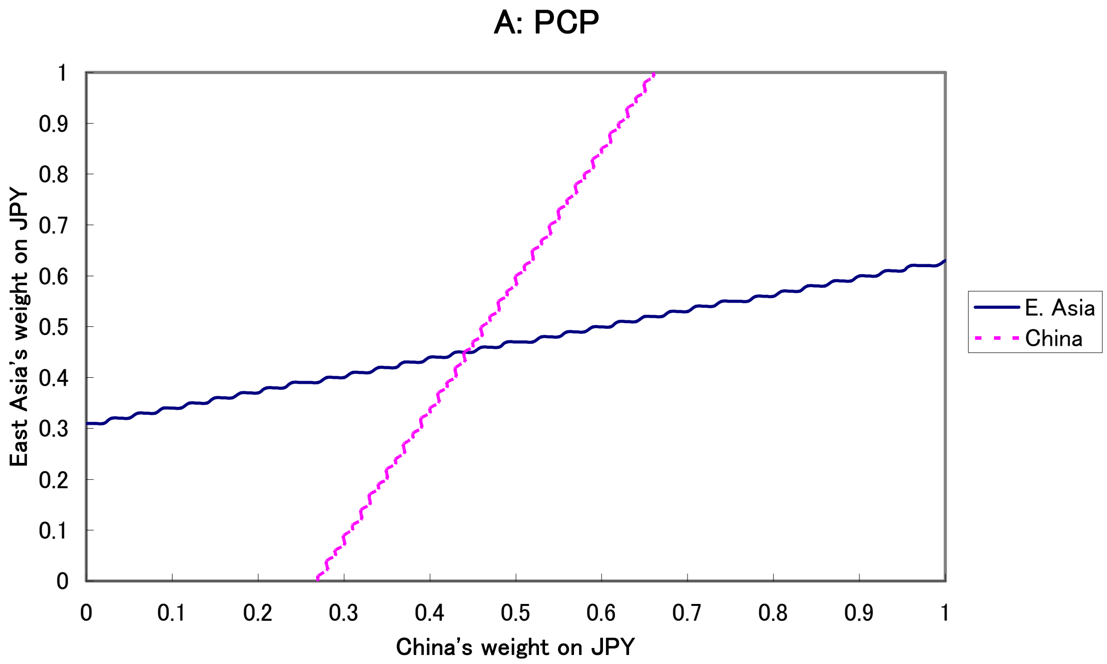
Figure 1: Reaction curves for East Asia and China,
Initial trade="balanced", Industrial structure="distinct"



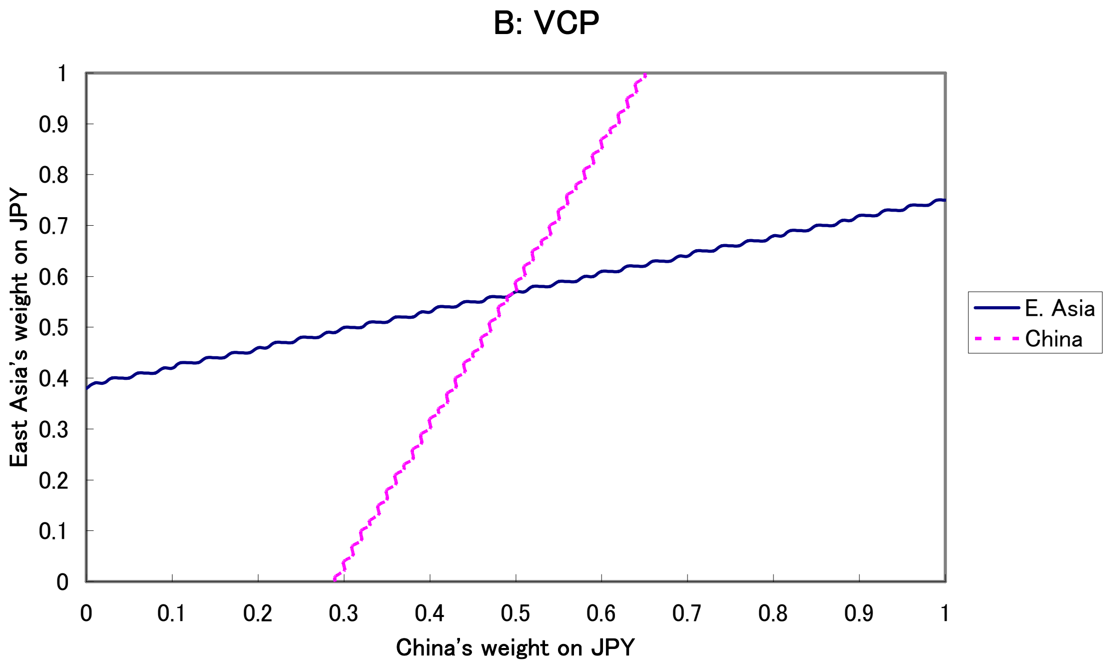


Figure 2: Reaction curves for East Asia and China,
Initial trade="unbalanced", Industrial structure="distinct"

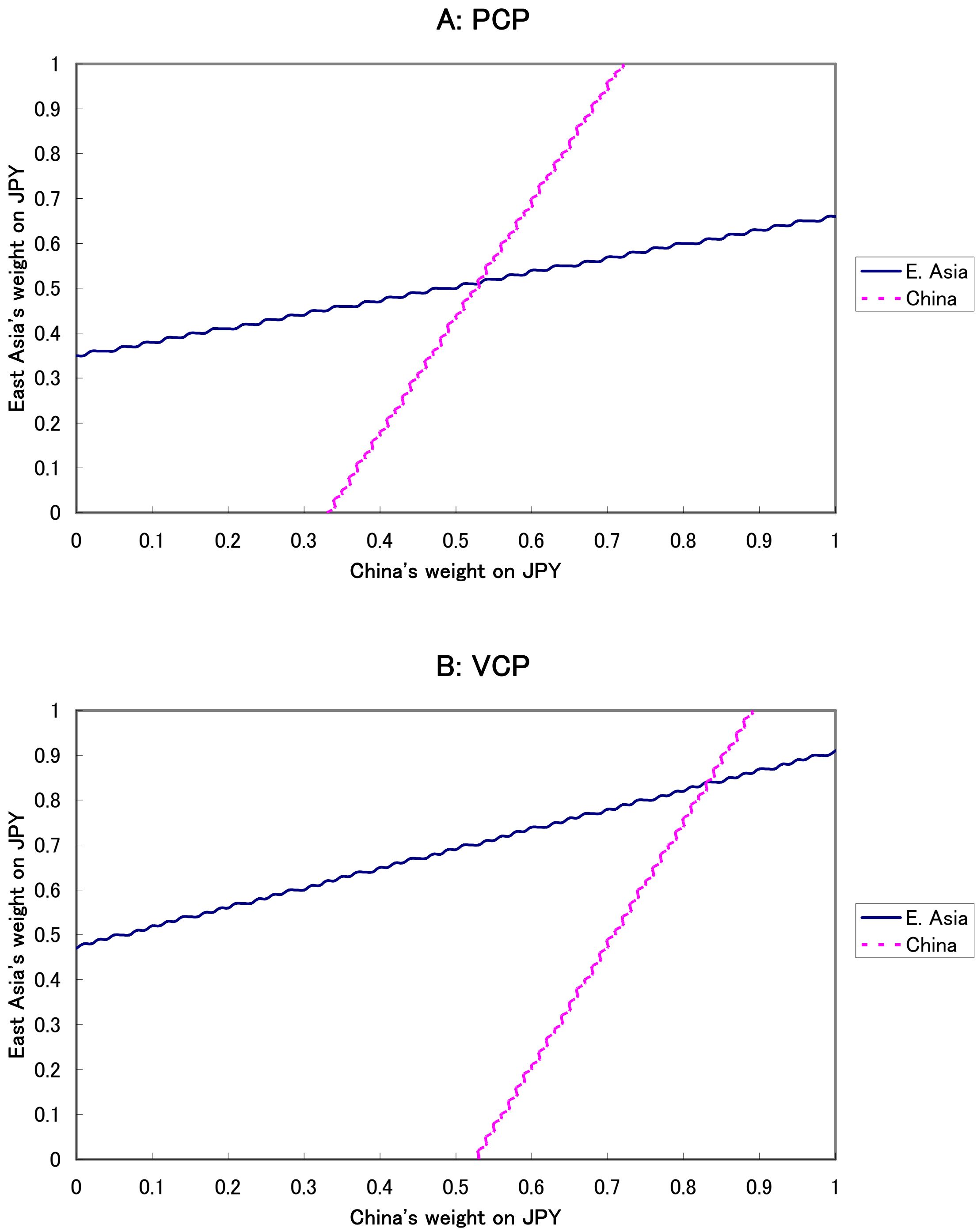
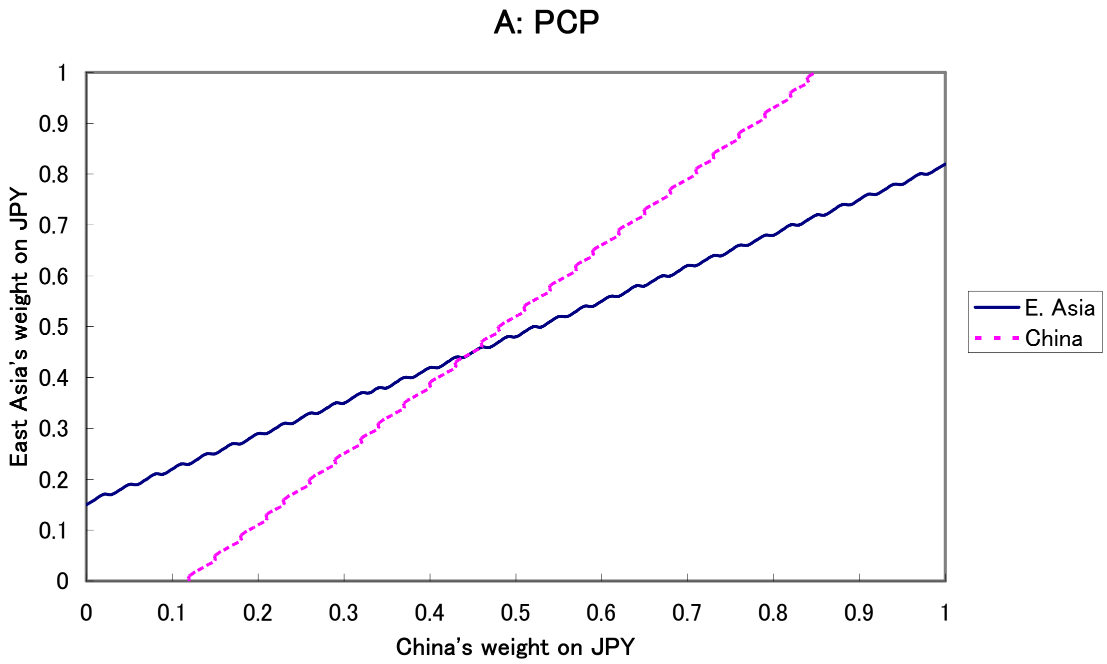


Figure 3: Reaction curves for East Asia and China,
Initial trade="balanced", Industrial structure="similar"



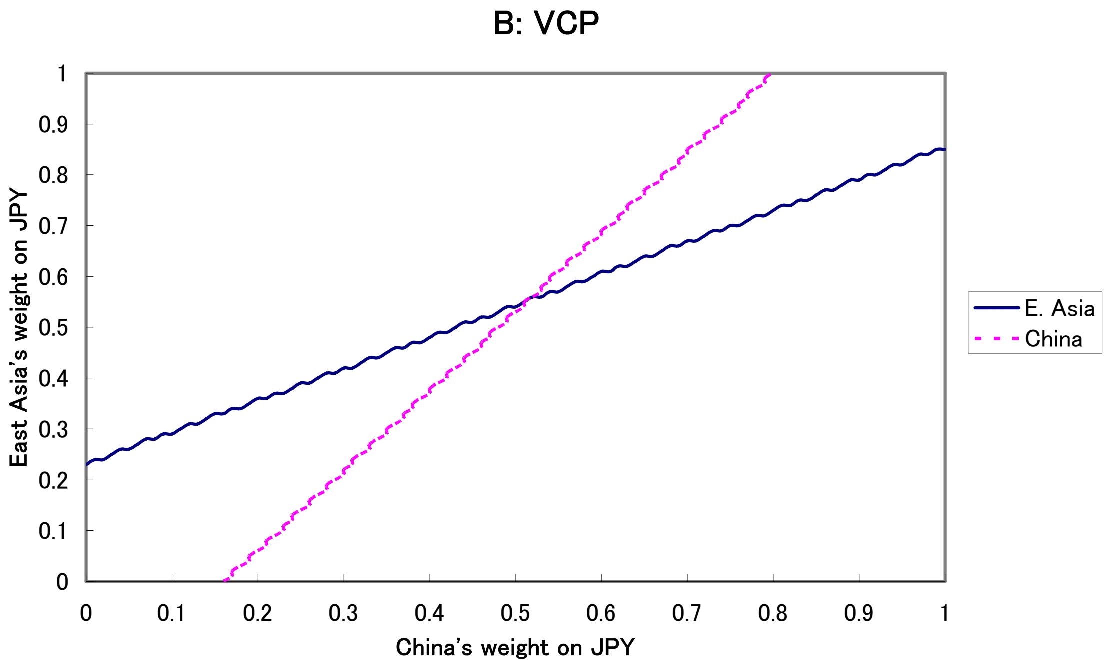


Figure 4: Reaction curves for East Asia and China,
Initial trade="unbalanced", Industrial structure="similar"