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China's Trade Imbalances

The Role of FDI

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Abstract

China has been running a large trade surplus with the rest of the world, particularly with the USA and EU. This has caused considerable diplomatic tensions and tremendous pressure on the Chinese currency. Existing analytical studies, however, mostly focus on real exchange rate and income as determinants of China's trade imbalances. Little attention has been given to the role of inflow and outflow of foreign direct investment (FDI). The purpose of this paper is to fill in this gap in the literature by adding FDI to China's trade balance model. Fitting aggregate annual data from 1979 to 2007 to SURE (Seemingly Unrelated Regression Equations) and later ARDL (Autoregressive Distributed Lags) models, we find that although outflow FDI does not play an important role in determining Chinese trade flows and trade balance, inflow FDI contribute significantly to Chinese exports and thus its trade surplus with the rest of the world. Interestingly, devaluation of the Chinese currency Yuan is found not to affect Chinese trade balance. We also find that both Chinese income and the income of the world play important roles in Chinese trade imbalance. Finally, we find that Chinese trade imbalance is stable.

Keywords: China, trade balance, FDI, real effective exchange rate

JEL classification: F14, P33

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Tables and figures appear at the end of the paper.

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1 Introduction

China has experienced dramatic growth in both exports and imports since 1978. However, Chinese exports grow at a much faster pace compared to imports, resulting in a large trade surplus. According to data from International Financial Statistics (IFS), Chinese exports in 1978 were US$9,954.8 million and imports were US$11,130.9 million. But its exports increased to US$889,660.0 million and imports increased to US$700,528 million in 2007 (see Figure 1). At the bilateral level, China has been running a trade surplus with the US since 1983, and with the EU and Japan since 1988. In 2005, the US deficit of US$201 billion (US$256 billion in 2007) was the largest, followed by the EU-15 at US$121.8 billion and Japan at US$28.5 billion. Within the EU, Germany's trade deficit with China was US$23 billion, the UK's was US$18.8 billion, and France's was US$9.9 billion. At the aggregate level, the Chinese trade balance had changed from a trade deficit of US$0.12 trillion to a trade surplus of US$18.9 trillion in 20 years. Such large imbalances have caused considerable diplomatic tensions and underlie tremendous pressure on the Chinese currency. It is thus important to ask: What causes such a large amount of Chinese trade surplus? Would devaluation of the Chinese currency advocated strongly and persistently by the US and governments constitute a solution to the problem of trade imbalance? Is this large amount of trade surplus stable?

Many attempts have been made to find the answer to the first two questions, while few if any address the third question. In order to answer the first two questions, most studies focus on exchange rate, along with both domestic and foreign incomes. The main reason is that the Chinese currency had been devalued substantially, which should improve the trade balance according to the traditional theory. The Chinese Yuan was devalued from 1.68 Yuan/US$ in 1978 to 8.28 Yuan/US$ in 2001. This was followed by pegging Yuan with the US dollar at 8.28 for four years. In 2005, China started to relax the exchange rate. The exchange rate was 8.19 Yuan/US$ in 2005, 7.97 Yuan/US$ in 2006, and 7.61 Yuan/US$ in 2007. Figure 2 shows the real effective exchange rate of the Chinese currency (index, 2000 = 100). Studies such as Brada et al. (1993), Zhang (1998, 1999a, 1999b) and Weixian (1999), Zhang and Wan (2007), and Groenewold and He (2007) find that in the long run the effect of exchange rate on the Chinese trade balance is not significant. In other words, revaluation of the Chinese currency would not help reduce the Chinese trade imbalance. On the other hand, studies such as Brada et al. (1993) find that Chinese income (see Figure 2) plays an important roles in affecting trade balance.

Since most earlier studies use aggregate trade data thus may suffer 'aggregation bias problem' (that is, exchange rate may affect trade balance between one country and some of her trading partners, but not others), Bahmani-Oskooee and Wang (2006) disaggregated trade data by country to investigate how the Chinese trade balance responds to the devaluation. They show that the real depreciation of Chinese currency only has positive impact on her trade balance with three major partners (Australia, France, and the USA) out of 13 they examined.

In passing, it is noted that data reported by China is different from those reported by the US. For example, the 2006 US trade deficit with China was US$232.5 billion according to US sources but was only US$144.3 billion based on sources from China. However, irrespective of data sources, there is no doubt that China's trade surplus has increased dramatically.

Clearly, exchange rate and income variables are insufficient to explain China's trade imbalance. Is it possible for inflow FDI and outflow FDI to play a significant role in Chinese trade balance? Since the beginning of the Chinese economic reform, Chinese income has grown rapidly and the Chinese currency has been devalued. But one of the most successful stories of Chinese economy is how China attracts foreign direct investment (FDI). In the late 1970s, inflow FDI was nearly zero. But in 2006 and 2007, the inflow FDI was almost US$80 billion while outflow FDI was about US$17,829 million (Figure 3). It is natural for us to ask if inflow and outflow FDI have any effects on China's trade balance.

Theoretically, both inflow FDI and outflow FDI can have different effects on exports and imports. Inflow FDI may increase Chinese exports for two reasons. First, inflow FDI may increase the competitiveness of Chinese firms through transfers of advanced technologies and skills to China. Second, if China is a low-cost source of production in the world, an increase in inflow FDI will expand Chinese exports. Consequently, we expect inflow FDI to help increase Chinese exports and contribute to the trade imbalances. Meanwhile, inflow FDI may have positive or negative effects on Chinese imports. Inflow FDI may increase Chinese imports for two reasons. First, as inflow FDI increases, domestic production may increase. If the increased production requires more capital goods or other inputs from the world, China's imports will increase. Second, inflow FDI may increase China's growth rate and thus purchasing power of China, leading to increases in its demand for goods produced by the world. But inflow FDI may decrease Chinese imports from the world for other reasons. As inflow FDI increases, technology in Chinese firms improves. China can produce some goods that previously had to be imported and thus import less from the world. Moreover, China is a low-cost source of production and thus China will substitute own production for production by the world. Putting all these effects together, it is uncertain if the overall impacts of FDI on trade balance would be positive or negative.

As far as outflow FDI is concerned, it is possible that it affects Chinese exports and imports for different reasons. However, since China originally was a lower income, less competitive and low-cost production country compared to most countries in the world, outflow FDI is not expected to play an important role in Chinese trade flows (imports and exports).

Despite the relevance of FDI to trade, most previous literature related to FDI has developed around the determinants of FDI and there are very few studies that test the effect of FDI on trade balance. Wilamoski and Tinkler (1999) is one exception. In this paper, they examine the effects of US FDI in Mexico on US exports to and imports from Mexico. They are able to find that FDI explains a large part of the rapid increase in trade between US and Mexico. Moreover, no previous attempt has been made to examine the impact of FDI on China's trade balance so far.[1] Hence, it is the purpose of this study to fill in this gap in the literature by modeling the effects of FDI on China's trade balance. Another purpose of this study is to examine the stability of Chinese trade imbalance, which has been neglected in previous studies.

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1 This information about the literature on FDI and Chinese trade balance is based on one of the largest economic paper database in USA, 'Econlit'.

The plan of this paper is as follows. Section 2 introduces the trade balance model and discusses estimation technique. Section 3 presents empirical results. Section 4 concludes the paper. Data definition and sources are provided in the Appendix.

2 The trade balance model

According to Rose and Yellen (1989), the trade balance of a country depends on the domestic and foreign income, and the real exchange rate, where trade balance is defined as the difference between exports and imports. This definition is sensitive to units of measurement and is affected by domestic price indices. To rectify these problems, in this paper trade balance is defined as the ratio of imports from the world over exports to the world (Haynes and Stone 1982, Bahmani-Oskooee and Brooks 1999) and the model is specified as:

$$Ln\left(\frac{M}{X}\right)_t = \alpha_0 + \alpha_1 LnY_{C,t} + \alpha_2 LnY_t + \alpha_3 Ln\ E_t + \varepsilon_t \tag{1}$$

In Equation (1), M is China's nominal imports from the world and X is her nominal exports to the world. Yc is Chinese income, Y is the income of the world, E is the real effective exchange rate and ε is the error term.

Since FDI may affect Chinese exports and imports, we augment Equation (1) by adding both inflow FDI and outflow FDI variables:

$$Ln\left(\frac{M}{X}\right)_t = \alpha_0 + \alpha_1 LnY_t + \alpha_2 LnY_{C,t} + \alpha_3 Ln\ E_t + \alpha_4 Ln\ F_t + \alpha_5 Ln\ OF_t + \varepsilon_t \tag{2a}$$

In Equation (2a), F is the inflow FDI to China and OF is the outflow FDI from China.

Clearly, Equation (2a) does not reveal the effects of various variables on exports and imports separately. To do so requires specification of both the import and export equations. Assuming perfectly elastic supply, Chinese exports can be expressed as a function of the income of world and real exchange rate, while imports are a function of Chinese income and real exchange rate. With FDI incorporated, the Chinese import and export functions now take the following forms:

$$Ln\,X_t = \beta_0 + \beta_1 LnY_t + \beta_2 Ln\,E_t + \beta_3 Ln\,F_t + \beta_4 Ln\,OF_t + \xi_t \tag{2b}$$

and

$$Ln\,M_t = \gamma_0 + \gamma_1 LnY_{C,t} + \gamma_2 Ln\,E_t + \gamma_3 Ln\,F_t + \gamma_4 Ln\,OF_t + \omega_t \tag{2c}$$

The expected sign of the coefficients are summarized in Table 1. As shown in Table 1, in Equation (2a), α_1 is expected to be negative since an increase in the world income (Y) usually will lead to an increase in Chinese exports, and then decrease Chinese trade balance ratio. For the same reason, the coefficient of Y in Chinese export function β_1 should be positive. It is expected that α_2 be positive since an increase in Chinese income (Y_C) usually leads to an increase in Chinese imports and thus increase China's trade balance ratio. For the same reason, the coefficient of Yc in the import function γ_1 should be positive.

The coefficient of real effective exchange rate in Equations (2a), (2b) and (2c) are uncertain. According to the J-curve theory, the trade balance will initially be worsened following currency devaluation, but eventually will improve. Currency devaluation will affect the trade balance through both a direct price effect and an indirect volume effect. The price effect refers to a decrease in the value of exports and an increase in the value of imports instantaneously following currency devaluation. That is, exports become relatively cheaper measured in foreign currency units and imports become relatively expensive measured in domestic currency units. These will lead to deterioration of the trade balance at first. The price effect responds to the change in exchange rate quickly. However, the volume of exports will eventually increase since exports are relatively cheaper, while the volume of imports will decrease since imports are relatively expensive. This is the volume effect, which takes time to realize. The volume effect reflects slow adjustment to alteration in relative prices. If the new exchange rate comes into force and the trade volume adjusts successfully to the relative prices, the trade balance will eventually improve. However, we may actually see no significant effect or negative effect of devaluation on trade balance if the volume effect does not adjust successfully to the relative prices. Empirical results on testing the J-curve theory are mixed. So, we are uncertain about the effect of devaluation on Chinese trade balance.

Note that a decrease in E reflects a real devaluation of the Chinese currency. Thus, α_3 will be positive, β_2 will be negative and γ_2 will be positive if the devaluation of Chinese currency does drive expansion of exports, decrease Chinese imports and thus decrease Chinese trade balance ratio (i.e., improve Chinese trade balance) according to the J-curve theory. Otherwise, the coefficient of exchange rate in Equations (2a), (2b) and (2c) may not be the same as what the J-curve predicts.

As discussed in the last section, we expect that inflow FDI will drive the expansion of Chinese exports. But the effect of inflow FDI on the Chinese imports are uncertain. Thus, the effects of inflow FDI on Chinese trade balance are also uncertain. In addition, the effects of outflow FDI are uncertain as well, although we expect the outflow FDI does not play a significant role. Thus, the coefficient of outflow FDI is expected to be insignificant in Equations (2a), (2b) and (2c).

Obviously, Equations (2a), (2b) and (2c) relate to each other. In fact, Equation (2a) can be simply obtained by subtracting Equation (2b) from Equation (2c). Consequently, Seemingly Unrelated Regressions Estimation (SURE) will be used to estimate model Equation 2.

While Equation (2a) captures the long-run relationship, short-run dynamics can be explored by specifying (2a) in an error-correction form. Following Pesaran et al. (2001), the error-correction version of Autoregressive Distributed Lags (ARDL) model for Equation (2a) takes the following form:

$$
\begin{aligned}
\Delta Ln(\frac{M}{X})_t = \alpha 0 + \sum_{k=1}^{n} \omega_k \Delta Ln(\frac{M}{X})_{t-k} + \sum_{k=0}^{n} \alpha 1_k \Delta Ln Y_{c,t-k} + \sum_{k=0}^{n} \alpha 2_k \Delta Ln Y_{t-k} \\
+ \sum_{k=0}^{n} \alpha 3_k \Delta Ln E_{t-k} + \sum_{k=0}^{n} \alpha 4_k \Delta Ln F_{t-k} + \sum_{k=0}^{n} \alpha 5_k \Delta Ln OF_{t-k} \\
+ \delta_1 Ln(\frac{M}{X})_{t-1} + \delta_2 Ln Y_{c,t-1} + \delta_3 Ln Y_{t-1} + \delta_4 Ln E_{t-1} + \delta 5 Ln F_{t-1} + \delta 6 Ln OF_{t-1} \\
+ u_t
\end{aligned} \tag{2d}
$$

Before the error-correction model can be estimated and interpreted, it is necessary to test for cointegration. This can be achieved by conducting an F-test where the null hypothesis of no cointegration is $\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6$. The critical values provided by Pesaran et al. (2001) take the stationarity into consideration. They provide two sets of critical values by assuming all variables to be $I(1)$ or $I(0)$. If the calculated F-statistic is greater than the upper bound critical value, there is cointegration among the variables. On the other hand, if the calculated F-statistics is less than the lower lever of the critical values, it implies absence of cointegration. If the calculated F-statistics fall between the upper and lower critical values, it is inconclusive. Thus, the main attractiveness of this approach is that we can use the F-test rather than unit root test to test cointegration. Following Kremers et al. (1992) and Bahmani-Oskooee and Brooks (1999), the error-correction term can be used for cointegration test. The error correction term, denoted by ECM_{t-1}, is a linear combination of lagged level variables. If the coefficient of ECM_{t-1} is negative and significant, the variables in the model are said to be cointegrated. The number of lags in Equation (2d) will be selected based on certain criterion such as the Akaike Information Criterion (AIC).

One may wonder if the model for China's trade imbalance is stable. This can be tested by applying the CUSUM and CUSUMSQ tests of Brown et al. (1975). The CUSUM test is based on the cumulative sum of recursive residuals. If the plot of CUSUM statistic stays within 5 per cent significance level (portrayed by two straight lines whose equations are given in Brown et al. (1975, section 2.3), then coefficient estimates are said to be stable. A similar procedure is used to carry out the CUSUMSQ which is based on the cumulative sum of squared recursive residuals.

3 The results

Annual data from 1979 to 2007 are used to fit Equations (2a), (2b) and (2c) as a system. Data definition and sources are in the appendix. The results are reported in Table 2.

As shown in Table 2, for the exports model, the world income Y carries an expected positive sign, suggesting that the increase in the world income increases Chinese exports. The real effective exchange rate carries a positive sign, indicating that devaluation of the Chinese currency does not improve Chinese exports. In other words, the volume effect is dominated by the price effect. The coefficient of inflow FDI is positive and significant, suggesting that the inflow FDI boosts Chinese exports.

However, the coefficient of outflow FDI is not significant, confirming our earlier arguments.

For Chinese imports, the only significant determinant is domestic income. For Chinese trade balance ratio, domestic income carries an expected positive sign, which indicates that an increase in Chinese income raises its trade balance ratio. Meanwhile, foreign income promotes Chinese exports, leading to lower trade balance ratio. The real effective exchange rate carries a negative sign and it is significant, which suggests that devaluation does not improve trade balance as J-curve theory suggests. Thus, there is little evidence suggesting that Chinese currency devaluation would help improve its trade balance. Interestingly, the inflow FDI carries a negative and significant sign. Therefore, an increase in inflow FDI helps to lower the ratio of China's imports to exports. Based on the imports and exports models, inflow FDI increases Chinese exports but not Chinese imports. Thus, FDI contributes significantly to China's trade surplus. Since the outflow FDI is not significant in any of the equations, with a *t*-ratio always less than unity, it is acceptable to drop this variable from the models. The re-estimated results are very similar to those in Table 2 thus not reported in the paper.

One may argue that the introduction of inflow FDI causes the coefficient of exchange rate to carry a different sign than what J-curve suggested. To examine this possibility, we drop both inflow and outflow FDI and re-estimate the models. The estimation results are reported in Table 3. As we can see from Table 3, the coefficient of the real effective exchange rate is not significant in any of the three equations, confirming the earlier finding.[2]

To summarize, we find that outflow FDI does not play an important role in Chinese trade flows and trade balance. There is no evidence suggesting that the devaluation of Chinese currency improves Chinese trade balance. But Chinese income, the world income, and inflow FDI are the main determinants for Chinese trade surplus.

Now, we consider the short-run dynamics by estimating Equation (2d). Since outflow FDI does not play an important role in Chinese trade balance, all terms involving *OF* are to be dropped before estimation. Three criterions are used to determine the lag length: Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn Criterion (HQC). Based on the method explained in Section 2, we first check cointegration among the variables. F-statistics reported in Table 4, possess critical values all greater than the upper bound of 4.01. Further, the ECM_{t-1} terms are all negative and significant. These results support cointegration among the variables in the model.

From Table 4, the results from ARDL approach under different criteria are almost identical. They are very similar to the results from SURE estimation (Table 3). In particular, all the corresponding coefficients carry the same signs and significance level. Moreover, the coefficients of exchange rate and inflow FDI possess almost the same magnitude. Therefore, we are confident that Chinese income, the world income, real effective exchange rate and inflow FDI are the main determinants for Chinese trade imbalance.

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2 We also estimated the exports and imports models with supply side variables added. We still cannot find any evidence suggesting that devaluation of the Chinese currency improve Chinese trade balance.

In order to check the stability of Chinese trade balance, we apply CUSUM and CUSUMSQ tests. A graphical presentation of these two tests is provided in Figures 4 and 5.

As can be seen from Figures 4 and 5, the plot of CUSUM and CUSUMSQ statistics stay within the critical bounds, indicating stability of the Chinese trade balance ratio model.

4 Summary and conclusion

The main contribution of this paper is to fill the gap in the literature by examining the effects of FDI on China's trade imbalance and the stability of the Chinese trade imbalance. By using aggregate, annual data from 1979 to 2007 and employing SURE and ARDL estimation approaches, five main findings are obtained:

- The determinants of Chinese trade balance are Chinese income, the income of the rest of the world, the real effective exchange rate and the inflow FDI. Outflow FDI does not play an important role in Chinese trade flows and trade balance.

- Increases in Chinese income raise Chinese imports and maybe the trade balance ratio (imports to exports). Increase in the income of the rest of the world raise Chinese exports and decrease the trade balance ratio. Thus, as traditional theories suggest, both Chinese income and the income of the rest of the world are important determinants of China's trade surplus.

- We do not find any evidence suggesting that devaluation of Chinese currency improves Chinese trade balance. Instead, the price effect of the devaluation of Chinese currency may still dominate, thus the devaluation actually discourage Chinese exports and increase Chinese trade balance ratio. But the devaluation does not have significant effects on Chinese imports.

- Importantly, inflow FDI helps expand Chinese exports and contributes dramatically to China's trade surplus.

- Chinese trade imbalance is stable over time. We can expect that China will still run a large amount of trade surplus for some time.

Appendix

Data definition and sources

All data are annual data from 1979 to 2007 and are collected from International Financial Statistics (IFS) CD-ROM.

Variables

M/X = Chinese trade balance ratio. That is the ratio of Chinese nominal imports from the world over China's nominal exports to the world

Yc = measure of Chinese real GDP, which is approximately by GDP volume of China (2000 = 100)

Y = measure of real GDP of the world, which is approximately by average GDP of industrial countries (2000 = 100)

E = Chinese real effective exchange rate (2000 = 100)

F = Inflow of foreign direct investment from the world to China

OF = Outflow of foreign direct investment from China to the world

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Table 1: Expected sign of the coefficients in equation (2a), (2b), and (2c)

	Y	*Yc*	*E*	*F*	*OF*
M/X	α_1 -	α_2 +	α_3 Uncertain	α_4 Uncertain	α_5 Uncertain
X	$_1$ +	NA	$_2$ Uncertain	$_3$ +	$_4$ Uncertain
M	NA	$_1$ +	$_2$ Uncertain	$_3$ Uncertain	$_4$ Uncertain

Note: NA means that the independent variable is not included in the estimation.

Table 2: Estimation results with inflow/outflow FDI using SURE

	Y	*Yc*	*E*	*F*	*OF*	*Inpt*
Exports (X)	5.59* (7.08)	NA	0.61* (2.40)	0.22* (2.41)	0.02 (0.45)	-18.2* (5.95)
Imports (M)	NA	1.62* (11.38)	0.01 (0.04)	-0.09 (1.23)	0.02 (0.49)	5.77* (5.40)
TB ratio (M/X)	-5.39* (6.89)	1.55* (10.70)	-0.58* (3.16)	-0.30* (4.20)	-0.01 (0.18)	23.13* (7.58)

Notes:

(1) NA means that the independent variable is not included in the estimation.

(2) * denotes 5% significance.

(3) The figures inside parentheses and under the coefficients represent the absolute value of the T-ratio.

Table 3: Estimation results without inflow/outflow FDI using SURE

	Y	*Yc*	*E*	*F*	*OF*	*Inpt*
Exports (X)	7.38* (15.50)	NA	0.17 (0.88)	NA	NA	-21.84* (7.61)
Imports (M)	NA	1.46* (23.38)	0.08 (0.65)	NA	NA	5.38* (7.07)
TB ratio (M/X)	-6.05* (14.03)	1.16* (16.96)	-0.10 (0.73)	NA	NA	22.55 (10.26)*

Notes:

(1) NA means that the independent variable is not included in the estimation.

(2) * denotes 5% significance.

(3) Figures inside parentheses are absolute T-ratios.

Table 4: Estimation results of Chinese trade balance ratio without outflow FDI using ARDL, lag length determined by three criterion

Criterion	*Y*	*Yc*	*E*	*F*	*Inpt*	*ECMt*-1	*F* Statistics
AIC	-1.65* (4.02)	0.44* (4.26)	-0.48* (6.11)	-0.20* (5.89)	9.43* (4.98)	-1.76* (8.25)	14.63
SBC	-1.35* (3.47)	0.34* (4.14)	-0.38* (8.79)	-0.16* (9.50)	7.64* (4.79)	-1.63* (9.27)	13.57
HQC	-1.35* (3.47)	0.34* (4.14)	-0.38* (8.79)	-0.16* (9.50)	7.64* (4.79)	-1.63* (9.27)	13.57

Notes:

(1) * denotes 5% significance.

(2) The figures inside parentheses and under the coefficients represent the absolute value of the T-ratio.

Figure 1: Chinese exports (X) and imports (M) in millions of US$ from 1979-2007

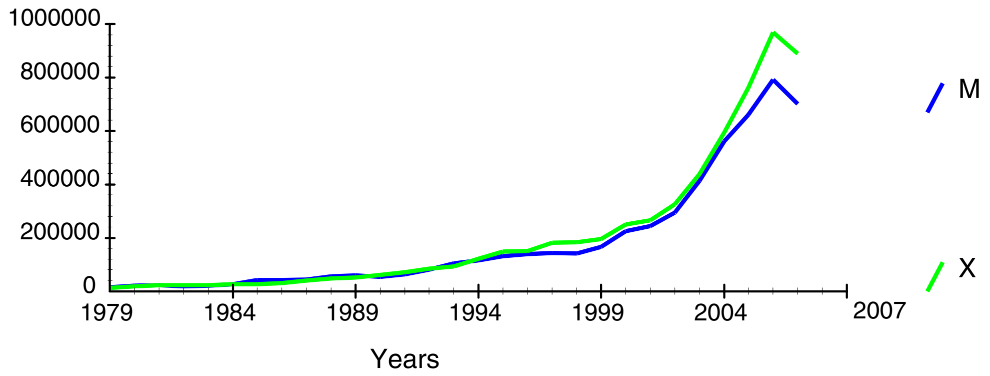

Figure 2: Chinese income (Yc) and real effective exchange rate (E) index from 1979-2007, 2000 = 100

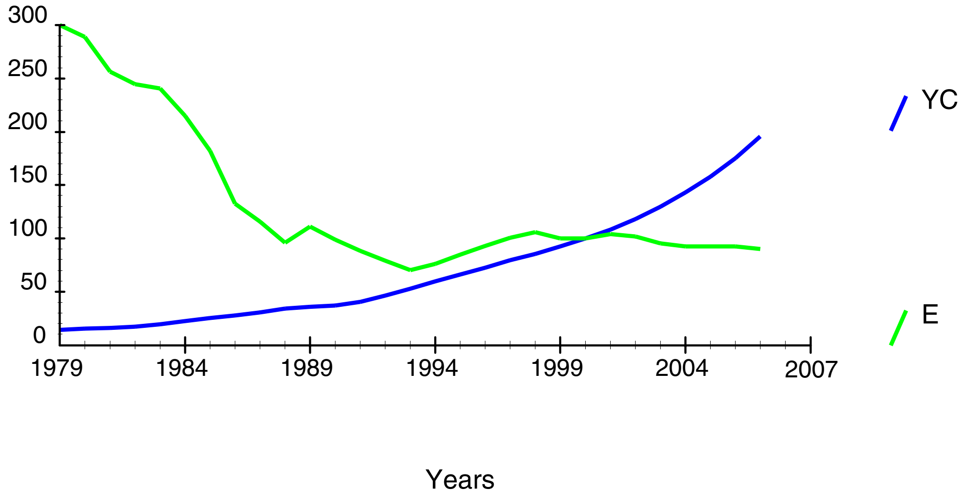

Figure 3: Chinese inflow FDI (F) and outflow FDI (OF) in millions of US$ from 1979 to 2007

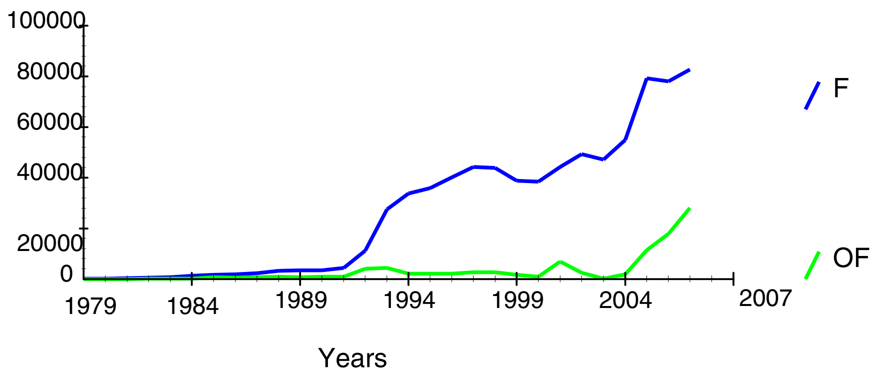

Figure 4: CUSUM test results

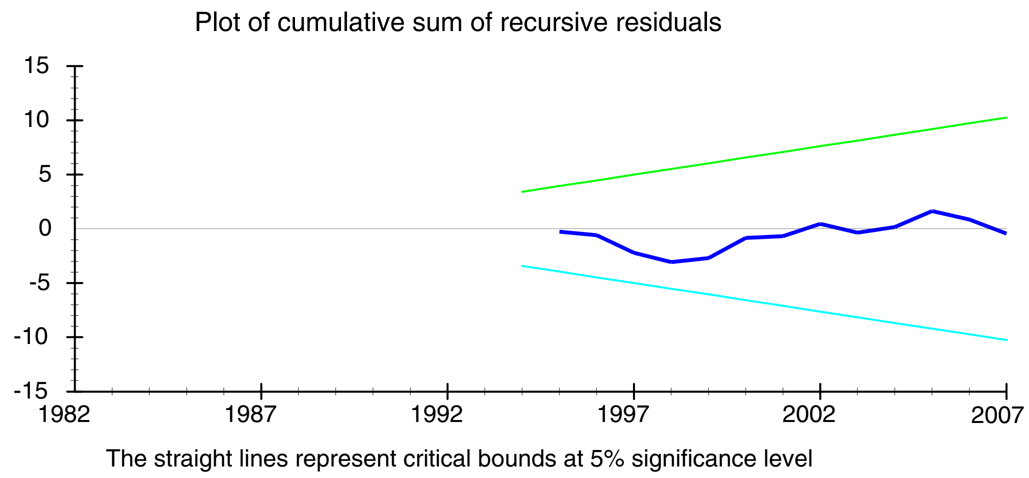

Figure 5: CUSUMSQ test results