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Abstract

The objective of this study is to contribute to the current discussion on the Renminbi (RMB) exchange rate by providing new evidence on China's exchange rate policy and the impacts of RMB devaluation/revaluation on China's output and trade balance. For a rigorous empirical examination, this research constructs a vector autoregression (VAR) model and employs the most recent econometric techniques to identify if the Chinese economic system has become responsive to the changes in the exchange rate after about three decades reform. More specifically, we use a structural VAR technique to estimate impulse response functions and variance decompositions for China's output and trade balance, and to determine how the fundamental macroeconomic shocks contribute to the fluctuations in the real exchange rate, and how output and trade account respond to the identified various shocks. This study will contribute to our better understanding of how far and how fast China's reforms have transformed the economy to a market-oriented economy, and also the recent discussion on China's exchange rate policy. It has important policy implications for the concerned economies.

Keywords: Chinese Exchange Rate Policy; Trade Balance; Structural Vector Autoregression; Variance Decompositions; East Asia
JEL classification: F14; F31; P21

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1. Introduction:

China's path-breaking initiatives of reforms have successfully transformed itself from a poor, closed nation to an important trading nation and manufacturing centre in the world (see Lardy, 1998; Naughton, 1996). The rapid rise of the Chinese economy is creating opportunities for many but also causing increasingly trade disputes with its major trading partners. During the recent years, the Renminbi (RMB) exchange rate issue has been at the centre of ongoing debate over the source of global current account imbalance, especially with the United States. The United States and other countries have expressed, with considerable concern, the view that China's national currency was seriously undervalued. The US Treasury Department has urged China strongly in recent years to adopt procedures that would allow the RMB to rise in value. US Congress has even been considering legislation that would place a 27.5% tariff on Chinese imports to the United States if the RMB is not revalued. Some analysts also indicate that the RMB needs to rise by as much as 40% in order to reflect its true value (see Zhang and Pan, 2004 and Chang and Shao, 2004) and others argue that further revaluation of the RMB will serve China's own interest (see Tung and Baker, 2004). Critics say that, by undervaluing its currency, China gains unfair trade advantage and has seriously injured the manufacturing sector in the United States. Moreover, some even attribute the recent East Asian financial crisis to the 50% devaluation of the Chinese currency in 1994. By far not many OECD countries have recognized China's market economy status after its 27-year market-oriented economic reforms.

Given China's "socialist market economy", how to determine if the Chinese currency has been undervalued or overvalued? To what extent has the Chinese economy been transformed to a market economy? How is the current foreign exchange system evolved and managed? How sensitive is the economic system to the market signals and how is China's balance of payments related to the exchange values of the RMB? And how would the changes in the exchange rates affect the economy and what implications to the other countries, especially the East Asian countries, should the Chinese government revalue its currency? These remain important issues but are not yet resolved satisfactorily.

The objective of this study is to construct a vector autoregression (VAR) model and employ the most recent econometric techniques to identify if the Chinese economic system has become responsive to the changes in the exchange rate after about three decades reform. In particular, we construct a structural VAR model to estimate impulse response functions and variance decompositions for China's output and trade balance, and to determine how the fundamental macroeconomic shocks contribute to the fluctuations in the real exchange rate, and how output and trade account respond to the identified various shocks. Thus, this study will contribute to the current discussion on the RMB exchange rate by providing new evidence on China's exchange rate policy and the impacts of RMB devaluation/revaluation on China's output and trade balance. This would also help explain why China was immune to the recent financial crisis in 1997 and how China could keep its currency value unchanged during the crisis. Apparently this would have important policy implications for the rest of the East Asian economies. This project implies three major contributions. First, it applies a VAR

model to the transition economy of China to determine the exchange value of the RMB and how the system responds to changes in the market signals. It contributes to our better understanding of how far and how fast China's reforms have transformed the economy to a market-oriented. It also contributes to the recent discussion on China's exchange rate policy. Then, it provides policy-makers both within and outside China with robust empirical evidence towards how effective the RMB devaluation/revaluation would be to affect the economy and its trade balance, and what policy implications to others. Finally, it helps explain why China could be immune to the recent East Asian financial crisis in 1997 and if China's RMB devaluation in 1994 is one of the causes to the crisis in 1997.

The remainder of this paper is organized as follows. In section 2, we briefly review the unique reform process of China's foreign exchange rate system, and discuss the rationale and motivations behind each run of the reform. Section 3 deals with the analytical framework and methodology employed in the paper. Section 4 discusses the data issue and presents the results of empirical estimation. Section 5 provides some concluding remarks.

2. Evolution of China's Exchange Rate System and Trade Account[1]

2.1. Exchange Rate System Before the Dual Rate Unification

[1] This section is referred to Zhang (1999). See also Lardy (1992).

Since it became a national currency in 1949, the Chinese renminbi has been fixed and inconvertible. It could neither respond flexibly to the change of price parities between China and the rest of the world, nor make prompt adjustment according to the changing supply and demand of foreign exchange. At most, it acted as an accounting tool, and failed to adjust the trade volume. This is actually associated with the state monopoly of China's foreign trade sector under which all import and export contracts with foreign firms could only be signed by a few authorized import and export corporations. Even though the number of the specialized foreign trade corporation had risen and fallen over the entire pre-reform period, by 1978 only 10 national import and export corporations under China's foreign trade ministry had been granted such authority. These foreign trade corporations (FTCs) in turn had to surrender all their foreign exchange earnings to and purchase foreign exchange from the Bank of China at the official exchange rate. The government collected all FTCs' profits and subsidized all their losses. Conspicuously, traders under this regime had no incentives to make trade adjustments in response to prices changes and exchange rate policy. The changes in the official exchange rate would simply redistribute financial profits and losses among different import and export products and thus among various individual FTCs, and would not affect the overall balance of trade (Lardy, 1992).

Since 1978, China’s foreign trade sector has experimented several reforms in order to increase the role of market forces and to reduce the burden of trade subsidies on the central government's budget (Zhang, 1997). Most notably, the introduction of agency system in 1984 helped break the traditional “air-locked” system between domestic enterprises and the world markets, and the responsibility system experimented

in 1987 allowed enterprises to assume independent responsibility for their gains and losses and freely to integrate industry with trade. In principle, under the agency system domestic prices of both imported and exported goods would be linked to international market prices via the exchange rate. During the early 1990s, experiments with cash retention have been conducted in some areas such as in Hainan, Shanghai, and Shenzhen.[2] As a result, the volume and share of retained foreign exchange earnings by local governments and enterprises increased dramatically. For instance, "(f)or the seven years 1980-6 total retentions were $46.6 billion... By the mid-1980s 42 percent of all foreign exchange was in the hands of the provinces and export producers, only 58 percent was controlled directly by the central government..." (Lardy, 1992, p.57).

In 1981 China introduced a dual exchange rate system: one is for non-trade transactions; and another rate for the internal settlement of trade transactions. The rationale for adopting a dual rate system was to set prices of imported goods via the internal settlement rate at the same (similar) level as comparable domestically produced goods, implying the traditional import substitution character of China's foreign trade regime. The dual rate system was abandoned in 1984 but re-emerged in 1986 when the foreign exchange adjustment centres (FEACs) or swap centres (markets) were set up. Under the new system, in-plan trade and out-plan trade could be conducted at two

[2] The foreign exchange retention system emerged in the early 1980s in line with the implementation of the agent system and the responsibility system. Under the retention system, exporters surrender their actual foreign exchange earnings and are issued retention quotas by the SAEC equivalent to a portion of such earnings. FTCs then gained the right to buy back at the official exchange rate the specified quotas and to make decision on the use of the retained portion of foreign exchanges subject to the relevant state policies. In February 1991 the government changed its policy to allow exporters (other than foreign-funded enterprises) to receive retention quotas for 80 percent of their foreign exchange earnings, while 100 percent for mechanical and electronical products. These retention quotas are distributed to foreign trade corporation (60 percentage points), the supplying enterprises (10 percentage points), and the local government (10 percentage points). The practice of the foreign exchange retention system has been terminated in 1994 due to considerable distortions and unfair regional competition. See Zhang (1999).

different exchange rates, i.e., the administered official exchange rate and the market-determined swap rates.

By 1988, the swap markets had come to dominate China's foreign-currency transactions, representing an estimated 80-85 percent of all such activities at over 100 swap locations. The exchange rate at the swap centres had been determined principally by market demand and supply conditions through a bidding process but the rates on the same day might differ among the swap centres given the flow control of foreign exchange between different centres (see Roberts and Tyers, 2001 and Zhang 1999). In 1989, the premium fell sharply in the wake of a devaluation of the official exchange rate and a rapid increase of foreign exchange supply in the swap market, and thereafter the differential between the two rates narrowed to about 8 percent before it widened again to about 45 percent by early 1993 (see Figure 1).

With more flexible exchange arrangements since 1986, the official exchange rate was in effect pegged to the US dollar. In 1991, the exchange policy was altered to small-scale, more frequent adjustments in the official rate according to the prevailing conditions from the relatively large, one-step currency devaluations of the past, following the two currency devaluations in 1989 (by 21 percent) and 1990 (by 9 percent). By April 1993, the real effective exchange rate of the official exchange rate had depreciated 33 percent more than in 1986 and 70 percent more than in 1980 (Bell et al. 1993).This has been seen as an important drive towards a more realistic exchange rate and the eventual currency convertibility.

The dual exchange rate system was only a special case of the general phenomenon of the dual price system in foreign exchange transaction. With the

liberalization of foreign trade, the degree of mandatory planning has been progressively reduced, while trade under the guidance planning and especially by foreign-funded enterprises has been rising substantially.[3] The establishment of swap markets in foreign exchange provided an innovative mechanism, short of internal convertibility of the domestic currency, for the reallocation of foreign exchange to meet the demands of a diverse group of importers (Lardy, 1992). Importers in this type were market-driven and would be willing to pay a market like price for foreign exchange via the swap market to finance their imports.[4] Another apparent role of the dual exchange rate system lies on its enhanced incentives for exporters in line with the retention system and allowing more flexible pricing for above-plan exports. On the other hand, the dual exchange rate system also was a result of the foreign exchange retention system. Initially, participation to the swap centres was limited to foreign-funded enterprises and late all enterprises with foreign exchange retention quotas were granted access to the centres. After freer trading was permitted in 1988, the premium on exchange rates in the swap centres rose to about 80 percent, reflecting an increased number of participants at the same time as aggregate demand was surging. This provided an additional incentive for exporters to sell goods on the international market and to convert their foreign exchange earnings into domestic currency on more favourable terms than the official rate. "...(It) was the equivalent of a devaluation of the currency but allowed the People's Bank of China the

[3] The guidance plans assign targets to provinces and FTCs for the value of exports and imports of a range of products. By 1991 exports and imports subject to mandatory planning had fallen to 30 percent and 20 percent of their respective totals, while the guidance plan accounted for 15 percent and 20 percent of exports and imports, respectively. Exports of foreign-funded enterprises reached some 20 percent of China's total exports by 1992. See Bell et al. (1993).

[4] Foreign exchange purchased by importers through the swap market accounted for about one fifth of China's total foreign exchange earnings by the end of the 1980s.

fig leaf of an unchanged official exchange rate" (Lardy, 1992, p.120). As a consequence, the effect of the 50% devaluation of the official exchange rate in 1994 on China's trade balance would have been much reduced since over 80% of the foreign-currency transactions were already conducted at the market determined swap rates. [5]

However, one must note that the dual rate system was a source of uneven competition. First, it created windfall profits or rents to those license holders when the quantities of imports and exports were rationed by a bureaucratically-allocated licensing system, and provided uneven chances of access to foreign exchange at the official rate and uneven benefits from decentralized exporting for local governments, exporters and producers. Second, even though the dual rate system could temporarily help solve the problem of currency inconvertibility, it was in fact an unfair mechanism to foreign investors as their equity contribution in foreign exchange was calculated according to the official rate while subsequently they had to pay the higher swap rate when they needed foreign exchange.

2.2. The Unified Foreign Exchange System and Ever Since

[5] Actually the main reason for China to slowly devalue its highly overvalued currency is the fear of an inflationary effect of currency devaluation. It might incur to the economy through raising domestic price of imported goods when priced on import cost and through enlarged government fiscal deficit which had to be financed largely by printing money for subsidizing imports. The concern over the issues of macroeconomic instability and domestic inflation undermined China's attempt to move its exchange rate towards the equilibrium level. This was more evident between the mid-1986 and late 1989 when China experienced rising domestic inflation. During these periods, China's real effective exchange rate had actually been appreciated. The dual exchange rate system, on the other hand, assisted in offsetting the effect of currency appreciation and promoting exports, and in sustaining the liberalization of foreign trade.

Beginning on January 1, 1994, the dual exchange rates of the official and the swap were replaced by a unified, market-based exchange rate. Under the new exchange regime, the foreign exchange retention system was abolished and replaced by a system where all domestic enterprises must sell their foreign exchange revenues to designated foreign exchange banks on the spot except receipt on the capital account, and all approved purchases of foreign exchange must be settled at the prevailing market rate. A national inter-bank foreign exchange market was established to link all the designated banks and to replace the local and unlinked swap centres. With the unified exchange rate system, the persistent differentials of the exchange rates among different swap centres have been eliminated and the efficiency of foreign exchange allocation has been enhanced. The establishment of national inter-bank foreign exchange trading system provided all firms with equal opportunity to access foreign exchange at the nationally unified rate and helped stop the speculative activities in foreign exchange trading and the rent-seeking opportunities across the swap centres and between the official rate and the swap rate. The new system has increased the effectiveness of the central bank market intervention and moved the SAEC from direct control and authorization to indirect foreign exchange management. This is because, with the new foreign exchange trading system, a bench-mark rate that reflects the aggregate demand and supply of foreign exchange and the margin around which the foreign exchange rates were quoted by the banks must be determined by the People's Bank. It can therefore more effectively intervene in the foreign exchange market to stabilize the foreign exchange rate. The SAEC, on the other hand, can focus on formulating its foreign exchange policy, regulating financial firms, approving and supervising the opening of foreign exchange

accounts, and supervising the operations of the designated foreign exchange banks. With the new foreign exchange system, China has achieved conditional convertibility of the Chinese currency on current account transaction, yet an important drive towards full convertibility.[6]

On the other hand, to maintain continuity in policies towards FDI and to protect the interest of foreign-funded enterprises, China decided to allow these enterprises to continue to keep their foreign exchange in designated accounts instead of selling it to a bank. They remained buying and selling foreign exchange through the swap markets which may require more time to settle a transaction than the inter-bank market. Since March 1996, restrictions on the foreign exchange transfers of foreign invested firms in 4 cities/regions (Shanghai, Shenzhen, Dalian and Jiangsu) have been removed such that they could exchange funds freely at selected banks without approval from the SAEC. Beginning on July 1, 1996 foreign-funded enterprises were allowed to enter the inter-bank foreign exchange market and all the remaining restrictions on currency convertibility for current account transactions were removed. This is apparently an important step in improving China's investment environment since foreign enterprises under the new system no longer need to calculate their business transactions at two different rates, and accounting and book-keeping procedures have become much simpler. Most remarkably, establishing the value of investment contribution in forming a joint-venture has become a lot more straightforward since in this case the local parties

[6] China has achieved its intermediate term objective of unconditional convertibility on current account transactions three years ahead of the year 2000 by which China had committed in its negotiation for accession to the WTO, and met the requirements of Article VIII of the Agreement of International Monetary Fund (IMF) by the end of 1996. The ultimate goal of the reform is full convertibility of the currency for capital account transactions and integration of the economy with international currency market. Until then, cross-border capital flows will still be subject to controls of the government.

can on longer overvalue their contribution by estimating its worth at the old official rate while actually contributing RMB worth far less.

The unification of the dual exchange rates led to a 50% devaluation of the currency to RMB 8.7 yuan to the US dollar, a rate quite close to that in the black market. Since the unification the exchange value of the RMB has been remained stable.[7] The rate was revalued to 8.27 yuan per US dollar in 1998, and stabilized at this level until July 2005 when China finally revalued the RMB by 2.1%. On July 21, 2005, with the intensified pressures from the USA, Japan and Europe on the revaluation of the RMB, the Chinese authority announced that it will allow the RMB to trade within a band of 0.3% per business day for the first time, and also the RMB is linked to a basket of internationally traded currencies according to their importance in China's external transactions including the USD, the Euro, the Japanese Yen and the Korean Won.

Thus, China has moved to a managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies. According to the Bank for International Settlements, over the past two years, the RMB has appreciated by 9.4% against the U.S. dollar, and the real effective exchange rate of the RMB has appreciated by 6.3%. To give the market a bigger role in determining the RMB exchange rate, a number of reforms have been initiated, including introducing a market-maker system and over-the-counter transactions in the interbank foreign exchange market; increasing the variety of foreign exchange products by introducing forward and swap transactions; and further widening the daily floating band of the RMB against the

[7] The new exchange rate system has contributed to the rapid increase of China's international reserves, rising from US$22 billion at the end of 1993 to over US$53 billion by the end of 1994, and further to US$107 billion in 1996. Since then China's foreign exchange reserves rose rapidly, exceeded US$1 trillion for the first time in October 2006. By the end of 2007, the reserves exceeded US$1.5 trillion. Data were adapted from the State Administration of Foreign Exchange, China.

U.S. dollar in the interbank spot foreign exchange market from 0.3% to 0.5%. Moreover, reform of the foreign exchange management system has been accelerated with a view to gradually promoting RMB convertibility under the capital account. Steps have been taken to facilitate the holding and use of foreign exchange by enterprises and individuals. A system of qualified institutional investors has been established, and efforts have been made to liberalize domestic financial and capital markets in an orderly way. Various means have been explored to facilitate capital outflows, and enterprises have been encouraged to invest abroad. The monitoring of cross-border capital flows has been strengthened to pave the way for further opening up.

3. Methodology and Model

To study if the Chinese economic system has become responsive to the changes in the exchange rate since reform, we construct a structural VAR model to estimate impulse response functions and variance decompositions for China's output the real (effective) exchange rate, and trade balance, and to determine how the fundamental macroeconomic shocks contribute to the fluctuations in the real exchange rate, and how output and trade account respond to the identified various shocks.

We extend the Lee and Chinn (2006) and Blanchard and Quah (1989) models to construct a 3-variable VAR model, including real output, real exchange rates, and trade balance. We use the US GDP and World GDP respectively to proxy for the income effect of the rest of the world that will possibly affect the trade balance. The structural model can be specified as follows:

$$X_t = \left(\Delta y_t^*, \Delta rer_t, (TB/y)_t\right)',$$

$$\varepsilon_t = \left(\varepsilon_{y,t}, \varepsilon_{e,t}, \varepsilon_{b,t}\right)',$$

and

$$X_t = A(L)\cdot\varepsilon_t = \begin{pmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{pmatrix}\cdot\varepsilon_t, \qquad (1)$$

where $A_{ij}(L) = a_{ij}^0 + a_{ij}^1 L + a_{ij}^2 L^2 + \cdots,$ and it is assumed that the structural shocks, ε_t, are serially uncorrelated and the covariance matrix are normalized to the identity matrix. y^* denotes US or world real GDP; *rer* the bilateral real exchange rate of Chinese yuan vis-à-vis the US dollar or the yuan's real effective exchange rate; *TB* the (nominal) trade balance against the United States or the world; and *y* the China's nominal GDP. Δ is the first-difference operator. ε_y is the US or world output shock, ε_e the real (effective) exchange rate shock, and ε_b the transitory (trade balance) shock.

In order to identify the structural A_i matrices, we follow the method developed by Blanchard and Quah (1989) and impose the following long-run restrictions. First, we assume that Δy^* is affected by only the US or world output shock (ε_y) in the long-run. Second, Δrer is affected by both the US or world output shocks and the real (effective) exchange rate shock (ε_e) in the long-run, but not affected by the transitory (trade balance) shock (ε_b). Finally, (TB/y) is influenced by all three shocks in the long-run. Thus, the long-run restrictions require $A_{12}(1) = A_{13}(1) = A_{23}(1) = 0$ that is sufficient to

identify the structural A_t matrices and the time series of structural shocks, $\varepsilon_t = \left(\varepsilon_{y,t}, \varepsilon_{e,t}, \varepsilon_{b,t}\right)'$. We estimate a reduced-form VAR as:

$$\Delta x_t = B(L)\Delta x_{t-1} + u_t, \qquad (2)$$

where u_t is a vector reduced form disturbance and $B(L)$ is a 3×3 matrix of lag polynomials. An MA representation of equation (2) is given as:

$$\Delta x_t = C(L)u_t, \qquad (3)$$

where $C(L) = (1 - B(L)L)^{-1}$ and the lead matrix of $C(L)$ is, by construction, $C_0 = I$. By comparing equations (1) and (3), we obtain the relationship between the structural and reduced form disturbances: $u_t = A_0\varepsilon_t$. As the shocks are mutually orthogonal and each shock has unit variance, $C(1)\Sigma C(1)' = A(1)A(1)'$ where $\Sigma = Eu_t u_t' = EA_0\varepsilon_t\varepsilon_t' A_0' = A_0 A_0'$. Letting H denote the lower triangular Choleski decomposition of $C(1)\Sigma C(1)'$, we obtain $A(1) = H$ since our long-run restrictions imply that $A(1)$ is also lower triangular. Consequently, we obtain $A_0 = C(1)^{-1}A(1) = C(1)^{-1}H$. Given an estimate of A_0, we can recover the time series of structural shocks.

4. Empirical Analysis

4.1 Data Description

We use the quarterly series of data spanning from 1987Q1 to 2007Q3 except for the real GDP series of OECD countries that ranges from 1995Q1 to 2007Q1. To assess the changing sensitivity of the economic system to the market signal during the reform period, we divide the whole sample period into three in our estimations. The first period covers the prior-exchange rate unification years, the second spans from 1994 through 2007, and finally the whole sample period. The purpose is to reflect the dynamics and comparatively investigates if the Chinese economic system has become more sensitive to market signal changing over the entire reform period. As the China's dual exchange rate system was abandoned in January 1994, we chose the sample starting from 1994Q2. In addition, China's trade surplus began to grow in the latter half of 1990s, our sample period seems quite reasonable to catch the most recent trend and to determine the effect of the exchange rate policy change on China's trade balance.

As a proxy for the world real GDP variable, we use the real GDP series of either the United States or OECD countries. The bilateral real exchange rate of Chinese yuan vis-à-vis the US dollar and the real effective exchange rate (REER) of the yuan are used in this study. Bilateral real exchange rate is constructed based on relative consumer price index (CPI) between China and the US. China's bilateral trade surplus with both the United States and the world is denominated in US dollars. China's nominal GDP is constructed using the real GDP and CPI and also converted into US dollar terms. All data are obtained from the Chinese State Bureau of Statistics, IMF, International Financial Statistics, CD-ROM; CEIC Global Database; and the NUS (National University of Singapore) Databank. Data are displayed in Figures 2 and 3.

We choose to use the first-difference model to ensure the stationarity of endogenous variables. We have checked the time-series properties of the endogenous variables and the results of unit-root test show that both y^* and *rer* are non-stationary in level but stationary in first-differences, while there is a conflict in the results of stationarity in (TB/y). To be consistent with the existing studies as well as due to the low power problem of unit-root tests, we chose to include the level of (TB/y) in a VAR model. As we attempt to analyse the result for sub-samples where the sample size is small, we do not conduct cointegration tests.

4.2 Empirical Results

The estimation results of our VAR model are reported in Table 1. We use two lags in each estimation based on Schwartz information criterion (SIC) and Akaike information criterion (AIC). In general the model estimation performs fairly well. The adjusted R^2 values for Chian's trade balance respectively with the rest of the world and the US vary from 0.53 to 0.99 with different sample periods, while those for the output and exchange rate equations take on values from 0.01 to 0.27. In particular, the adjusted R^2 values for the trade balance with the US ranges from 0.81 for the prior-unification period to 0.986 for the post-unification period. It is interesting to note that first differences of the real exchange rate exhibit some serial correlation with the highest coefficient exceeding 0.40 in the cases of real exchange rate with the US dollar prior-unification and REER. All the coefficients are statistically significant. Similar pattern can be observed for the output. As we are interested of how China's trade balance

responds to shocks, we will focus our discussion on the results of trade balance equations only.

As it can be seen from Table 1, the coefficients relating China's trade balance to the once lagged changes in the real exchange rate are negative and not statistically significant in all cases. The coefficients relating the bilateral trade balance against the US to changes in the real exchange rate with two lags for the entire sample period and prior-unification period show positive but insignificant, taking on values from 0.0088 to 0.0383. Hence, one might speculate upon the dynamic effect of exchange rate on China's trade balance. The results seem not lend much support to the view that the Chinese economic system has become responsive to changes in the exchange rate after about three decades reform.

The response of China's trade balance to the once lagged US and world output is positive, taking on values from 0.15 to 1.21, even though not statistically significant. The coefficient relating the trade balance to the once lagged change in the trade balance is positive and also statistically significant, taking on values from 0.67 to 0.97. These results inspire one's expectation that China's balance of trade is mainly determined by the world demand and its trade performance, with the latter being a result of its successfully maintained comparative advantage.

Figure 4 reports the results of impulse responses of each endogenous variable to structural shocks. The black line indicates the impulse response, while the blue line shows the 16 percent and 84 percent fractiles that correspond to one standard deviation if symmetrical error bands were set based on estimates of the variance.[8] In Figure 4,

8 This follows Sims and Zha (1999) and conducts the Monte Carlo integration of 2,500 replications.

there are 4 panels displayed, representing China's trade balance with either the US or the rest of the world during different sample period. Each panel, from the left to the right, reports the response of each variable to the vertically specified shocks.

It is interesting to note that in general China's balance of trade situation is affected largely by the world demand shock and trade balance shock, and exchange rate shock affects the trade balance with an undetermined pattern. When exchange rate shock occurs, the effect on the trade balance becomes either positive or negative. It is not conclusively clear if the depreciation of the RMB will firmly improve China's balance of trade. However, the result does indicate the trend of increasing sensitivity of the trade balance to the exchange rate shock since the dual rate unification. Moreover, the response of the exchange rate to all the three structural shocks is short-lived, mostly lasting for only one quarter and then immediately back to a zero-level effect. One may interpret this response pattern as the rigidity of China's exchange rate regime even though efforts have been given in the recent year to let the market play a bigger role in determining the RMB exchange rate.

To identify the contribution of each shock to the three variables, we conducted Variance Decomposition (VD) analysis to decompose variation in the percentage change of the forecast error variance of changes in the world output, exchange rates and trade balance that are due to each shock at the 1 through 20 quarter horizons. Table 2 reports the forecast error variances of each endogenous variable to respective shocks.

As it can be seen from Table 2, the movement of the US output is attributed largely to its own shocks during the entire sample period, while China's trade balance and the exchange rate are found to be the predominant shocks accounting for the

variability of the US output during the period 1994-2007. The movement of the world output is attributed largely to the world output shocks, but China's exchange rate shock is found to be increasingly effective on the fluctuation of the world output. The finding is consistent with our casual observation that the emerging Chinese economy as the world's manufacturing centre will inevitably generate increasing effects on the rest of the world through the channels of international trade and direct investment.

Fluctuations in real exchange rates were predominantly caused by China's trade balance and exchange rate shocks at all horizons except during the prior-unification period. The trade balance shock accounts for over 51 percent of the variability at all horizons for the whole sample period, and over 73 percent in the post-unification period. Trade balance shock increases pressure on the exchange rate, inducing appreciation. The finding also reflects China's recent move towards market-determined exchange rate.

It is found that the movement of China's trade balance against the US is attributed largely to the US output shock during the post unification period and even before, while the exchange rate effect does not contribute much. When we look at the whole sample period and also the trade balance with the rest of the world, the exchange rate effect becomes obvious, taking a percentage of 30 to 40 through the horizons. The finding seems to suggest that, after about three-decade reform, the Chinese economic system has been gradually transformed towards a market-originated system under which economic agents have become responsive to market signals to allow changes in exchange rates to influence the trade balance. However, the exchange rate effect on China's balance of trade is still limited.

5. Concluding Remarks

In this paper we have critically reviewed the evolution of the Chinese exchange rate system and discussed how far and how fast the reform has been done, and constructed a vector autoregression (VAR) model to assess if the Chinese economic system has become responsive to the changes in the exchange rate after about three decades reform.

The results from the VAR estimations indicate that the coefficients relating China's trade balance to the once lagged changes in the real exchange rate are negative and not statistically significant in all cases, while these with two lags for the whole sample and prior-unification period show positive but insignificant, taking on values from 0.0088 to 0.0383 in the case of trade balance with the US. The response of China's trade balance to the once lagged US and world output is positive, taking on values from 0.15 to 1.21 even though not statistically significant, and to the once lagged change in the trade balance is positive and also statistically significant, taking on values from 0.67 to 0.97. These results inspire one's expectation that, the dynamic effect of exchange rate on China's trade balance is still very limited, and China's balance of trade is mainly determined by the world demand and its trade performance, with the latter being a result of its successfully maintained comparative advantage. These are supported by the results from the impulse analysis, that the trade balance is found to be affected largely by the world demand shock and trade balance shock, and exchange rate shock affects the trade balance with an undetermined pattern. The results from the variance decomposition analysis further confirm that the movement of China's trade balance

against the US is attributed largely to the US output shock during the post unification period and even before, while the exchange rate effect does not contribute much. The exchange rate effect has becomes observable only when we look at the whole sample period with the US and also the trade balance with the rest of the world. The movement of the US output is attributed largely to its own shocks during the entire sample period, while China's trade balance and the exchange rate are found to be the predominant shocks accounting for the variability of the US output during the period 1994-2007. The movement of the world output is attributed largely to the world output shocks, but China's exchange rate shock is found to be increasingly effective on the fluctuation of the world output. The findings seems to suggest that, after about three-decade reform, the Chinese economic system has been gradually transformed towards a market-originated system under which economic agents have become responsive to market signals to allow changes in exchange rates to influence the trade balance. However, the exchange rate effect on China's balance of trade is still limited.

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Table 1: Results of Vector Autoregression

	Bilateral Trade with US 1987Q2-2007Q3			Bilateral Trade with US 1987Q2-1993Q4			Bilateral Trade with US 1994Q2-2007Q3			Trade with World 1995Q2-2007Q1		
	DY	DEXR	TB	DY	DEXR	TB	DY	DEXR	TB	DY	DEXR	TB
DY(-1)	0.1510	-0.1399	0.1503	0.2227	-1.8069	0.2911	0.0871	-0.2163	0.1680	0.5172	0.7223	1.2125
	0.1112	1.1438	0.1582	0.2591	2.0156	0.3899	0.1425	0.5100	0.1638	0.1574	1.0839	1.6498
DY(-2)	0.3058	-1.4273	0.1835	0.1419	-0.3352	0.1336	0.2999	0.0260	0.1160	0.0110	-1.8419	-1.4863
	0.1122	1.1539	0.1596	0.2594	2.0183	0.3904	0.1408	0.5039	0.1618	0.1554	1.0704	1.6292
DEXR(-1)	0.0010	0.1784	-0.0045	-0.0144	0.4669	-0.0072	0.0078	0.0551	-0.0061	0.0085	0.4037	-0.1385
	0.0117	0.1203	0.0166	0.0273	0.2125	0.0411	0.0155	0.0556	0.0179	0.0204	0.1405	0.2139
DEXR(-2)	-0.0162	-0.0672	0.0088	-0.0217	-0.0572	0.0383	-0.0082	-0.0884	-0.0046	0.0041	-0.0561	-0.0230
	0.0110	0.1134	0.0157	0.0269	0.2096	0.0405	0.0133	0.0477	0.0153	0.0206	0.1417	0.2156
TB(-1)	-0.0139	1.8136	0.8832	0.0823	2.4874	0.7385	-0.0467	1.0518	0.9689	0.0128	0.1401	0.6724
	0.0857	0.8812	0.1218	0.1578	1.2276	0.2375	0.1257	0.4496	0.1444	0.0153	0.1057	0.1608
TB(-2)	0.0118	-1.8624	0.1244	-0.0895	-2.4149	0.1900	0.0392	-0.9933	0.0331	-0.0160	-0.2141	0.1833
	0.0873	0.8980	0.1242	0.1594	1.2403	0.2399	0.1286	0.4601	0.1478	0.0185	0.1276	0.1942
C	0.4235	1.3683	-0.0946	0.4529	0.6369	0.3097	0.5632	-1.2310	0.0276	0.3270	0.8725	1.1387
	0.1703	1.7515	0.2422	0.4887	3.8018	0.7354	0.2658	0.9509	0.3054	0.1205	0.8299	1.2632
Adj.R^2	0.0985	0.0050	0.9800	0.0141	0.2733	0.8136	0.0358	0.0978	0.9858	0.1793	0.1402	0.5257

Note: DY denotes either 1st-difference of log of US real GDP or world (OECD) real GDP; DEXR refers to either 1st-differnce of log of bilateral real exchange rate of Chinese yuan vis-à-vis the US dollar or real effective exchange rate of Chinese yuan; TB either the ratio of China's bilateral trade surplus against the United States to China's nominal GDP or the corresponding ratio of China's total trade surplus against world. Standard errors (in red font) are reported just below the estimates (in black font).

Table 2: Results of the Variance Decomposition Test

1a) VAR Model of Bilateral Trade with US (1987Q2-2007Q3; Lag order is 2)

Horizon	Std Error	DYUS	DRER	TB_US
Decomposition of Variance for Series DYUS				
1	0.46	89.83	0.05	10.12
4	0.50	89.36	1.45	9.19
8	0.50	89.32	1.66	9.02
12	0.50	89.31	1.67	9.02
16	0.50	89.30	1.67	9.03
20	0.50	89.30	1.67	9.03
Decomposition of Variance for Series DRER				
1	4.74	5.55	40.61	53.85
4	4.94	6.07	43.22	50.71
8	4.95	6.22	43.16	50.63
12	4.95	6.23	43.15	50.62
16	4.95	6.23	43.15	50.62
20	4.95	6.23	43.15	50.62
Decomposition of Variance for Series TB				
1	0.66	1.76	29.80	68.44
4	1.21	9.72	29.98	60.29
8	1.72	17.16	28.03	54.82
12	2.14	20.85	26.73	52.42
16	2.50	22.87	25.99	51.14
20	2.83	24.10	25.54	50.37

1b) VAR Model of Bilateral Trade with US (1987Q2-1993Q4; Lag order is 2)

Horizon	Std Error	DYUS	DRER	TB_US
Decomposition of Variance for Series DYUS				
1	0.48	77.69	20.77	1.54
4	0.55	79.80	17.18	3.02
8	0.56	80.03	17.00	2.97
12	0.56	79.98	17.00	3.01
16	0.56	79.97	17.00	3.03
20	0.56	79.96	17.00	3.04
Decomposition of Variance for Series DRER				
1	3.75	27.50	69.88	2.62
4	5.03	48.93	44.83	6.25
8	5.10	49.76	44.11	6.13
12	5.10	49.79	44.08	6.14
16	5.10	49.78	44.07	6.15
20	5.10	49.78	44.07	6.16
Decomposition of Variance for Series TB				
1	0.73	32.06	0.00	67.94
4	1.15	19.85	4.37	75.78
8	1.44	15.24	6.35	78.42
12	1.58	13.45	6.84	79.71
16	1.65	12.62	7.01	80.36
20	1.69	12.21	7.09	80.70

Table 1: Results of the Variance Decomposition Test (cont'd)

1c) VAR Model of Bilateral Trade with US (1994Q2-2007Q3; Lag order is 2)

Horizon	Std Error	DYUS	DRER	TB_US
Decomposition of Variance for Series DYUS				
1	0.44	4.81	78.25	16.93
4	0.46	4.85	77.84	17.32
8	0.46	4.85	77.80	17.35
12	0.46	4.91	77.75	17.34
16	0.46	4.97	77.70	17.33
20	0.46	5.04	77.65	17.31
Decomposition of Variance for Series DRER				
1	1.58	0.51	18.03	81.45
4	1.68	9.81	16.43	73.76
8	1.68	9.93	16.43	73.64
12	1.68	10.03	16.42	73.55
16	1.68	10.14	16.41	73.46
20	1.68	10.24	16.39	73.37
Decomposition of Variance for Series TB				
1	0.51	97.40	1.68	0.92
4	1.01	98.55	1.08	0.37
8	1.45	97.30	2.16	0.53
12	1.78	96.64	2.72	0.63
16	2.06	96.30	3.01	0.69
20	2.30	96.09	3.19	0.72

1d) VAR Model of Trade with World (1995Q2-2007Q3; Lag order is 2)

Horizon	Std Error	DYWOR	DREER	TB_WOR
Decomposition of Variance for Series DYWOR				
1	0.26	83.36	13.73	2.92
4	0.31	80.14	13.53	6.33
8	0.31	79.47	13.97	6.56
12	0.32	78.92	14.27	6.81
16	0.32	78.69	14.39	6.92
20	0.32	78.58	14.45	6.97
Decomposition of Variance for Series DREER				
1	1.81	5.10	60.99	33.91
4	2.08	6.83	52.82	40.34
8	2.15	6.92	52.39	40.70
12	2.16	6.98	52.34	40.68
16	2.16	7.01	52.32	40.66
20	2.16	7.02	52.32	40.66
Decomposition of Variance for Series TB				
1	2.75	10.99	33.26	55.75
4	4.10	10.60	41.78	47.62
8	4.76	11.71	43.46	44.82
12	5.03	11.94	44.03	44.04
16	5.15	12.02	44.24	43.74
20	5.20	12.06	44.33	43.61

Figures:

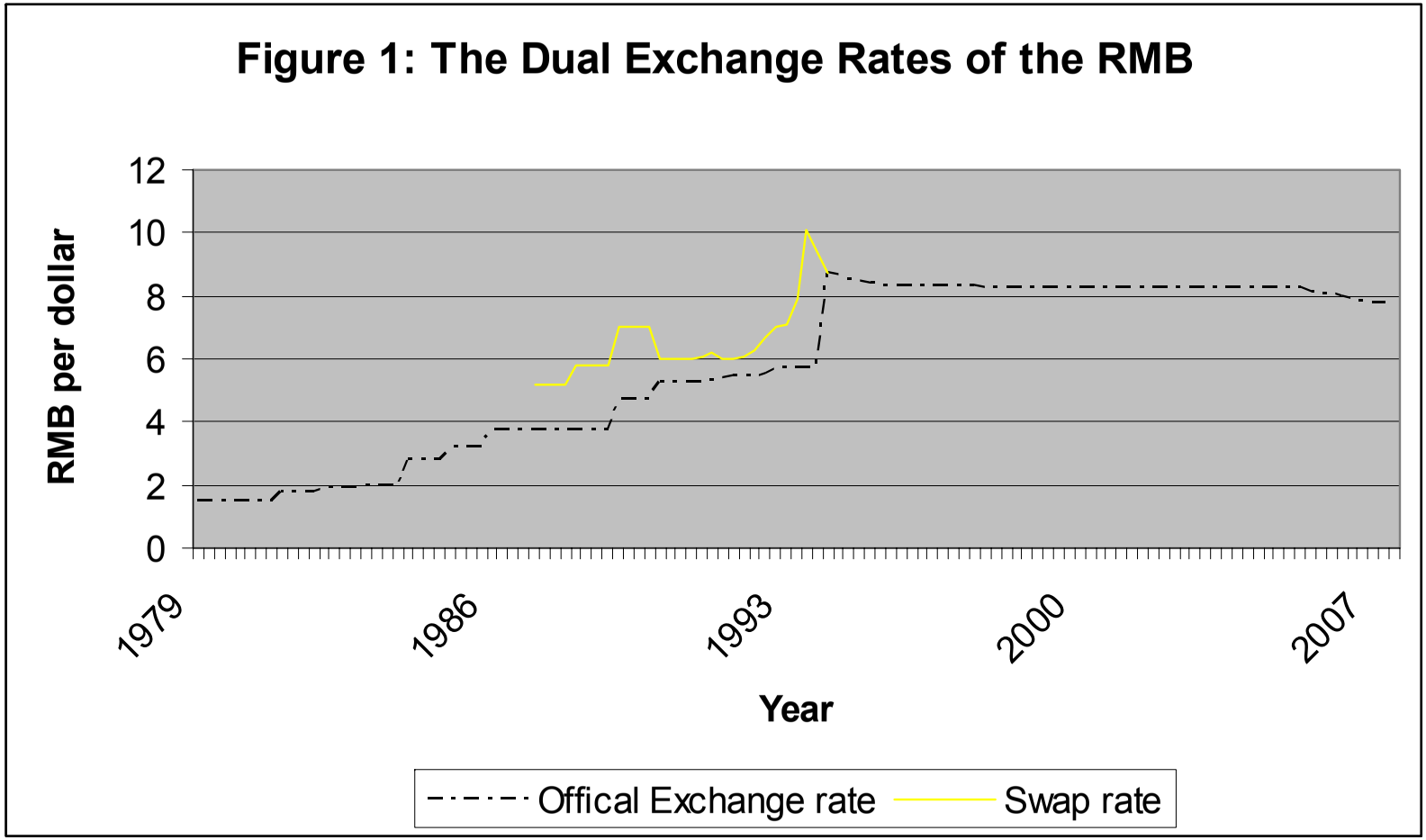
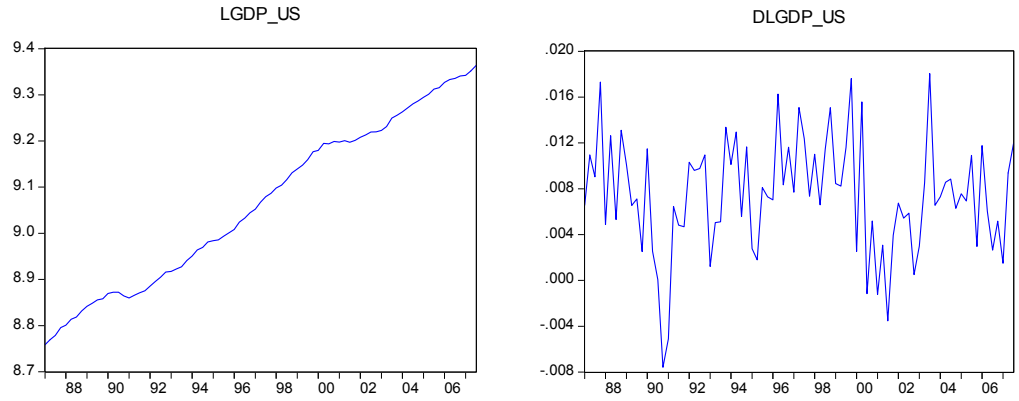


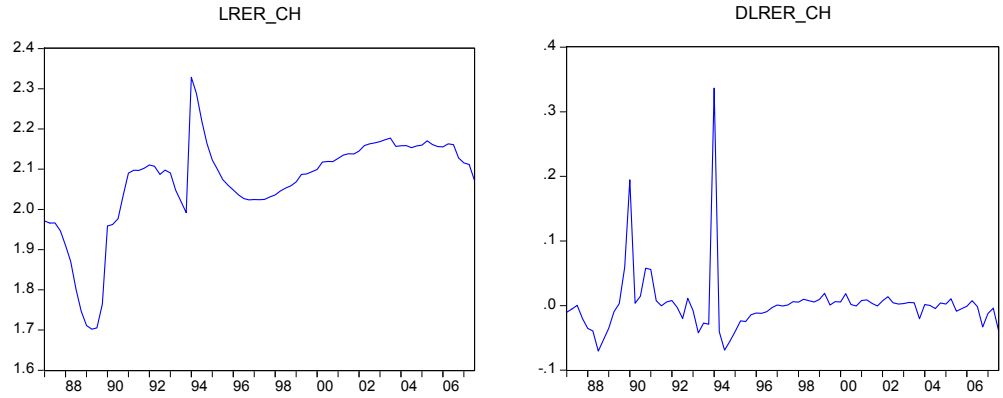
Figure 1: The Dual Exchange Rates of the RMB
RMB per dollar
12
10
8
6
4
2
0
1979
1986
1993
2000
2007
Year
Offical Exchange rate
Swap rate

Figure 2: Graphical Analysis of Data (1987Q1-2007Q3)

(a) US GDP (real) in log level and the first-difference:



(b) Bilateral Real Exchange Rate of Chinese Yuan vis-à-vis the US Dollar (level and 1st-diff)



(c) Bilateral Trade Balance with US to China's GDP (level and 1st-difference)

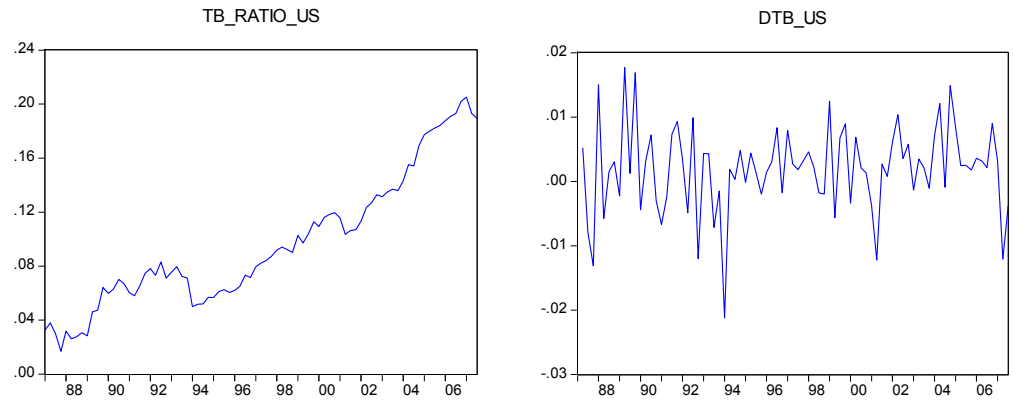
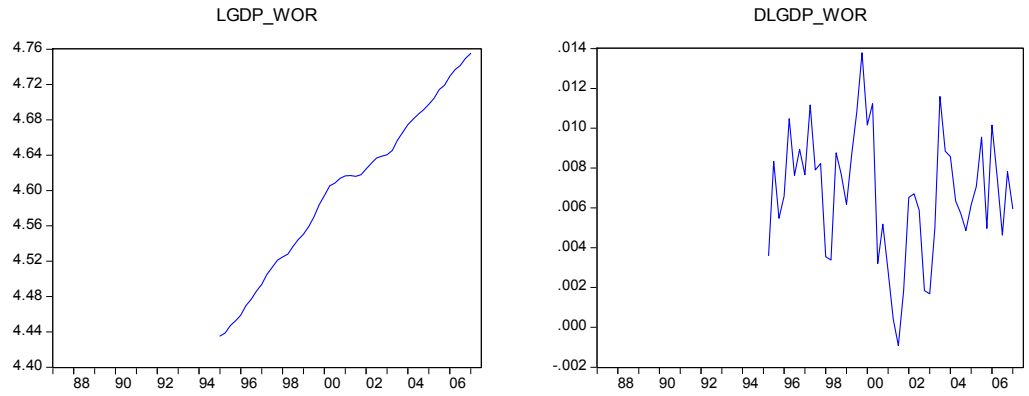
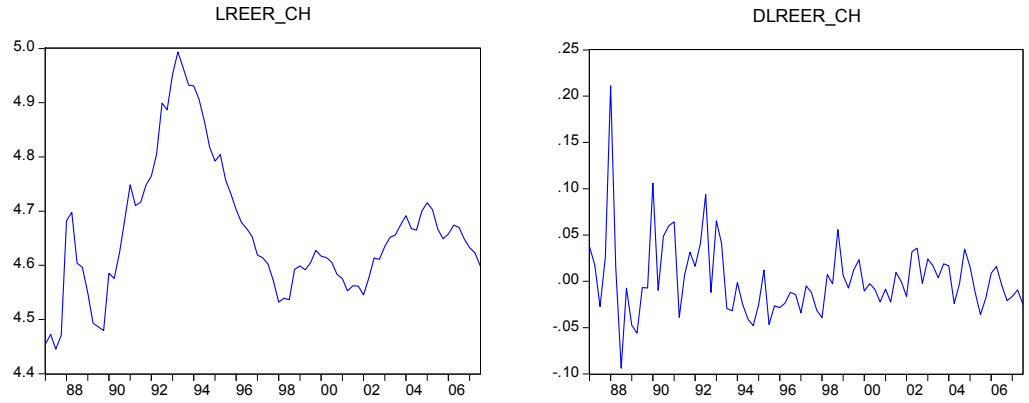


Figure 3: Graphical Analysis (1987Q1-2007Q3)

(a) World (OECD) GDP (real) in log level and the first-difference:



(b) Real Effective Exchange Rate of Chinese Yuan (level and 1st-diff)



(c) Trade Balance with World to China's GDP (level and 1st-difference)

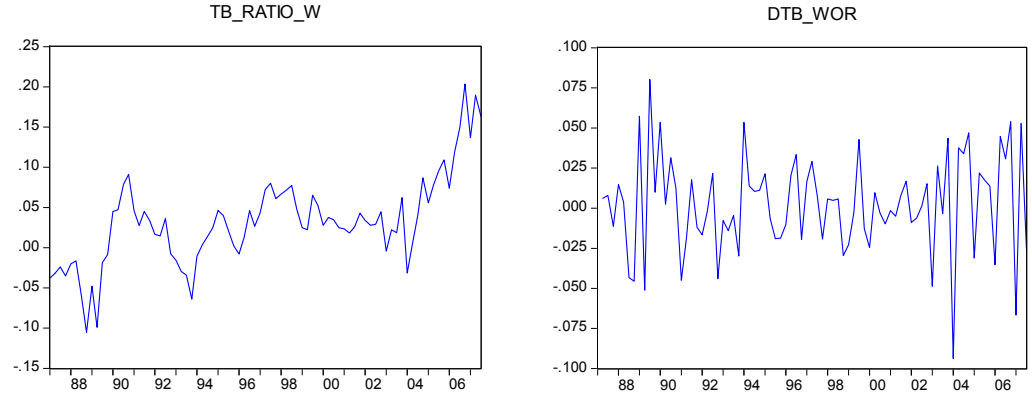
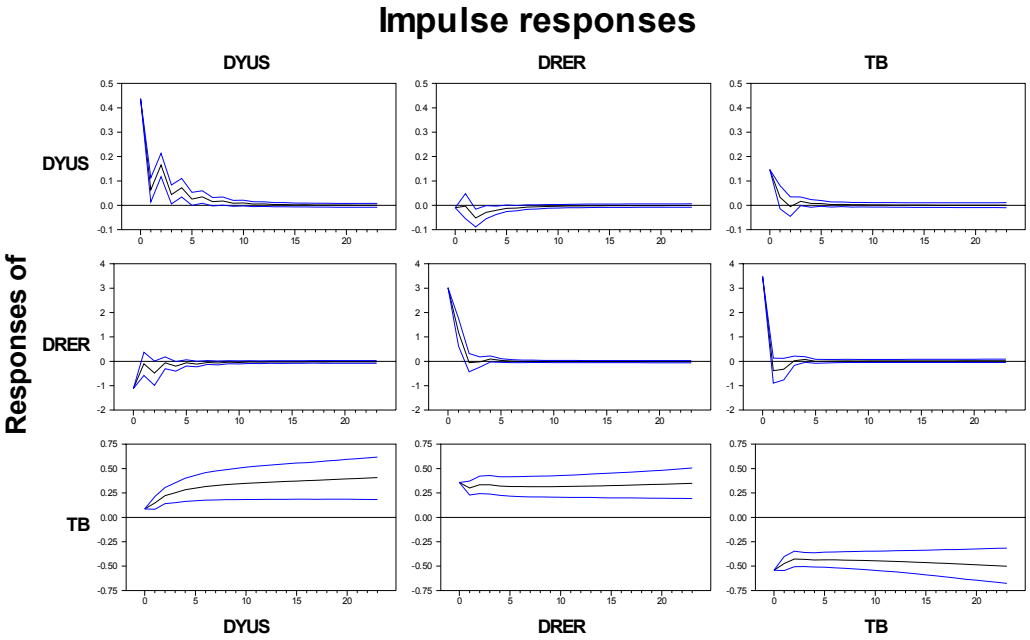


Figure 4: Impulse Response Function Analysis

1a) VAR Model of Bilateral Trade with US (1987Q2-2007Q3; Lag order is 2)



1b) VAR Model of Bilateral Trade with US (1987Q2-1993Q4; Lag order is 2)

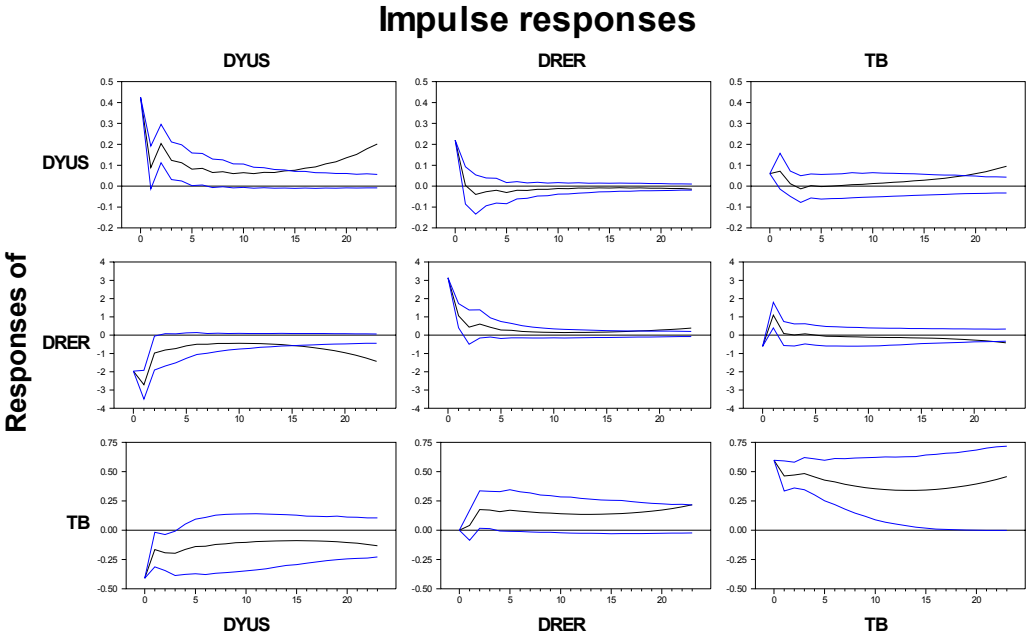
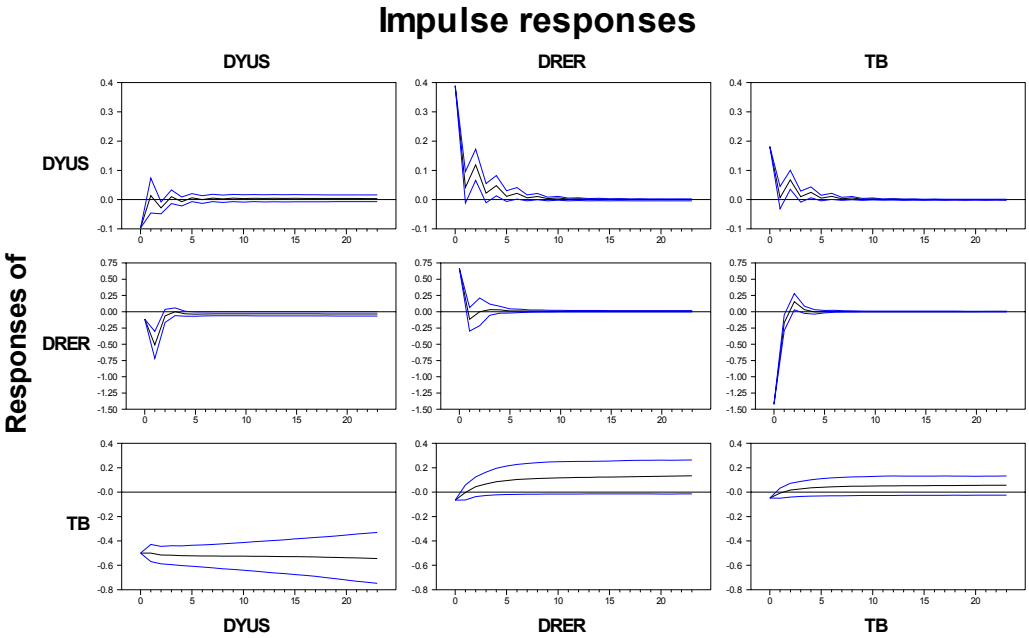


Figure 4: Impulse Response Function Analysis (cont'd)

1c) VAR Model of Bilateral Trade with US (1994Q2-2007Q3; Lag order is 2)



1d) VAR Model of Trade with World (1995Q2-2007Q3; Lag order is 2)