How much depreciation of the US dollar for sustainability of the current accounts?*

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1. Introduction

The United States have been faced with the increasing current account deficits in the recent years. Its current account deficits were recorded over 5 percent of GDP in 2002. We remember that the current account deficits were over 3 percent of GDP in the mid of 1980s when the US dollar made a large depreciation after the Plaza Accord in September 1985. It is regarded that the recent current account deficits are going beyond a dangerous level by comparing the recent situation with that in the mid of 1980s.

Though the US dollar began to depreciate several months before the Plaza Accord, the depreciation of the US dollar gained momentum by the Plaza Accord. The real effective exchange rate of the US dollar depreciated nearly 40% from the peak in the early 1985 to the early 1988. Following the depreciation, the current account deficit was reduced from 3.4% in the last quarter of 1986 to 1.4% in the second quarter of 1990 (see Figure 1).

Some researchers doubt that such the current account deficits of the United States are sustainable in the current level of the exchange rates because the current account deficits began to increase again and have reached to 5% of GDP. This paper investigates how much the US dollar should be depreciated for reducing the current account deficits in the United States.

This paper quotes our empirical analytical results from Kudo and Ogawa (2003) to explain unsustainable current account deficits in the United States in the next section. In Section 3, we conduct a simulation analysis to investigate how much depreciation of the US dollar is needed to reduce the current account deficits in the near future. We use some VAR models to estimate relationships between the exchange rate of the US dollar and the current accounts in the United States. Then we use the estimated VAR models to conduct the simulation analysis about impacts of hypothetical exchange rate movements on the current account deficits. We suppose five scenarios of exchange rate movements; 10%, 30%, and 50% of depreciation of the US dollar in the second quarter in 2004 and depreciations of the US dollar in the same ways as the post Plaza Accord and the Indonesian currency crisis from 1997 to 1998.

2. Unsustainable Current Account Deficits in the United States

In this section, our empirical analytical results in Kudo and Ogawa (2003) are explained as for sustainability of the current account deficits in the United States. We used the method of Bohn (1995) and Ahmed and Rogers (1995) in order to derive the necessary and sufficient conditions. The sustainability of the current account deficits was empirically analyzed from a perspective based on international capital flows in addition to perspectives of domestic investment-saving relationship and international trade flows according to Mann (2002). We investigated whether the current account is sustainable in the sense of the external debt solvency.

2.1. Methodology and Data

Kudo and Ogawa (2003) conducted empirical analyzes on the sustainability of the current account deficits from perspectives of the domestic investment-saving relationship, the international trade flows, and the international capital flows according to Mann (2002). Their theoretical backgrounds are explained in the Appendix.

In our empirical analysis based on investment-saving balance, we represent the repayment for the external debts $r_t D_{t-1}$ as RD, the private savings S_t as PS, the private investments I_t as PI. We use data on the private gross savings and investments as PS and PI, respectively. We replace the government expenditure G_t by the government gross investment GE and the tax revenue T_t by the government gross saving GS. In addition, we make data series of the national gross saving NS and the national gross investment NI. We also make data series of the investment-saving balances of the private sector PIS and the public sector GIS as well as the national investment-saving balance NIS.

In our empirical analysis based on international trade flows, we represent the exports of goods and services X_t as EX and the imports of good and services M_t as IM. In addition, we make data series of a sum the repayment for external debt $r_t D_{t-1}$ and the imports M_t, which is represented as MM. We also use the trade balance TB. We also test directly whether the current account deficit CAD is stationary.

In our empirical analysis based on international capital flows, we represent the change in foreign reserve ΔR_t as RES, the capital inflows Fin_t as FIN, and the capital outflows $Fout_t$ as FOUT. In the analysis on the items in financial account, we use the direct investment inflow DIIN, the portfolio investment inflow PIIN, and the other investment inflow OIIN, and the direct investment outflow DIOUT, the portfolio investment outflow PIOUT, and the other investment outflow OIOUT. In addition, we make data series on the direct investment balance DIB, the portfolio investment balance PIB, and the other investment balance OIB.

We used the Johansen's method to investigate whether the relevant variables are cointegrated.[1] We used the unit-root tests on the relevant variables in the systems to investigate whether all the variables are the elements of the cointegration in advance. If the variables are relevant to the cointegration system, they are expected to follow the same order integration processes. As the result, we can find that the system is cointegrated.

We test whether the conditions of the cointegration vector are satisfied, for the systems in which all variables are cointegrated.[2] If the system passes all of the tests, we can conclude that the condition of the current account sustainability is satisfied. Based on the analysis in the preceding section, we analyze the sustainability of the current account.

The original variables and the standardized variables by GDP are prepared for all of the data. Most of the data in the analysis based on the domestic investment-saving balance are taken from the "National Income and Production Account Tables" by the Bureau of Economic Analysis. The balance of payments data are taken from the "International Transactions Accounts". All of the data were seasonally adjusted. The

[1] We use the table 1 in Osterwald-Lenum (1992) as the critical value here.

[2] Noticing that the linear restriction which is described in previous section is imposed on the cointegration vector, Miyao (2001) tests the cointegration by using the framework of the Engle-Granger test. Though he carries out unit-root test on the series of RD+IM-EX, this is similar to carry out the Engle-Granger test on the system of RD, IM, EX by imposing the restriction (1,1,-1) on the cointegration vector.

sample period of the data covers from the first quarter of 1960 to the fourth quarter of 2002. The number of observations is 172.

2.2. Empirical Results from the Perspective on the Domestic Investment-Saving Balance

In this subsection, we investigate the current account sustainability from the perspective based on the domestic investment-saving balance. We consider the following pattern as

(1) RD+PI+GE-PS-GS,

(2) RD+NI-NS,

(3) RD+PIS+GIS,

(4) RD+NIS.

Equation (1) is the same as the system in equation (A7) in Appendix. In equation (2), we define the national investments NI as a sum of private investments PI plus government investments GE and the national savings NS as a sum of private savings PS plus government savings GS. This means we analyze the whole economy's investment-saving relationship. In equation (3), we use investment-saving balance of both the private and public sectors. We analyze the national investment-saving balance in equation (4).

In the case of using the non-standardized data, the ADF test rejected a unit-root for the government savings GS in equation (1) (Table 1.1). In the case of using the data standardized by GDP, a unit-root is rejected in the private investments PI and the government savings GS in equation (1).

In the case of using the non-standardized data, the ADF test did not reject any unit-root for all variables in equation (2) (Tables 1.1 and 1.2). The cointegration test showed that this system has full rank in the cointegration relationship but that this is contradiction to the assumption of this test (Table 1.3). In the case of using the standardized data, a unit-root is rejected for the national savings NS in equation (2).

In the case of using the non-standardized data, the ADF test rejected a unit-root for the private and public sectors' investment-saving balances, PIS and GIS in equation (3) (Table 1.1). In the case of using the data standardized by GDP, a unit-root is rejected for the private and public sectors' investment-saving balances, PIS and GIS in equation (3) (Table 1.1).

In the case of using the non-standardized data, every variable follows a first-order integrated process in equation (4) (Tables 1.1 and 1.2). We conducted the cointegration test for the system of equation (4). The cointegration test cannot reject that the system has no cointegration vector in terms of both the non-standardized data. In the case of using the standardized data, a unit-root is rejected for the national investment-saving balance NIS.

Therefore, each of the systems of equation (1), (2), and (3) is not cointegrated in terms of both the non-standardized and standardized data. On one hand, the system of equation (4) is not cointegrated in terms of the standardized data.

2.3 Empirical Results from the Perspective on the International Trade Flows

We investigate the current account sustainability from the perspective based on the international trade flows. For the cointegration relationship in equation (A10), we consider the following pattern as

(5) RD+IM-EX,

(6) MM-EX,

(7) RD-TB,

(8) CAD.

Equation (5) follows directly the definition in equation (A10) in Appendix. Next, we use MM rather than RD and IM in equation (6). In equation (7), we use the trade balance TB rather than the imports and the exports. In addition, we conduct a unit-root test for the current account deficit CAD itself in equation (8).

In the case of using the non-standardized data, the ADF tests show that a unit-root is rejected for the imports IM in equation (5) (Table 2.1). Therefore, this system has no cointegration relationship in terms of the non-standardized data. In the case of using the standardized data, we cannot reject the repayment for the external debt RD and imports IM following an I(2) process while the exports EX follows a first-order integrated process (Tables 2.1 and 2.2). We regard that the power of the ADF test is very weak and conduct the cointegration test for this system..

In the case of using the non-standardized data, we can find that the sum of the imports and repayment for the external debts MM follows a first-order integrated process and that the exports EX follows a second-order integrated process in equation (6). Since the power of the ADF test is weak, we conduct the cointegration test for the system of equation (6). We obtain a result that the system has a cointegration vector. We also test whether a linear restriction on the cointegration vector is satisfied. As a result, the test rejected the null hypothesis of a linear restriction on the cointegration vector. One hand, in the case of using the standardized data, a unit-root is rejected for the exports EX.

In the case of using the non-standardized data, all variables in this system follow first-order integrated processes in equation (7) (Tables 2.1 and 2.2). The cointegration test found that this system has no cointegration vector (Table 2.3). In the case of using the standardized data, a unit-root is rejected for the trade balance TB.

In equation (8), the stationarity of the current account deficit CAD is the condition of the current account sustainability. We investigate whether this condition is satisfied. Table 3.1 shows that we cannot reject any unit-root for the current account deficit.

Therefore, each of the systems of equations (5), (6), and (7) are not cointegrated. On one hand, the system of equation (8) has a unit root for the current account deficit. Thus, these results show that the U.S. current account deficit is unsustainable from the perspective based on the international trade flows.

2.4. An Analysis on the Finance for Current Account Deficits

We investigated the U.S. current account sustainability from the perspectives based on the domestic investment-saving relationships and on the international trade flows. These analytical results show that the U.S. current account deficit is not sustainable. Next, we investigate which items in the international capital inflows finance the current account deficit in the long run.

First, we analyze the cointegration relationship among the current account deficit, the international capital flows, and the change in the foreign reserves. We conduct unit-root tests for relevant variables in advance. The results are shown in Table 3.1. The results is that the unit-root is rejected for the change in the foreign reserves ΔR_t. The empirical results in the previous section showed that the current account deficit CAD_t is non-stationary. Therefore, the current account deficit CAD_t and the international capital flows FB_t should be cointegrated in equation (A11) in Appendix in order to be consistent with the fact that the change in the foreign reserves ΔR_t is stationary.

The results of unit-root and cointegration tests on the current account deficit and the international capital flows are shown in Tables 3.1, 3.2, and 3.3. The results of unit-root tests in the case of using the non-standardized data is that a second-order integration is not rejected for the financial balance FB while the current account deficit CAD follows a first-order integration process. In the case of using the standardized data, the financial balance FB and the current account deficit CAD follow a first-order integration process.

We also conduct cointegration tests between the current account deficit and the financial balance.[3] The results are shown in Table 3.3. In the case of using the non-standardized data, the rank of cointegration is full-rank and it contradicts with the assumptions. In the case of using the standardized data, we can find a cointegration vector in the system that includes the current account deficit CAD and the financial balance FB.

Next, we conduct the analysis by decomposing the financial balance FB into the direct investment balance DIB, the portfolio investment balance PIB and the other investment balance OIB. Because the change in foreign reserves ΔR_t is stationary, some of the other variables (DIB, PIB, and OIB) in equation (A12) in Appendix should

[3] Though it is not rejected for FB to follow the second-order integrated process, we carried out the cointegration test on the system since it is said that the power of ADF test is weak.

be cointegrated. The unit-root tests show that the current account deficit and the portfolio investment balance follow first-order integrated processes.

Table 3.3 shows that the cointegration rank is 2 among the variables in the case of using the non-standardized data. The cointegration rank is 1 among the variables in the case of using the standardized data. Thus, the cointegration has full-rank and it contradicts with the assumptions of the analysis in the case of using the non-standardized data. On one hand, there is a cointegration vector in the system which includes the current account deficit and the portfolio investment balance in the case of using the standardized data. Accordingly, we can conclude that the huge current account deficit in the United States has been financed by the portfolio investment from other countries in the long run in terms of the stationary relationship.

3. Simulation Analysis on Depreciation of the US Dollar for Sustainable Current Account Deficits

In this section, we investigate how impact depreciation of the US dollar would give on the current account deficits in the United States and how much depreciation of the US dollar is needed to make the current account deficits sustainable.

3.1. Methodology and Data

We simulate how much depreciation the US dollar is needed for its current account sustainability by using the estimated parameters of vector autoregression (VAR) models. Three VAR models are estimated in our analysis. The first model (Model 1) is a 2 variables VAR model which contains the exchange rate and the current account. The second model (Model 2) is a 3 variables VAR model which contains the exchange rate, trade balance and factor income receipt from abroad from a viewpoint of international trade flows. The last model (Model 3) is a 3 variables VAR model which contains the exchange rate, saving-investment balances for the private and the public sectors from a viewpoint of domestic investment saving balance.

We suppose some cases of exchange rate movements in order to simulate their effects on the current account deficits. The supposed cases are that the US dollar will sharply depreciate in the second quarter of 2004. We suppose three cases where the US dollar will depreciate against its trading partners' currencies in terms of the real effective exchange rates by 10%, 30%, and 50% in the second quarter of 2004. In addition, we suppose two hypothetical movements of the exchange rate. One is that the US dollar is supposed to make similar movements as the actual movements after the Plaza Accord during the three years after the Plaza Accord. The other is that the US dollar is supposed to make similar movements as the actual movements during the Indonesian currency crisis period from the third quarter of 1997 to the second quarter of 1998.

In addition to the data used in the previous sections, we use the real effective exchange rate of the US dollar as one of the vector in the three VAR models. The real effective exchange rate data is taken from the IMF's *International Financial Statistics*.

Before we estimate the three VAR models, we test the stationarity of relevant variables by using the Augmented Dickey-Fuller (ADF) tests. The results are shown in Table 4. The null hypothesis of non-stationarity is not rejected for all of the variables at 5% significance level. Next, we test cointegration for the three VAR models. The results are shown in Table 5. The first and third VAR models are not cointegrated while the second VAR model is cointegrated. The estimated cointegration vector of the second VAR model is shown in Table 6. Considering the results as stated above, we estimate the differenced variables VARs in addition to the original data VARs, and the vector error correction model (VECM) for the second VAR model.

3.2. VAR Models

We estimate the three VAR models in this analysis. The first VAR model (Model 1) is the two-variable VAR contains the exchange rate and the current account. In the second model (Model 2), we decompose the current account into the trade balance and the income receipt. On the other hand, from a viewpoint of the domestic investment saving balance, the third VAR model (Model 3) contains the exchange rate and the saving-investment balances for the private and the public sectors.

The results of estimating Model 1 estimation are shown in Table 7. Almost all of the estimates in terms of levels are significant at 5% level while all of the estimates in terms of log difference are not significant. The estimated parameters of Model 2 are shown in Table 8. Most of the parameters are significantly estimated at 5% significance level in the original variables estimation, while the estimates in difference variables estimation are not significant. In the error correction model estimation, all variables except for the income receipt equation are not significant. The results of Model 3 are shown in Table 9. In the VAR estimation using original level variables, almost all of the estimates are significantly estimated though all of the estimates are not significant in the VARs using the difference variables.

3.3. Results of Simulation Analysis

3.3.1. Impacts of Depreciation of the US Dollar on the Current Account Deficits

In this subsection, we show results of the simulation analysis based on the three estimated VAR models for some scenarios of the US dollar depreciation. At first, we suppose three cases where the US dollar will depreciate against its trading partners' currencies in terms of the real effective exchange rates by 10%, 30%, and 50% in the second quarter of 2004. In addition, we suppose two hypothetical movements of the exchange rate. One is that the US dollar is supposed to make similar movements as the actual movements after the Plaza Accord during the three years after the Plaza Accord. The other is that the US dollar is supposed to make similar movements as the actual movements during the Indonesian currency crisis period from the third quarter of 1997 to the second quarter of 1998.

At first, we simulate the current account behavior if the US dollar were sharply depreciated by 10% in the second quarter of 2004. Figure 2 shows a current account behavior that is obtained by the simulation analysis based on Model 1. Figure 3 shows a current account behavior based on that is obtained by the simulation analysis based on Model 2. Figure 4 shows a current account behavior based on that is obtained by the simulation analysis based on Model 3. The 10% depreciation would gradually reduce the current account deficits to 2% of GDP by 2018 in the cases of Models 1 and 2. On one hand, it would reduce the current account deficits to 2% of GDP by 2008.

Next, we simulate the current account behavior if the US dollar were sharply depreciated by 30% in the second quarter of 2004. Figure 5 shows a current account behavior that is obtained by the simulation analysis based on Model 1. Figure 6 shows a current account behavior based on that is obtained by the simulation analysis based on Model 2. Figure 7 shows a current account behavior based on that is obtained by the simulation analysis based on Model 3. The 30% depreciation would reduce the current account deficits to 2% of GDP by 2011 and then to 1.6% of GDP in 2018 in the cases of Models 1 and 2. On one hand, it would reduce the current account deficits to 1.3% of GDP in 2008 and then increase it to 2.5% in 2020 in the case of Model 3.

Moreover, we simulate the current account behavior if the US dollar were sharply depreciated by 50% in the second quarter of 2004. Figure 8 shows a current account behavior that is obtained by the simulation analysis based on Model 1. Figure 9 shows a current account behavior based on that is obtained by the simulation analysis based on Model 2. Figure 10 shows a current account behavior based on that is obtained by the simulation analysis based on Model 3. The 50% depreciation would reduce the current account deficits to 0.8% of GDP by 2013 in the case of Model 1 and to 1% of GDP by 2015 in the case of Model 2. On one hand, it would reduce the current account deficits to 0.5% of GDP in 2008 and then increase it to 2.8% in 2020 in the case of Model 3.

We suppose two more scenarios of the US dollar depreciation. The first case is that the exchange rate of the US dollar from the last quarter of 2003 to the third quarter of 2006 move in the same way as the exchange rate of the US dollar actually moved after the Plaza Accord. Figure 11 shows a current account behavior that is obtained by the simulation analysis based on Model 1. Figure 12 shows a current account behavior based on that is obtained by the simulation analysis based on Model 2. Figure 13 shows a current account behavior based on that is obtained by the simulation analysis based on Model 3. The exchange rate movements would reduce the current account deficits to 2% of GDP by 2010 and then to about 1% in 2016 in the cases of Models 1 and 2. On one hand, it would reduce the current account deficits to about 1% of GDP in 2009 and then increase it to 2.8% of GDP in 2020.

The second case is that the exchange rate of the US dollar depreciates from the last quarter of 2003 in the same way as the Indonesia rupiah depreciation in the Asian currency crisis from the second quarter of 1997 to the first quarter of 1998. Figure 14 shows a current account behavior that is obtained by the simulation analysis based on Model 1. Figure 15 shows a current account behavior based on that is obtained by the simulation analysis based on Model 2. Figure 16 shows a current account behavior based on that is obtained by the simulation analysis based on Model 3. The exchange rate movements would sharply reduce the current account deficits to 2% of GDP by 2006 in the cases of Models 1 and 2. The current accounts would be surplus in the case of Model 1 and equilibrium in the case of Model 2 in 2013. After then, the current account deficits would be 1% of GDP in 2020. On one hand, the current account deficits would reduce to 2% of GDP in 2005 and then turn to surplus by 2007. However, the current accounts would turn to deficit and then increase to about 3% in 2017.

3.3.2. Depreciation of the US Dollar and Sustainability of the Current Account

We investigate whether each series of the simulated current account deficits is sustainable. The Augmented Dickey-Fuller (ADF) test is used to investigate the sustainability of the current account deficits. The analytical results can conclude that the simulated current account deficits would be sustainable if the null hypothesis of unit-root is rejected by the ADF test. We conduct the unit-root test not only for during the full sample period (from the first quarter of 1976 to the fourth quarter of 2020) but for the forecasted for the sub-sample period (from the fourth quarter of 2003 to the fourth quarter of 2020). While Table 10 shows results of the unit-root tests for the estimated values during a estimation period from the first quarter of 1976 to the third quarter of 2003, results for the estimated and simulated values in each of the VAR models during the full sample period and the sub-sample period are shown in Table 11.

We find the same tendency from the results of Model 1 and 2. In these models, the null hypothesis of unit-root of the simulated current account cannot be rejected for the full-sample period while the null hypothesis of unit-root can be rejected for the forecasted sub-sample period except for the case of exchange rate movements in the same way as the post Plaza Accord (Case 4).

From the results of the unit-root tests for the simulated current account data based on the third VAR model (Model 3) contains the exchange rate and the saving-investment balances for the private and the public sectors, we find that the null hypothesis of unit-root for the series can be rejected not only for the sub-sample period but also for the full-sample period. Accordingly, we can regard that the simulated current account deficits based on Model 3 are sustainable for all of the cases of supposed exchange rate movements.

4. Conclusion

This paper investigated how much the US dollar should be depreciated for reducing the current account deficits in the United States. We conclude that some scenarios of the US dollar depreciation would reduce the current account deficits to a level under 2% of GDP in the next several years. The results are regarded as robust for each of the scenarios thought they depend on our supposed VAR models. The results were derived from the 2 variables VAR model and the 3 variables VAR models by taking into account relationships between the current accounts and the exchange rates without exogenously reducing fiscal deficits. It is expected that smaller depreciation of the US dollar should reduce the current account deficits if the US government reduced the fiscal deficits at the same time. In other words, the US government should reduce the fiscal deficits in order that it should prevent a large depreciation of the US dollar for reducing the current account deficits and make them sustainable in the near future.

We can regard that the simulated current account deficits based on the third

VAR model (Model 3) contains the exchange rate and the saving-investment balances for the private and the public sectors are sustainable for all of the cases of supposed exchange rate movements. It is not so robust to conclude sustainability of the simulated current account deficits because the result is obtained in only Model 3. However, it is possible to obtain sustainable current account series by taking into account relationships among the exchange rate, the private sector's saving-investment balance, and fiscal deficits according to Model 3. The result enables us to speculate that the fiscal deficits are the most important factors that would make the current account deficits in the United States sustainable in the near future.

Appendix

A.1. A Perspective Based on the Domestic Investment-Saving Balance

In this appendix, we explain the econometric methods that we use in our analysis and summarize the three perspectives that Mann (2002) pointed out.

As the first perspective, we investigate the relationship among the domestic investment-saving balance, the current account deficit, and the external debts. As we described above, we investigate the investment-saving balance for each of the sectors (private and public sectors). First, the relationship between the change in the external debts in the end of the period D_t and the current account deficit CAD_t is represented by

(A1) $$D_t - D_{t-1} = CAD_t \, .$$

The current account deficit increases the external debts as the current account deficit is financed the international capital inflows. This can be interpreted as a "budget constraint" of the whole economy in period t.

Next, we consider both the domestic investment and saving behavior of each of the sectors.[4] The budget constraint of the private sector in period t is represented by

(A2) $$A_t - A_{t-1} = r_t A_{t-1} + S_t - I_t \, ,$$

[4] Matsubayashi (2002) analyzes that each sector's budget constraint is satisfied from the view of the necessary condition and sufficient condition. But, we will not consider each sector's budget constraint for focusing on the current account sustainability.

where r_t is the interest rate, A_t is the asset holdings by the private sector, which include the claims on the public sectors and foreigners, S_t is the savings of the private sector, and I_t is the investments of the private sector.

The budget constraint of the public sector (government) is represented by

(A3) $$B_t - B_{t-1} = r_t B_{t-1} + G_t - T_t ,$$

where B_t is the government debts, G_t is the government expenditures, and T_t is the tax revenues. The government bonds are held by the private sector and foreigners.

We obtain $B_t - A_t = D_t$ since the government bond holdings by the private sector equal to the liabilities of the public sector to the private sector. From equations (A2) and (A3), we derive the relationship between the current account deficit and the domestic investment-saving balance as

(A4) $$CAD_t = r_t D_{t-1} + I_t + G_t - S_t - T_t .$$

We define the stochastic discount factor of the private sector as $Q_{t,t+k} = [\beta^k u'(C_{t+k})/u'(C_t)]$, where C_t is consumption, $u(\cdot)$ is utility function and $u'(\cdot) > 0, u''(\cdot) < 0$ are satisfied, and $Q_{t,t} = 1$. The Euler equation of intertemporal consumption is

(A5) $$E_t\left[Q_{t,t+k}\left(\prod_{j=0}^{k}(1+r_{t+j})\right)\right] = 1 .$$

Substituting equation (A4) into equation (A1), we obtain a difference equation of D_t. We solve forward the equation and use equation (A5) to derive the whole economy's intertemporal budget constraint based on the domestic investment-saving balance:

(A6) $$E_t\sum_{k=0}^{\infty}(Q_{t,t+k}I_{t+k}) + E_t\sum_{k=0}^{\infty}(Q_{t,t+k}G_{t+k}) - E_t\sum_{k=0}^{\infty}(Q_{t,t+k}S_{t+k}) - E_t\sum_{k=0}^{\infty}(Q_{t,t+k}T_{t+k}) + (1+r_t)D_{t-1} = \lim_{K\to\infty} E_t(Q_{t,t+K}D_{t+K}).$$

Now, we consider solvency of the external debts based on the equation (A6). We suppose that the transversarity condition $\lim_{K\to\infty} E_t(Q_{t,t+K}D_{t+K}) = 0$ to obtain

$$(1+r_t)D_{t-1} = E_t\sum_{k=0}^{\infty}Q_{t,t+k}(S_{t+k} + T_{t+k} - I_{t+k} - G_{t+k}) .$$

This means that the external debts at the present time should be equal to the present value of the net savings in the present and the future because the present value of the external debts in the terminal period to converge to zero in order to satisfy the transversarity condition. Thus, the current account sustainability condition of the economy is that the external debts at the present time have to be repaid by the net savings in the present and the future.

Ahmed and Rogers (1995) derived the necessary and sufficient conditions of the current account sustainability by transforming the equation (A6) to an applicable econometric method. According to them, we difference the both sides of equation (A6) to obtain:

$$\begin{aligned} \text{(A7)} \quad & \Delta E_t \sum_{k=0}^{\infty}(Q_{t,t+k}I_{t+k}) + \Delta E_t \sum_{k=0}^{\infty}(Q_{t,t+k}G_{t+k}) - \Delta E_t \sum_{k=0}^{\infty}(Q_{t,t+k}S_{t+k}) \\ & - \Delta E_t \sum_{k=0}^{\infty}(Q_{t,t+k}T_{t+k}) + (r_t D_{t-1} + I_t + G_t - S_t - T_t) \\ & = \lim_{K\to\infty} E_t(Q_{t,t+K}D_{t+K}) - \lim_{K\to\infty} E_{t-1}(Q_{t-1,t+K-1}D_{t+K-1}), \end{aligned}$$

where Δ is the difference operator.

From this equation, Ahmed and Rogers (1995) show that the necessary and sufficient conditions of the current account sustainability or the transversarity condition is that $r_t D_{t-1}, I_t, G_t, S_t, T_t$ are cointegrated and have the cointegration vector $(1, 1, 1, -1, -1)$ under some assumptions.[5] We analyze the cointegration among these variables to investigate whether the current account sustainability condition is satisfied.

A.2. A Perspective on the International Trade Flows

Next, we consider the solvency of the external debts from the international trade flows as the second perspective of the current account sustainability. By

[5] The following conditions should be satisfied. (i) I_t, G_t, S_t, T_t follow I(1) processes, (ii) the utility function is separable for time, the marginal utility of consumption $u'(C_t)$ follows a random-walk process, and the subjective discount factor satisfies $\beta \in (0,1)$, (iii) all risks are invariant for any time period i.e. the covariance between the stochastic discount factor and each variable is constant, (iv) the series of the external debt follows I(1) process, and (v) the expectation operator E_t represents the rational expectation. Under these assumptions, Ahmed and Rogers (1995) show that the stationarity of the right hand side of equation (7) is identical to cointegrate the relevant variables.

abstracting the net receipts of labor income and the current transfers in the balance of payments, we can represent the current account deficit as

(A8) $$CAD_t = r_t D_{t-1} - X_t + M_t,$$

where X_t is exports of goods and services and M_t is imports of goods and services.

We substitute equation (A8) into equation (A1) to obtain a difference equation of D_t. We solve forward the difference equations and use equation (A5) to derive the economy's intertemporal budget constraint based on the international trade flows:

(A9) $$E_t \sum_{k=0}^{\infty} (Q_{t,t+k} M_{t+k}) - E_t \sum_{k=0}^{\infty} (Q_{t,t+k} X_{t+k}) + (1+r_t) D_{t-1} = \lim_{K \to \infty} E_t (Q_{t,t+K} D_{t+K}).$$

The transversarity condition in equation (A9) means that the initial external debts are repaid by the net exports in the present and the future. We difference the both sides of equation (A9) to obtain:

(A10) $$\Delta E_t \sum_{k=0}^{\infty} (Q_{t,t+k} M_{t+k}) - \Delta E_t \sum_{k=0}^{\infty} (Q_{t,t+k} X_{t+k}) + (r_t D_{t-1} - X_t + M_t) = \lim_{K \to \infty} E_t (Q_{t,t+K} D_{t+K}) - \lim_{K \to \infty} E_{t-1} (Q_{t-1,t+K-1} D_{t+K-1}).$$

According to equation (A10), the necessary and sufficient conditions of the current account deficit sustainability should be that $r_t D_{t-1}, X_t, M_t$ are cointegrated and have the cointegration vector $(1, -1, 1)$. Thus, from the perspective on the international trade flows, we analyze this cointegration relationship to investigate the current account sustainability.

A.3. A Perspective on the International Capital Flows

Finally, we consider the condition of the current account sustainability from the perspective on the international capital flows. The definition of the balance of payments tells us that the relationship between the current account deficit and the international capital flows should be represented by the following equation:

(A11) $$CAD_t = Fin_t - Fout_t - \Delta R_t,$$

where Fin_t is the capital inflows, $Fout_t$ is the capital outflows, and R_t is the foreign reserves.

The definition of the balance of payments tells us that equation (A11) always holds. Accordingly, we should analyze whether the private capital flows finance the current account deficit. We analyze the cointegration relationship by omitting the change in foreign reserves in equation (A11).

If we find the cointegration between the current account deficit and the capital flows in equation (A11), then we will consider which items in the financial account finance the current account deficit. Focusing on each of the international capital flows in equation (A11), we can rewrite equation (A11) as

(A12) $$CAD_t = DIB_t + PIB_t + OIB_t - \Delta R_t ,$$

where DIB_t is direct investment in the financial account, PIB_t is portfolio investment in the financial account, and OIB_t is other investment in the financial account. If variables in the sub-system including the current account deficit and some of the times in equation (A12) are cointegrated, then the items would support the current account deficit in the long run. Thus, we also test the cointegration relationship in the sub-system of the equation (A12).

References

Miyao, R., (2001) “Another Look at Origins of the Asian Crisis: Tests of External Borrowing Constraints,” presented at the international workshop *The Asian Crisis and After*, Economic and Social Research Institute, Cabinet Office.

Ahmed, S. and J. H. Rogers, (1995) “Government Budget Deficits and Trade Deficits: Are Present Value Constraints Sustained in Long-term Data?” *Journal of Monetary Economics*, 36, pp.351-374.

Bohn, H., (1995) “The Sustainability of Budget Deficits in a Stochastic Economy,” *Journal of Money, Credit and Banking*, 27, pp.257-271.

Husted, S., (1992) “The Emerging U.S. Current Account Deficit in the 1980s: A Cointegration Analysis”, *Review of Economics and Statistics*, 74, pp.159-166.

Kudo, T. and E. Ogawa, (2003) “The U.S. Current Account Deficit is supported by the

International Capital Inflows?" Hitotsubashi University, *Faculty of Commerce and Management, Working Papers*, No. 92.

Mann, C. L., (2002) "Perspectives on the U.S. Current Account Deficit and Sustainability," *Journal of Economic Perspectives*, 16, pp.131-152.

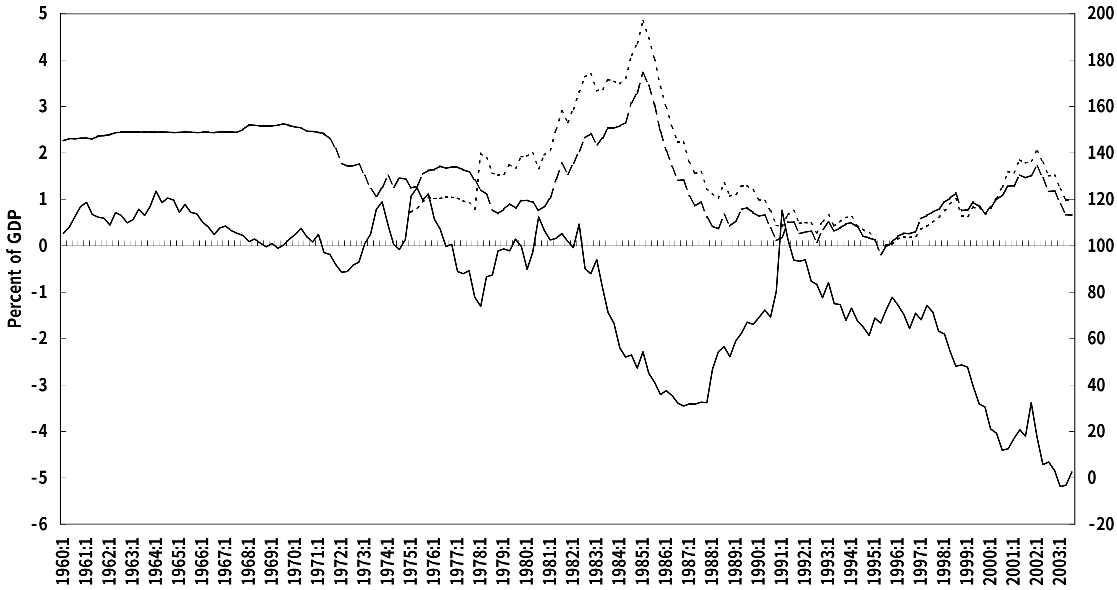
McKinnon, R. I., (2001) "The International Dollar Standard and the Sustainability of the U.S. Current Account Deficit," *Brookings Papers on Economic Activity*, 2001(1), pp.227-239.

Matsubayashi, Y., (2002) "Are U.S. Current Accounts Deficits Unsustainable?: Testing for the Private and Government Intertemporal Budget Constraints," mimeo.

Milesi-Ferretti, G. M. and A. Razin, (1996) *Current-Account Sustainability*, Princeton Studies in International Finance, 81.

Osterwald-Lenum, M., (1992) "A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics," *Oxford Bulletin of Economics and Statistics*, 54, pp.461-472.

Figure 1: Current Account and Effective Exchange Rates



Sources: Current account, Bureau of Economic Analysis. Effective exchange rates, International Financial Statistics, IMF.

Table 1: Current Account Sustainability from the view of Domestic Investment-Saving Balance

Table 1.1: Results of Unit-Root Tests (Level of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significance Level	Critical Value	Conclusion
System 1: Equation (1)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
PI	5	166	158	Yes	Yes	t(rho-1)/tao	-1.75	-3.41	Trend=0 under the UR	3.15	0.05	6.25	Series contains a unit root with drift
		166	159	Yes	No	t(rho-1)/mu	1.19	-2.86	Constant=0 under the UR	5.86	0.00	4.59	
		166	160			Constant=0	3.21	*	using normal distribution	*	0.00		
						Testing UR	1.19	*	using normal distribution	*	0.23		
GE	5	166	158	Yes	Yes	t(rho-1)/tao	-1.14	-3.41	Trend=0 under the UR	4.27	0.02	6.25	Series stationary around a non-zero mean
		166	159	Yes	No	t(rho-1)/mu	2.15	-2.86	Constant=0 under the UR	5.77	0.00	4.59	
		166	160			Constant=0	2.60	*	using normal distribution	*	0.01		
						Testing UR	2.15	*	using normal distribution	*	0.03		
PS	11	160	146	Yes	Yes	t(rho-1)/tao	-2.69	-3.41	Trend=0 under the UR	6.95	0.00	6.25	Series stationary around a linear trend
									Constant,Trend=0 under the UR	10.73	0.00	4.68	
		160	147			Trend=0	2.53	*	using normal distribution	*	0.01		
						Testing UR	-2.69	*	using normal distribution	*	0.01		
GS	11	160	146	Yes	Yes	t(rho-1)/tao	-3.98	-3.41					Series has no unit root
System 2: Equation (2)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
NI	9	162	150	Yes	Yes	t(rho-1)/tao	-2.62	-3.41	Trend=0 under the UR	3.43	0.03	6.25	Series contains a unit root with zero drift
		162	151	Yes	No	t(rho-1)/mu	-0.73	-2.86	Constant=0 under the UR	1.40	0.25	4.59	
		162	152	No	No	t(rho-1)	0.49	-1.95					
NS	3	168	162	Yes	Yes	t(rho-1)/tao	-2.43	-3.41	Trend=0 under the UR	3.13	0.05	6.25	Series contains a unit root with zero drift
		168	163	Yes	No	t(rho-1)/mu	-0.07	-2.86	Constant=0 under the UR	2.51	0.08	4.59	
		168	164	No	No	t(rho-1)	1.65	-1.95					
System 3: Equation (3)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
PIS	5	166	158	Yes	Yes	t(rho-1)/tao	-2.38	-3.41	Trend=0 under the UR	2.88	0.06	6.25	Series stationary around a zero mean
		166	159	Yes	No	t(rho-1)/mu	-2.35	-2.86	Constant=0 under the UR	2.77	0.07	4.59	
		166	160	No	No	t(rho-1)	-2.28	-1.95					
GIS	11	160	146	Yes	Yes	t(rho-1)/tao	-3.85	-3.41					Series has no unit root
System 4: Equation (4)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
NIS	10	161	148	Yes	Yes	t(rho-1)/tao	0.00	-3.41	Trend=0 under the UR	1.75	0.18	6.25	Series contains a unit root with zero drift
		161	149	Yes	No	t(rho-1)/mu	-0.12	-2.86	Constant=0 under the UR	0.38	0.68	4.59	
		161	150	No	No	t(rho-1)	-0.48	-1.95					
Standardized by GDP													
System 1: Equation (1)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
PI	3	168	162	Yes	Yes	t(rho-1)/tao	-3.79	-3.41					Series has no unit root
GE	0	170	165	Yes	Yes	t(rho-1)/tao	-1.38	-3.41	Trend=0 under the UR	3.95	0.02	6.25	Series contains a unit root with zero drift
		170	166	Yes	No	t(rho-1)/mu	-1.45	-2.86	Constant=0 under the UR	79.28	0.00	4.59	
		170	167			Constant=0	1.34	*	using normal distribution	*	0.18		
PS	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	3.01	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.77	-2.86	Constant=0 under the UR	1.58	0.21	4.59	
		170	168	No	No	t(rho-1)	-0.27	-1.95					
GS	2	169	164	Yes	Yes	t(rho-1)/tao	-2.73	-3.41	Trend=0 under the UR	3.77	0.03	6.25	Series stationary around a zero mean
		169	165	Yes	No	t(rho-1)/mu	-2.54	-2.86	Constant=0 under the UR	3.37	0.04	4.59	
		169	166	No	No	t(rho-1)	-2.47	-1.95					
System 2: Equation (2)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
NI	3	168	162	Yes	Yes	t(rho-1)/tao	-3.36	-3.41	Trend=0 under the UR	6.67	0.00	6.25	Series contains a unit root with zero drift
									Constant,Trend=0 under the UR	4.65	0.00	4.68	
		168	163			Trend=0	-1.38	*	using normal distribution	*	0.17		
NS	4	167	160	Yes	Yes	t(rho-1)/tao	-3.96	-3.41					Series has no unit root
System 3: Equation (3)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
PIS	2	169	164	Yes	Yes	t(rho-1)/tao	-3.46	-3.41					Series has no unit root
GIS	2	169	164	Yes	Yes	t(rho-1)/tao	-3.03	-3.41	Trend=0 under the UR	4.59	0.01	6.25	Series stationary around a non-zero mean
		169	165	Yes	No	t(rho-1)/mu	-2.98	-2.86					
System 4: Equation (4)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
NIS	5	166	158	Yes	Yes	t(rho-1)/tao	-2.69	-3.41	Trend=0 under the UR	4.15	0.02	6.25	Series stationary around a zero mean
		166	159	Yes	No	t(rho-1)/mu	-2.20	-2.86	Constant=0 under the UR	2.47	0.09	4.59	
		166	160	No	No	t(rho-1)	-1.96	-1.95					

Table 1.2: Results of Unit-Root Tests (Difference of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significanc e Level	Critical Value	Conclusion
System 1: Equation (1)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
PI	4	166	159	Yes	Yes	t(rho-1)/tao	-6.51	-3.41					Series has no unit root
GE	5	165	157	Yes	Yes	t(rho-1)/tao	-4.10	-3.41					Series has no unit root
PS	2	168	163	Yes	Yes	t(rho-1)/tao	-7.36	-3.41					Series has no unit root
GS	5	165	157	Yes	Yes	t(rho-1)/tao	-4.86	-3.41					Series has no unit root
System 2: Equation (2)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
NI	2	168	163	Yes	Yes	t(rho-1)/tao	-5.23	-3.41					Series has no unit root
NS	2	168	163	Yes	Yes	t(rho-1)/tao	-5.25	-3.41					Series has no unit root
System 3: Equation (3)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
PIS	4	166	159	Yes	Yes	t(rho-1)/mu	-5.57	-3.41					Series has no unit root
GIS	5	165	157	Yes	Yes	t(rho-1)/tao	-5.11	-3.41					Series has no unit root
System 4: Equation (4)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
NIS	9	161	149	Yes	Yes	t(rho-1)/tao	-5.72	-3.41					Series has no unit root
Standardized by GDP													
System 1: Equation (1)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
PI	0	169	164	Yes	Yes	t(rho-1)/tao	2.59	-3.41	Trend=0 under the UR	3.35	0.04	6.25	Series contains a unit root with zero drift
		169	165	Yes	No	t(rho-1)/mu	9.82	-2.86	Constant=0 under the UR	48.21	0.00	4.59	
		169	166			Constant=0	0.02	*	using normal distribution	*	0.98		
GE	0	169	164	Yes	Yes	t(rho-1)/tao	-3.47	-3.41					Series has no unit root
PS	0	169	164	Yes	Yes	t(rho-1)/tao	8.40	-3.41	Trend=0 under the UR	35.40	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	23.60	0.00	4.68	
		169	165			Trend=0	-0.04	*	using normal distribution	*	0.97		
GS	1	169	165	Yes	Yes	t(rho-1)/tao	-7.25	-3.41					Series has no unit root
System 2: Equation (2)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
NI	0	169	164	Yes	Yes	t(rho-1)/tao	-9.47	-3.41					Series has no unit root
NS	3	167	161	Yes	Yes	t(rho-1)/tao	-6.43	-3.41					Series has no unit root
System 3: Equation (3)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
PIS	0	169	164	Yes	Yes	t(rho-1)/tao	-7.06	-3.41					Series has no unit root
GIS	1	169	165	Yes	Yes	t(rho-1)/tao	-7.09	-3.41					Series has no unit root
System 4: Equation (4)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
NIS	10	160	147	Yes	Yes	t(rho-1)/tao	-6.58	-3.41					Series has no unit root

Table 1.3: Results of Cointegration Tests

System	Lags	Rank	Eigen Value	Trace	Trace95	Trace90	L-max	L-max95	L-max90	Cointegration Vectors	LR	p-Value
Eq.(2): RD,NI,NS	11	0	0.121	36.37	29.68	26.79	20.55	20.97	18.60	1.000, 0.210, -0.208		
		1	0.068	15.82	15.41	13.33	11.27	14.07	12.07	1.000, 0.443, -0.403		
		2	0.028	4.55	3.76	2.69	4.55	3.76	2.69	1.000, 0.019, -0.014		
Eq.(4): RD,NIS	11	0	0.072	12.12	15.41	13.33	12.07	14.07	12.07			
		1	0.000	0.05	3.76	2.69	0.05	3.76	2.69			

Notes:
1) Lags means the lag-length of the VARs. They are determined by AIC.
2) Trace means the statistic for Trace tests, and L-max means the statistic for maximum eigen-value test.
3) Trace95 and Trace90 mean the 95% and 90% critical values on trace tests. Similarly, L-max95 and L-max90 mean the critical values.
4) LR means the Likelihood ratio test for the hypothesis of linear restriction on the cointegration vectors.

Table 2: Current Account Sustainability from the view of International Trade

Table 2.1: Results of Unit-Root Tests (Level of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significance Level	Critical Value	Conclusion
System 1: Equation (5)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
IM	10	161	148	Yes	Yes	t(rho-1)/tao	0.38	-3.41	Trend=0 under the UR	4.99	0.01	6.25	Series stationary around a non-zero mean
		161	149	Yes	No	t(rho-1)/mu	2.67	-2.86	Constant=0 under the UR	5.56	0.00	4.59	
		161	150			Constant=0	1.96	*	using normal distribution	*	0.05		
						Testing UR	2.67	*	using normal distribution	*	0.01		
EX	10	161	148	Yes	Yes	t(rho-1)/tao	-2.14	-3.41	Trend=0 under the UR	2.40	0.09	6.25	Series contains a unit root with zero drift
		161	149	Yes	No	t(rho-1)/mu	-0.52	-2.86	Constant=0 under the UR	1.07	0.34	4.59	
		161	150	No	No	t(rho-1)	-0.04	-1.95					
System 2: Equation (6)													
MM	8	163	152	Yes	Yes	t(rho-1)/tao	0.90	-3.41	Trend=0 under the UR	8.96	0.00	6.25	Cannot reject unit root.
									Constant,Trend=0 under the UR	8.36	0.00	4.68	
		163	153			Trend=0	4.14	*	using normal distribution	*	0.00		
						Testing UR	0.90	*	using normal distribution	*	0.37		
EX	10	161	148	Yes	Yes	t(rho-1)/tao	-2.14	-3.41	Trend=0 under the UR	2.40	0.09	6.25	Series contains a unit root with zero drift
		161	149	Yes	No	t(rho-1)/mu	-0.52	-2.86	Constant=0 under the UR	1.07	0.34	4.59	
		161	150	No	No	t(rho-1)	-0.04	-1.95					
System 3: Equation (7)													
RD	4	167	160	Yes	Yes	t(rho-1)/tao	-0.90	-3.41	Trend=0 under the UR	1.58	0.21	6.25	Series contains a unit root with zero drift
		167	161	Yes	No	t(rho-1)/mu	-1.72	-2.86	Constant=0 under the UR	1.51	0.22	4.59	
		167	162	No	No	t(rho-1)	-1.07	-1.95					
TB	2	169	164	Yes	Yes	t(rho-1)/tao	0.39	-3.41	Trend=0 under the UR	2.63	0.08	6.25	Series contains a unit root with zero drift
		169	165	Yes	No	t(rho-1)/mu	1.95	-2.86	Constant=0 under the UR	3.44	0.03	4.59	
		169	166	No	No	t(rho-1)	2.59	-1.95					
System 4: Equation (8)													
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	9.13	-3.41	Trend=0 under the UR	53.41	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	41.43	0.00	4.68	
		170	166			Trend=0	-0.17	*	using normal distribution	*	0.87		
Standardized by GDP													
System 1: Equation (5)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
IM	1	170	166	Yes	Yes	t(rho-1)/tao	-3.33	-3.41	Trend=0 under the UR	5.58	0.00	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-0.56	-2.86	Constant=0 under the UR	1.99	0.14	4.59	
		170	168	No	No	t(rho-1)	1.61	-1.95					
EX	5	166	158	Yes	Yes	t(rho-1)/tao	-2.56	-3.41	Trend=0 under the UR	3.45	0.03	6.25	Series contains a unit root with zero drift
		166	159	Yes	No	t(rho-1)/mu	-1.48	-2.86	Constant=0 under the UR	1.56	0.21	4.59	
		166	160	No	No	t(rho-1)	0.53	-1.95					
System 2: Equation (6)													
MM	1	170	166	Yes	Yes	t(rho-1)/tao	-3.81	-3.41					Series has no unit root
EX	5	166	158	Yes	Yes	t(rho-1)/tao	-2.56	-3.41	Trend=0 under the UR	3.45	0.03	6.25	Series contains a unit root with zero drift
		166	159	Yes	No	t(rho-1)/mu	-1.48	-2.86	Constant=0 under the UR	1.56	0.21	4.59	
		166	160	No	No	t(rho-1)	0.53	-1.95					
System 3: Equation (7)													
RD	1	170	166	Yes	Yes	t(rho-1)/tao	-2.15	-3.41	Trend=0 under the UR	2.95	0.05	6.25	Series contains a unit root with zero drift
		170	167	Yes	No	t(rho-1)/mu	-1.05	-2.86	Constant=0 under the UR	0.75	0.47	4.59	
		170	168	No	No	t(rho-1)	-1.02	-1.95					
TB	0	170	165	Yes	Yes	t(rho-1)/tao	-5.63	-3.41					Series has no unit root
System 4: Equation (8)													
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	2.60	-3.41	Trend=0 under the UR	8.47	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	17.63	0.00	4.68	
		170	166			Trend=0	0.78	*	using normal distribution	*	0.44		

Table 2.2: Results of Unit-Root Tests (Difference of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significance Level	Critical Value	Conclusion
System 1: Equation (5)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
IM	4	166	159	Yes	Yes	t(rho-1)/tao	-7.46	-3.41					Series has no unit root
EX	0	169	164	Yes	Yes	t(rho-1)/tao	7.34	-3.41	Trend=0 under the UR	32.83	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	21.97	0.00	4.68	
		169	165			Trend=0	-0.80	*	using normal distribution	*	0.42		
System 2: Equation (6)													
MM	7	163	153	Yes	Yes	t(rho-1)/tao	-5.64	-3.41					Series has no unit root
EX	0	169	164	Yes	Yes	t(rho-1)/tao	7.34	-3.41	Trend=0 under the UR	32.83	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	21.97	0.00	4.68	
		169	165			Trend=0	-0.80	*	using normal distribution	*	0.42		
System 3: Equation (7)													
RD	2	168	163	Yes	Yes	t(rho-1)/tao	-10.68	-3.41					Series has no unit root
TB	1	169	165	Yes	Yes	t(rho-1)/tao	-6.91	-3.41					Series has no unit root
System 4: Equation (8)													
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	-8.67	-3.41					Series has no unit root
Standardized by GDP													
System 1: Equation (5)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
IM	0	169	164	Yes	Yes	t(rho-1)/tao	-1.46	-3.41	Trend=0 under the UR	1.06	0.35	6.25	Series contains a unit root with zero drift
		169	165	Yes	No	t(rho-1)/mu	12.03	-2.86	Constant=0 under the UR	72.46	0.00	4.59	
		169	166			Constant=0	-0.06	*	using normal distribution	*	0.95		
EX	5	165	157	Yes	Yes	t(rho-1)/tao	-4.64	-3.41					Series has no unit root
System 2: Equation (6)													
MM	0	169	164	Yes	Yes	t(rho-1)/tao	-2.50	-3.41	Trend=0 under the UR	3.57	0.03	6.25	Series contains a unit root with zero drift
		169	165	Yes	No	t(rho-1)/mu	8.99	-2.86	Constant=0 under the UR	41.88	0.00	4.59	
		169	166			Constant=0	-0.03	*	using normal distribution	*	0.98		
EX	5	165	157	Yes	Yes	t(rho-1)/tao	-4.64	-3.41					Series has no unit root
System 3: Equation (7)													
RD	0	169	164	Yes	Yes	t(rho-1)/tao	6.27	-3.41	Trend=0 under the UR	20.26	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	14.66	0.00	4.68	
		169	165			Trend=0	-0.10	*	using normal distribution	*	0.92		
TB	0	169	164	Yes	Yes	t(rho-1)/tao	10.64	-3.41	Trend=0 under the UR	56.58	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UR	38.00	0.00	4.68	
		169	165			Trend=0	0.02	*	using normal distribution	*	0.98		
System 4: Equation (8)													
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	0.90	-3.41	Trend=0 under the UR	0.44	0.65	6.25	Series stationary around a non-zero mean
		169	165	Yes	No	t(rho-1)/mu	-7.92	-2.86					

Table 2.3: Results of Cointegration Tests

System	Lags	Rank	Eigen Value	Trace	Trace95	Trace90	L-max	L-max95	L-max90	Cointegration Vectors	LR	p-Value
Eq.(6): MM,EX	10	0	0.221	41.81	15.41	13.33	40.41	14.07	12.07	1.000, -1.564	38.11	0.00
		1	0.009	1.40	3.76	2.69	1.40	3.76	2.69			
Eq.(7): RD,TB	3	0	0.048	10.80	15.41	13.33	8.33	14.07	12.07			
		1	0.015	2.47	3.76	2.69	2.47	3.76	2.69			
Standardized by GDP												
Eq.(5): RD,IM,EX	2	0	0.051	11.27	29.68	26.79	8.97	20.97	18.60			
		1	0.013	2.30	15.41	13.33	2.30	14.07	12.07			
		2	0.000	0.00	3.76	2.69	0.00	3.76	2.69			

Notes:
1) Lags means the lag-length of the VARs. They are determined by AIC.
2) Trace means the statistic for Trace tests, and L-max means the statistic for maximum eigen-value test.
3) Trace95 and Trace90 mean the 95% and 90% critical values on trace tests. Similarly, L-max95 and L-max90 mean the critical values.
4) LR means the Likelihood ratio test for the hypothesis of linear restriction on the cointegration vectors.

Table 3: Financing Current Account Deficits from the View of International Capital Flows

Table 3.1: Results of Unit-Root Tests (Level of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significance Level	Critical Value	Conclusion
System 1: Equation (A11)													
RES	4	167	160	Yes	Yes	t(rho-1)/tao	-6.45	-3.41					Series has no unit root
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	9.13	-3.41	Trend=0 under the UR	53.41	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	41.43	0.00	4.68	
		170	166			Trend=0	-0.17	*	using normal distribution	*	0.87		
FB	12	159	144	Yes	Yes	t(rho-1)/tao	1.83	-3.41	Trend=0 under the UR	4.69	0.01	6.25	Series contains a unit root with zero drift
		159	145	Yes	No	t(rho-1)/mu	3.07	-2.86	Constant=0 under the UR	6.03	0.00	4.59	
		159	146			Constant=0	1.59	*	using normal distribution	*	0.11		
System 2: Equation (A12)													
RES	4	167	160	Yes	Yes	t(rho-1)/tao	-6.45	-3.41					Series has no unit root
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	9.13	-3.41	Trend=0 under the UR	53.41	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	41.43	0.00	4.68	
		170	166			Trend=0	-0.17	*	using normal distribution	*	0.87		
DIB	11	160	146	Yes	Yes	t(rho-1)/tao	-6.17	-3.41					Series has no unit root
PIB	12	159	144	Yes	Yes	t(rho-1)/tao	-0.51	-3.41	Trend=0 under the UR	1.62	0.20	6.25	Series contains a unit root with zero drift
		159	145	Yes	No	t(rho-1)/mu	0.56	-2.86	Constant=0 under the UR	0.82	0.44	4.59	
		159	146	No	No	t(rho-1)	0.97	-1.95					
OIB	2	169	164	Yes	Yes	t(rho-1)/tao	-5.10	-3.41					Series has no unit root
Standardized by GDP													
System 1: Equation (A11)													
RES	4	167	160	Yes	Yes	t(rho-1)/tao	-5.38	-3.41					Series has no unit root
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	2.60	-3.41	Trend=0 under the UR	8.47	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	17.63	0.00	4.68	
		170	166			Trend=0	0.78	*	using normal distribution	*	0.44		
FB	2	169	164	Yes	Yes	t(rho-1)/tao	-3.07	-3.41	Trend=0 under the UR	5.11	0.01	6.25	Series contains a unit root with zero drift
		169	165	Yes	No	t(rho-1)/mu	-1.37	-2.86	Constant=0 under the UR	1.27	0.28	4.59	
		169	166	No	No	t(rho-1)	-0.84	-1.95					
System 2: Equation (A12)													
RES	4	167	160	Yes	Yes	t(rho-1)/tao	-5.38	-3.41					Series has no unit root
CAD	0	170	165	Yes	Yes	t(rho-1)/tao	2.60	-3.41	Trend=0 under the UR	8.47	0.00	6.25	Series contains a unit root with drift
									Constant,Trend=0 under the UI	17.63	0.00	4.68	
		170	166			Trend=0	0.78	*	using normal distribution	*	0.44		
DIB	11	160	146	Yes	Yes	t(rho-1)/tao	-4.39	-3.41					Series has no unit root
PIB	12	159	144	Yes	Yes	t(rho-1)/tao	-1.71	-3.41	Trend=0 under the UR	2.13	0.12	6.25	Series contains a unit root with zero drift
		159	145	Yes	No	t(rho-1)/mu	-0.52	-2.86	Constant=0 under the UR	0.73	0.48	4.59	
		159	146	No	No	t(rho-1)	0.11	-1.95					
OIB	2	169	164	Yes	Yes	t(rho-1)/tao	-4.63	-3.41					Series has no unit root

Table 3.2: Results of Unit-Root Tests (Difference of the Variables)

Variable	lags	No. of Obs.	D.F.	Drift	Trend	Test Type	t-Value	Critical Value	Test Type	F-Value	Significance Level	Critical Value	Conclusion
System 1: Equation (A11)													
RES	9	161	149	Yes	Yes	t(rho-1)/tao	-7.38	-3.41					Series has no unit root
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	-8.67	-3.41					Series has no unit root
FB	12	158	143	Yes	Yes	t(rho-1)/tao	-2.46	-3.41	Trend=0 under the UR	3.47	0.03	6.25	Series contains a unit root with zero drift
		158	144	Yes	No	t(rho-1)/mu	-1.74	-2.86	Constant=0 under the UR	1.75	0.18	4.59	
		158	145	No	No	t(rho-1)	-1.40	-1.95					
System 2: Equation (A12)													
RES	9	161	149	Yes	Yes	t(rho-1)/tao	-7.38	-3.41					Series has no unit root
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	-8.67	-3.41					Series has no unit root
DIB	12	158	143	Yes	Yes	t(rho-1)/tao	-3.85	-3.41					Series has no unit root
PIB	12	158	143	Yes	Yes	t(rho-1)/tao	-4.82	-3.41					Series has no unit root
OIB	7	163	153	Yes	Yes	t(rho-1)/tao	-7.32	-3.41					Series has no unit root
Standardized by GDP													
System 1: Equation (A11)													
RES	7	163	153	Yes	Yes	t(rho-1)/tao	-6.80	-3.41					Series has no unit root
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	0.90	-3.41	Trend=0 under the UR	0.44	0.65	6.25	Series stationary around a non-zero mean
		169	165	Yes	No	t(rho-1)/mu	-7.92	-2.86					
FB	2	168	163	Yes	Yes	t(rho-1)/tao	-11.25	-3.41					Series has no unit root
System 2: Equation (A12)													
RES	7	163	153	Yes	Yes	t(rho-1)/tao	-6.80	-3.41					Series has no unit root
CAD	0	169	164	Yes	Yes	t(rho-1)/tao	0.90	-3.41	Trend=0 under the UR	0.44	0.65	6.25	Series stationary around a non-zero mean
		169	165	Yes	No	t(rho-1)/mu	-7.92	-2.86					
DIB	11	159	145	Yes	Yes	t(rho-1)/tao	-3.23	-3.41	Trend=0 under the UR	5.63	0.00	6.25	Series stationary around a non-zero mean
		159	146	Yes	No	t(rho-1)/mu	-3.30	-2.86					
PIB	11	159	145	Yes	Yes	t(rho-1)/tao	-4.26	-3.41					Series has no unit root
OIB	2	168	163	Yes	Yes	t(rho-1)/tao	-12.30	-3.41					Series has no unit root

Table 3.3: Results of Cointegration Tests

System	Lags	Rank	Eigen Value	Trace	Trace95	Trace90	L-max	L-max95	L-max90	Cointegration Vectors
Eq.(A11): CAD,FB	4	0	0.202	43.20	28.00	15.41	38.00	14.07	12.07	1.000, -0.998
		1	0.031	5.20	6.41	3.76	5.20	3.76	2.69	1.000, 1.455
Eq.(A12): CAD,PIB	4	0	0.142	33.72	28.00	15.41	25.81	14.07	12.07	1.000, -1.694
		1	0.046	7.91	6.41	3.76	7.91	3.76	2.69	1.000, -0.079
Standardized by GDP										
Eq.(A11): CAD,FB	4	0	0.134	24.43	28.00	15.41	24.10	14.07	12.07	1.000, -1.032
		1	0.002	0.33	6.41	3.76	0.33	3.76	2.69	
Eq.(A12): CAD,PIB	4	0	0.133	23.95	28.00	15.41	23.95	14.07	12.07	1.000, -1.972
		1	0.000	0.00	6.41	3.76	0.00	3.76	2.69	

Notes:
1) Lags means the lag-length of the VARs. They are determined by AIC.
2) Trace means the statistic for Trace tests, and L-max means the statistic for maximum eigen-value test.
3) Trace95 and Trace90 mean the 95% and 90% critical values on trace tests. Similarly, L-max95 and L-max90 mean the critical values.

Table 4: Augmented Dickey-Fuller tests for unit-root

	Real effective exchange rate	Current account	Trade balance	Net income receipt	Saving-investment balance for private sector	Saving-investment balance for public sector
Level	-1.485	-0.962	-1.293	-0.909	-2.322	-2.612 *
p-value	0.614	0.854	0.721	0.867	0.165	0.083
Number of lags	3	2	2	5	4	9
Difference	-5.082 ***	-5.388 ***	-4.775 ***	-5.287 ***	-5.617 ***	-2.202
p-value	0.000	0.000	0.000	0.000	0.000	0.202
Number of lags	2	2	2	4	2	8

1) Sample period: 1975Q1-2003Q3
2) All variables are standardized by GDP.
3) Testing models are with constant terms but without trend terms.
4) Number of lags are determined by Akaike's Information Criteria (AIC).
5) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Table 5: Johansen's trace tests for cointegration

	Current account and Exchange rate		
Number of lags	Optimal(0)	1	4
Log likelihood	178.022	159.844	168.388
AIC	-170.022	-147.844	-144.388
Eigen value 1	0.095	0.121	0.132
Eigen value 2	0.042	0.048	0.073
H0: # of coint.=0	16.033	17.812 *	18.698 **
p-value	0.101	0.056	0.042
H0: # of coint.=<1		4.969 **	6.520 ***
p-value		0.023	0.009

	Real effective exchange rate, Trade balance, and Net income receipt			Real effective exchange rate, Saving-investment balance for private sector, Saving-investment balance for public sector		
Number of lags	Optimal(0)	1	4	Optimal(0)	1	4
Log likelihood	253.879	259.564	276.088	46.726	53.288	70.105
AIC	-238.879	-235.564	-225.088	-31.726	-29.288	-19.105
Eigen value 1	0.314	0.202	0.223	0.255	0.239	0.183
Eigen value 2	0.127	0.135	0.121	0.136	0.138	0.067
Eigen value 3	0.032	0.042	0.034	0.039	0.050	0.053
H0: # of coint.=0	55.012 ***	40.607 ***	36.991 **	48.443 ***	46.354 ***	28.931 **
p-value	0.000	0.010	0.025	0.001	0.002	0.170
H0: # of coint.=<1	17.003 *	18.439 **	14.549	18.780 **	19.531 **	10.944
p-value	0.074	0.046	0.154	0.040	0.031	0.389
H0: # of coint.=<2	3.285 *	4.224 **	3.096 *	4.028 **	4.984 **	4.809 **
p-value	0.066	0.037	0.074	0.042	0.023	0.026

1) Sample period: 1975Q1-2003Q3
2) All variables are standardized by GDP.
3) Testing models are with constant terms and without trend terms.
4) Number of lags are determined by Akaike's Information Criteria (AIC).
5) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Table 6: Cointegrating vectors

	Real effective exchange rate	Trade balance	Income receipt
1	1.000	0.118	1.527

Table 7: VARs contain the Exchange rate and the Current account (Model 1)

(Levels of variables)

Regressors	Dependent	Exchange rate	Current account	Exchange rate	Current account	Exchange rate	Current account
	# of lags	Optimal(1)		1		4	
	Sample	1975:2-2003:3		1975:2-2003:3		1976:1-2003:3	
	# of obs.	114		114		111	
Constant		0.115	1.115	0.115	1.115	0.146	0.926
(s.e.)		0.100	1.028	0.100	1.028	0.105	1.082
Exchange rate(-1)		0.978 ***	-0.249	0.978 ***	-0.249	1.109	-1.407
(s.e.)		0.021	0.212	0.021	0.212	0.097 ***	1.005
Exchange rate(-2)						-0.152	1.271
(s.e.)						0.144	1.481
Exchange rate(-3)						0.121	0.574
(s.e.)						0.143	1.473
Exchange rate(-4)						-0.108	-0.649
(s.e.)						0.097	1.005
Current account(-1)		0.005 **	0.974 ***	0.005 **	0.974 ***	0.001	0.964 ***
(s.e.)		0.002	0.022	0.002	0.022	0.009	0.098
Current account(-2)						0.015	-0.037
(s.e.)						0.013	0.135
Current account(-3)						-0.028 **	0.224
(s.e.)						0.013	0.135
Current account(-4)						0.015	-0.181 *
(s.e.)						0.010	0.099
Adjusted R-square		0.952	0.945	0.952	0.945	0.952	0.939
Log-likelihood		173.846		173.846		173.136	
AIC		-167.846		-167.846		-155.136	

(Differences of variables)

Regressors	Dependent	Exchange rate	Current account	Exchange rate	Current account	Exchange rate	Current account
	# of lags	Optimal(1)		1		4	
	Sample	1975:3-2003:3		1975:3-2003:3		1976:2-2003:3	
	# of obs.	113		113		110	
Constant		0.000	-0.055	0.000	-0.055	0.000	-0.038
(s.e.)		0.003	0.035	0.003	0.035	0.004	0.037
Exchange rate(-1)		0.135	-1.220	0.135	-1.220	0.144	-1.153
(s.e.)		0.095	0.956	0.095	0.956	0.099	0.992
Exchange rate(-2)						-0.011	-0.383
(s.e.)						0.100	1.001
Exchange rate(-3)						0.109	0.585
(s.e.)						0.099	0.987
Exchange rate(-4)						0.077	-1.034
(s.e.)						0.099	0.988
Current account(-1)		0.002	-0.031	0.002	-0.031	0.001	-0.030
(s.e.)		0.009	0.095	0.009	0.095	0.010	0.098
Current account(-2)						0.017 *	-0.059
(s.e.)						0.010	0.096
Current account(-3)						-0.011	0.169 *
(s.e.)						0.010	0.098
Current account(-4)						0.005	0.126
(s.e.)						0.010	0.099
Adjusted R-square		0.000	-0.003	0.000	-0.003	0.008	0.005
Log-likelihood		169.088		169.088		170.161	
AIC		-163.088		-163.088		-152.161	

1) Optimal number of lags are determined by Akaike's Information Criteria (AIC).
2) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Table 8: External Balance VARs (Model 2)

(Levels of variables)

Dependent	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt
# of lags		Optimal(1)			1			4	
Sample		1975:2-2003:3			1975:2-2003:3			1976:1-2003:3	
Regressors # of obs.		114			114			111	
Constant	0.425 ***	2.484 **	-0.968 *	0.425 ***	2.484 **	-0.968 *	0.611 ***	4.735 ***	0.695
(s.e.)	0.139	1.169	0.559	0.139	1.169	0.559	0.183	1.444	0.686
Exchange rate(-1)	0.904 ***	-0.583 **	0.239 *	0.904 ***	-0.583 **	0.239 *	1.011 ***	-0.805	-0.677 *
(s.e.)	0.031	0.259	0.124	0.031	0.259	0.124	0.100	0.789	0.375
Exchange rate(-2)							-0.119	-0.349	0.607
(s.e.)							0.142	1.124	0.534
Exchange rate(-3)							0.087	0.582	0.009
(s.e.)							0.142	1.122	0.533
Exchange rate(-4)							-0.117	-0.539	-0.082
(s.e.)							0.096	0.759	0.360
Trade balance(-1)	-0.006	0.910 ***	0.049 ***	-0.006	0.910 ***	0.049 ***	-0.021 *	0.971 ***	-0.020
(s.e.)	0.004	0.035	0.017	0.004	0.035	0.017	0.012	0.097	0.046
Trade balance(-2)							0.026	-0.090	0.049
(s.e.)							0.017	0.133	0.063
Trade balance(-3)							-0.022	0.227 *	0.002
(s.e.)							0.017	0.132	0.063
Trade balance(-4)							0.004	-0.288 ***	-0.023
(s.e.)							0.012	0.094	0.045
Income receipt(-1)	0.052 ***	0.263 ***	0.793 ***	0.052 ***	0.263 ***	0.793 ***	0.043	-0.008	0.473 ***
(s.e.)	0.015	0.129	0.062	0.015	0.129	0.062	0.026	0.208	0.099
Income receipt(-2)							0.005	0.136	0.248 **
(s.e.)							0.029	0.233	0.111
Income receipt(-3)							-0.011	0.528 **	0.044
(s.e.)							0.029	0.233	0.111
Income receipt(-4)							0.035	-0.077	0.244 **
(s.e.)							0.028	0.221	0.105
Adjusted R-square	0.955	0.944	0.862	0.955	0.944	0.862	0.955	0.944	0.878
Log-likelihood		270.234			270.234			289.258	
SBIC		-235.225			-235.225			-175.999	

(Differences of variables)

Dependent	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt
# of lags		Optimal(1)			1			4	
Sample		1975:3-2003:3			1975:3-2003:3			1976:2-2003:3	
Regressors # of obs.		113			113			110	
Constant	0.000	-0.046	-0.008	0.000	-0.046	-0.008	0.001	-0.018	-0.008
(s.e.)	0.003	0.029	0.013	0.003	0.029	0.013	0.004	0.029	0.013
Exchange rate(-1)	0.137	0.014	-0.664	0.137	0.014	-0.664	0.121	0.045	-0.539
(s.e.)	0.094	0.775	0.347	0.094	0.775	0.347	0.100	0.783	0.360
Exchange rate(-2)							0.002	-0.590	0.003
(s.e.)							0.102	0.796	0.366
Exchange rate(-3)							0.088	0.316	0.064
(s.e.)							0.101	0.793	0.364
Exchange rate(-4)							0.101	-0.844	-0.166
(s.e.)							0.101	0.786	0.361
Trade balance(-1)	-0.010	0.060	-0.007	-0.010	0.060	-0.007	-0.010	0.077	-0.026
(s.e.)	0.012	0.096	0.043	0.012	0.096	0.043	0.013	0.099	0.046
Trade balance(-2)							0.018	-0.029	0.039
(s.e.)							0.012	0.097	0.045
Trade balance(-3)							-0.008	0.216 **	0.030
(s.e.)							0.012	0.096	0.044
Trade balance(-4)							-0.003	0.065	0.025
(s.e.)							0.013	0.098	0.045
Income receipt(-1)	0.030	0.010	-0.391 ***	0.030	0.010	-0.391 ***	0.052 *	0.023	-0.472 ***
(s.e.)	0.024	0.196	0.088	0.024	0.196	0.088	0.028	0.221	0.102
Income receipt(-2)							0.047	0.009	-0.214 **
(s.e.)							0.031	0.243	0.112
Income receipt(-3)							0.027	0.439 *	-0.156
(s.e.)							0.031	0.241	0.111
Income receipt(-4)							0.038	0.288	0.134
(s.e.)							0.028	0.221	0.102
Adjusted R-square	0.014	-0.024	0.149	0.014	-0.024	0.149	-0.006	0.008	0.171
Log-likelihood		263.438			263.438			274.021	
SBIC		-228.482			-228.482			-235.021	

(Vector error correction model)

Dependent	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt	Exchange rate	Trade balance	Income receipt
# of lags		Optimal(1)			1			4	
Sample		1975:3-2003:3			1975:3-2003:3			1976:2-2003:3	
Regressors # of obs.		113			113			110	
Constant	0.012	-0.119	0.095 ***	0.012	-0.119	0.095 ***	0.008	-0.082	0.105 ***
(s.e.)	0.009	0.073	0.031	0.009	0.073	0.031	0.009	0.074	0.032
Error-correction	-0.011	0.067	0.093 ***	-0.011	0.067	0.093 ***	-0.007	0.058	-0.103 ***
(s.e.)	0.007	0.061	0.026	0.007	0.061	0.026	0.008	0.062	0.026
Exchange rate(-1)	0.124	0.095	-0.776 **	0.124	0.095	-0.776 **	0.118	0.077	-0.596 *
(s.e.)	0.094	0.778	0.331	0.094	0.778	0.331	0.100	0.784	0.337
Exchange rate(-2)							-0.008	-0.514	-0.133
(s.e.)							0.102	0.800	0.344
Exchange rate(-3)							0.079	0.384	-0.058
(s.e.)							0.102	0.796	0.342
Exchange rate(-4)							0.093	-0.776	-0.285
(s.e.)							0.101	0.790	0.339
Trade balance(-1)	-0.008	0.052	0.004	-0.008	0.052	0.004	-0.010	0.072	-0.017
(s.e.)	0.012	0.096	0.041	0.012	0.096	0.041	0.013	0.100	0.043
Trade balance(-2)							0.018	-0.027	0.037
(s.e.)							0.012	0.097	0.042
Trade balance(-3)							-0.008	0.212 **	0.038
(s.e.)							0.012	0.096	0.041
Trade balance(-4)							-0.002	0.060	0.033
(s.e.)							0.013	0.098	0.042
Income receipt(-1)	0.028	0.025	-0.412 ***	0.028	0.025	-0.412 ***	0.047	0.058	-0.534 ***
(s.e.)	0.024	0.197	0.084	0.024	0.197	0.084	0.029	0.225	0.096
Income receipt(-2)							0.042	0.051	-0.289 ***
(s.e.)							0.032	0.247	0.106
Income receipt(-3)							0.024	0.468 *	-0.209 **
(s.e.)							0.031	0.243	0.104
Income receipt(-4)							0.034	0.324	0.069
(s.e.)							0.029	0.225	0.097
Adjusted R-square	0.060	-0.022	0.233	0.060	-0.022	0.233	-0.008	0.007	0.277
Log-likelihood		271.254			271.254			282.623	
SBIC		-227.559			-227.559			-160.842	

1) Optimal number of lags are determined by Schwartz Bayesian Information Criterion (SBIC).
2) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Table 9: Domestic Saving-investment balance VARs (Model 3)

(Levels of variables)

Dependent	Exchange rate	Private sector	Public sector	Exchange rate	Private sector	Public sector	Exchange rate	Private sector	Public sector
# of lags		Optimal(1)			1			4	
Sample		1975:3-2003:3			1975:3-2003:3			1976:2-2003:3	
Regressors # of obs.		113			113			110	
Constant	0.119	-2.478	4.009 **	0.119	-2.478	4.009 **	0.061	-1.914	2.613
(s.e.)	0.097	2.281	1.857	0.097	2.281	1.857	0.112	2.200	1.604
Exchange rate(-1)	0.983 ***	0.525	-0.885 **	0.983 ***	0.525	-0.885 **	0.946 ***	-0.636	-2.096
(s.e.)	0.020	0.474	0.386	0.020	0.474	0.386	0.102	1.994	1.454
Exchange rate(-2)							-0.063	2.922	1.249
(s.e.)							0.142	2.791	2.035
Exchange rate(-3)							0.128	-1.518	-0.309
(s.e.)							0.145	2.837	2.068
Exchange rate(-4)							-0.015	-0.393	0.589
(s.e.)							0.104	2.047	1.492
Private sector(-1)	0.010 ***	0.932 ***	-0.027	0.010 ***	0.932 ***	-0.027	0.011 *	1.012 ***	-0.012
(s.e.)	0.003	0.062	0.050	0.003	0.062	0.050	0.007	0.128	0.093
Private sector(-2)							0.003	0.009	-0.128
(s.e.)							0.009	0.179	0.131
Private sector(-3)							0.001	-0.202	0.267 **
(s.e.)							0.009	0.175	0.128
Private sector(-4)							-0.005	0.053	-0.102
(s.e.)							0.006	0.127	0.093
Public sector(-1)	0.014 ***	0.008	0.907 ***	0.014 ***	0.008	0.907 ***	0.019 **	-0.161	0.932 ***
(s.e.)	0.003	0.072	0.058	0.003	0.072	0.058	0.009	0.172	0.125
Public sector(-2)							-0.001	0.000	0.248
(s.e.)							0.012	0.227	0.165
Public sector(-3)							0.003	0.122	0.029
(s.e.)							0.010	0.200	0.146
Public sector(-4)							-0.007	-0.021	-0.237 **
(s.e.)							0.008	0.154	0.112
Adjusted R-square	0.958	0.887	0.903	0.958	0.887	0.903	0.955	0.905	0.940
Log-likelihood		28.362			28.362			68.771	
SBIC		6.647			6.647			44.488	

(Differences of variables)

Dependent	Exchange rate	Private sector	Public sector	Exchange rate	Private sector	Public sector	Exchange rate	Private sector	Public sector
# of lags		Optimal(1)			1			4	
Sample		1975:3-2003:3			1975:3-2003:3			1976:2-2003:3	
Regressors # of obs.		113			113			110	
Constant	0.001	-0.061	0.015	0.001	-0.061	0.015	0.001	-0.029	-0.018
(s.e.)	0.003	0.070	0.056	0.003	0.070	0.056	0.004	0.068	0.050
Exchange rate(-1)	0.130	-1.551	-1.454	0.130	-1.551	-1.454	0.052	-1.219	-2.490 *
(s.e.)	0.094	1.924	1.543	0.094	1.924	1.543	0.101	1.935	1.413
Exchange rate(-2)							0.002	1.666	-1.107
(s.e.)							0.103	1.974	1.442
Exchange rate(-3)							0.126	0.005	-1.351
(s.e.)							0.102	1.956	1.428
Exchange rate(-4)							0.139	-0.483	0.571
(s.e.)							0.102	1.947	1.422
Private sector(-1)	0.010	0.053	-0.037	0.010	0.053	-0.037	0.009	0.045	-0.029
(s.e.)	0.006	0.128	0.103	0.006	0.128	0.103	0.007	0.132	0.096
Private sector(-2)							0.011	0.098	-0.157 *
(s.e.)							0.007	0.128	0.093
Private sector(-3)							0.012 *	-0.092	0.129
(s.e.)							0.007	0.132	0.096
Private sector(-4)							-0.001	0.070	0.063
(s.e.)							0.007	0.129	0.094
Public sector(-1)	0.013 *	0.043	-0.142	0.013 *	0.043	-0.142	0.018 *	-0.233	-0.033
(s.e.)	0.008	0.155	0.125	0.008	0.155	0.125	0.010	0.183	0.134
Public sector(-2)							0.013	-0.157	0.226 *
(s.e.)							0.009	0.176	0.129
Public sector(-3)							0.014	0.037	0.277 **
(s.e.)							0.009	0.166	0.121
Public sector(-4)							0.001	0.231	0.044
(s.e.)							0.008	0.162	0.118
Adjusted R-square	0.019	-0.020	-0.003	0.019	-0.020	-0.003	0.016	-0.007	0.123
Log-likelihood		28.000			28.000			59.513	
SBIC		6.956			6.956			53.570	

1) Optimal number of lags are determined by Schwartz Bayesian Information Criterion (SBIC).
2) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Figure 2: Simulated Current Account Based on Model 1
(Case 1: 10% exchange rate depreciation in 2004:2)

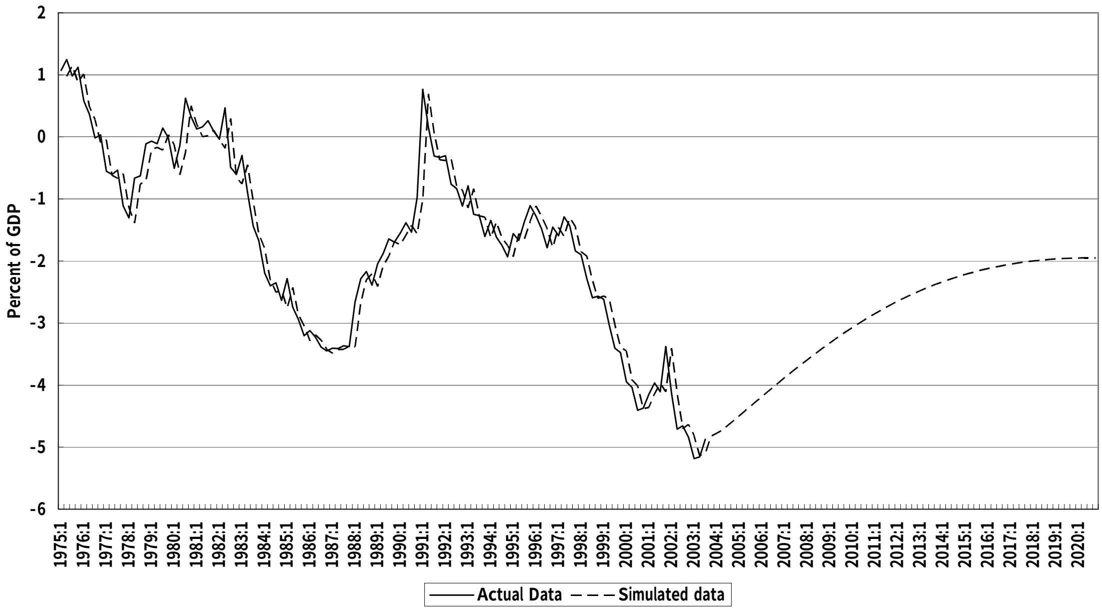


Figure 3: Simulated Current Account Based on Model 2
(Case 1: 10% exchange rate depreciation in 2004:2)

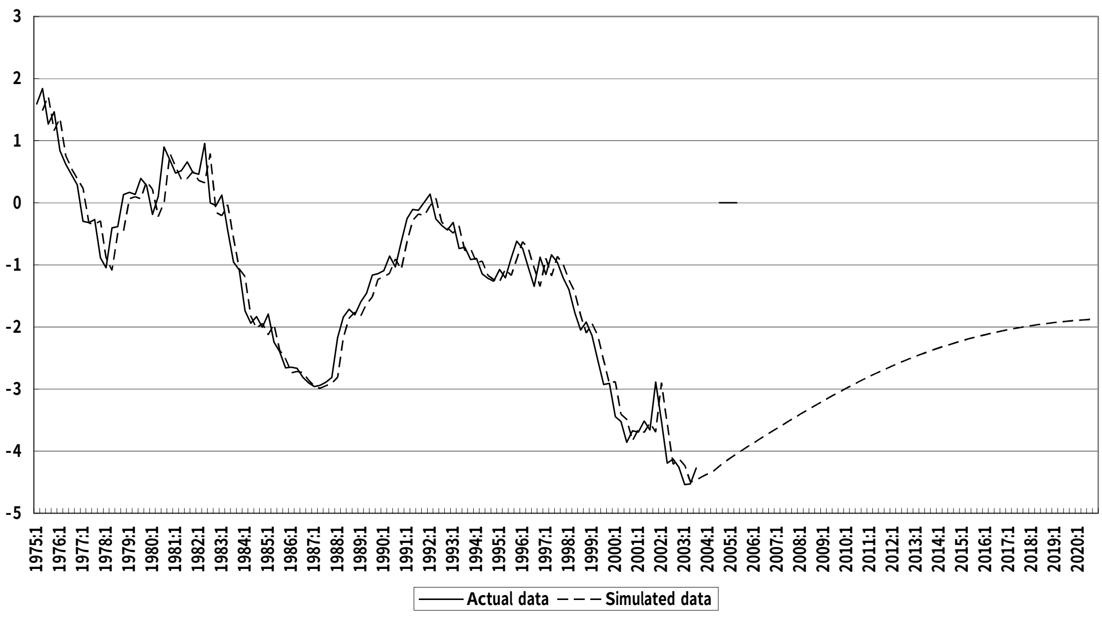


Figure 4: Simulated Current Account Based on Model 3
(Case 1: 10% exchange rate depreciation in 2004:2)

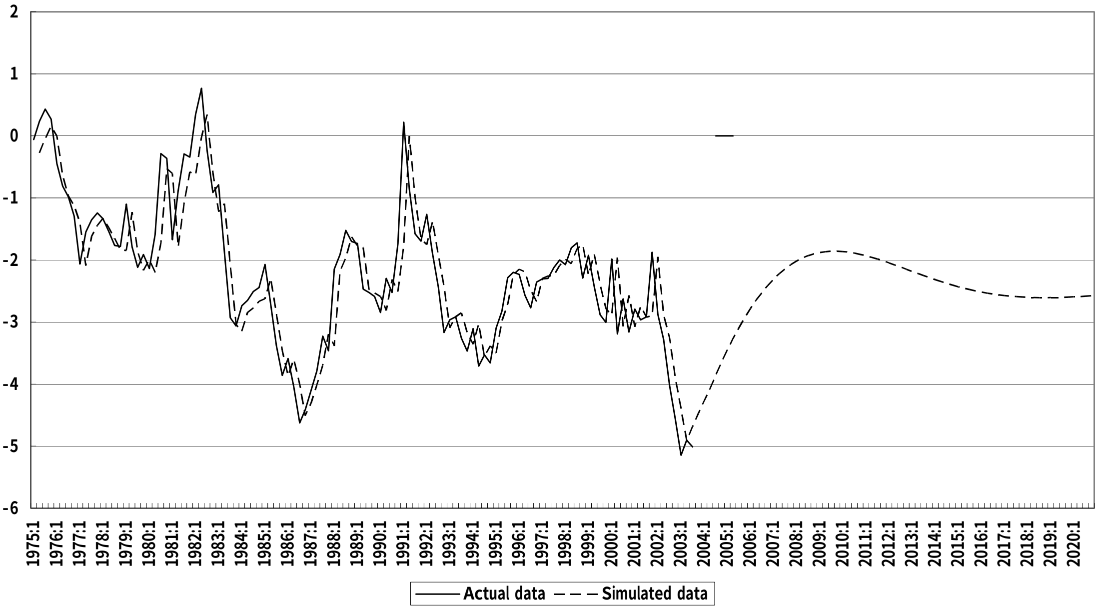


Figure 5: Simulated Current Account Based on Model 1
(Case 2: 30% exchange rate depreciation in 2004:2)

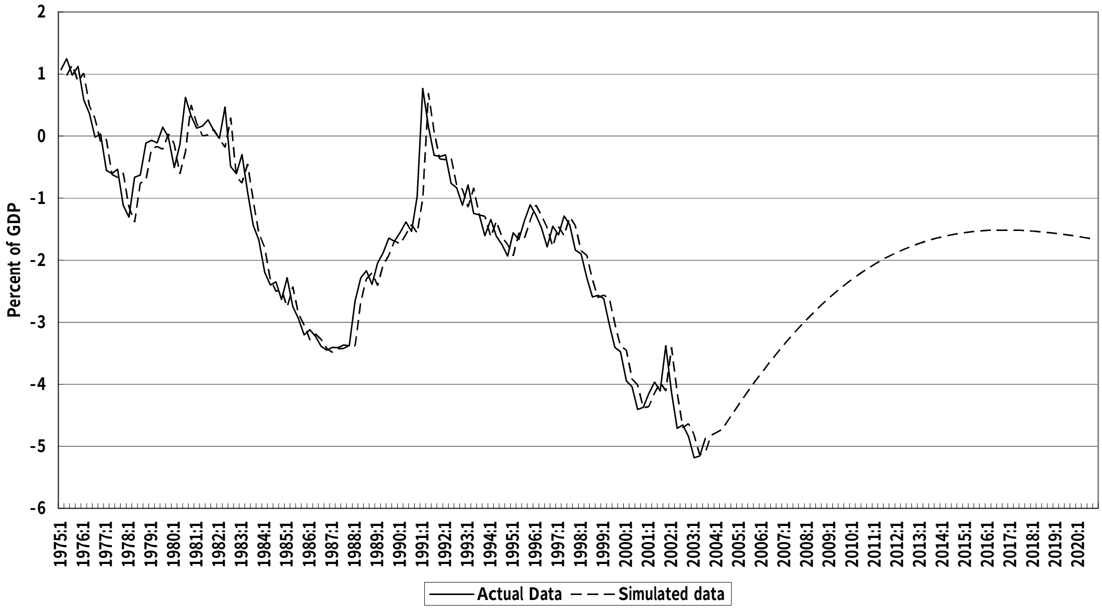


Figure 6: Simulated Current Account Based on Model 2
(Case 2: 30% exchange rate depreciation in 2004:2)

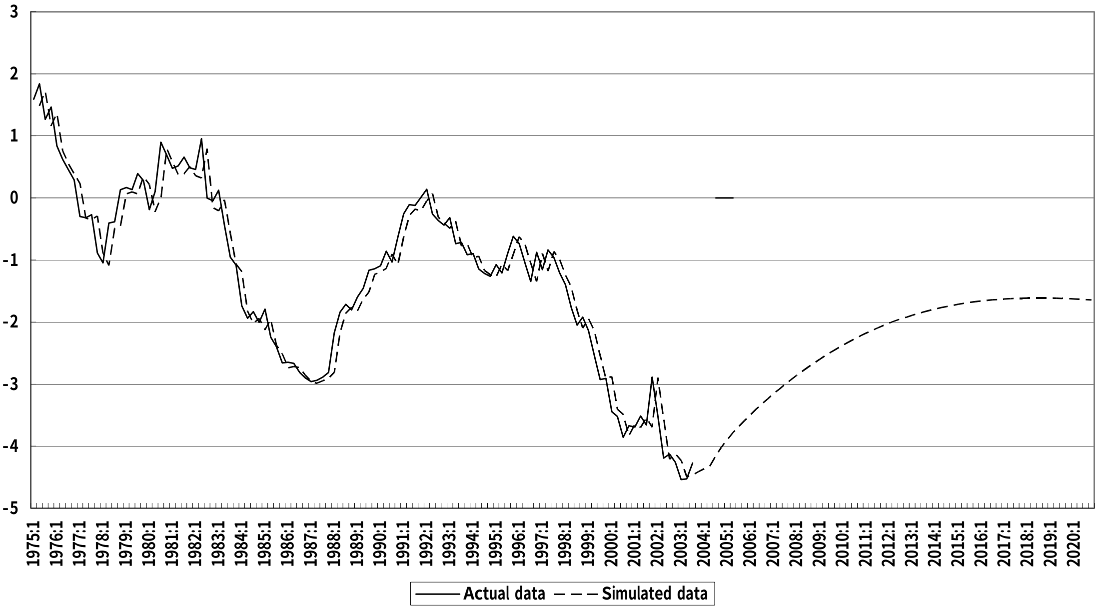


Figure 7: Simulated Current Account Based on Model 3
(Case 2: 30% exchange rate depreciation in 2004:2)

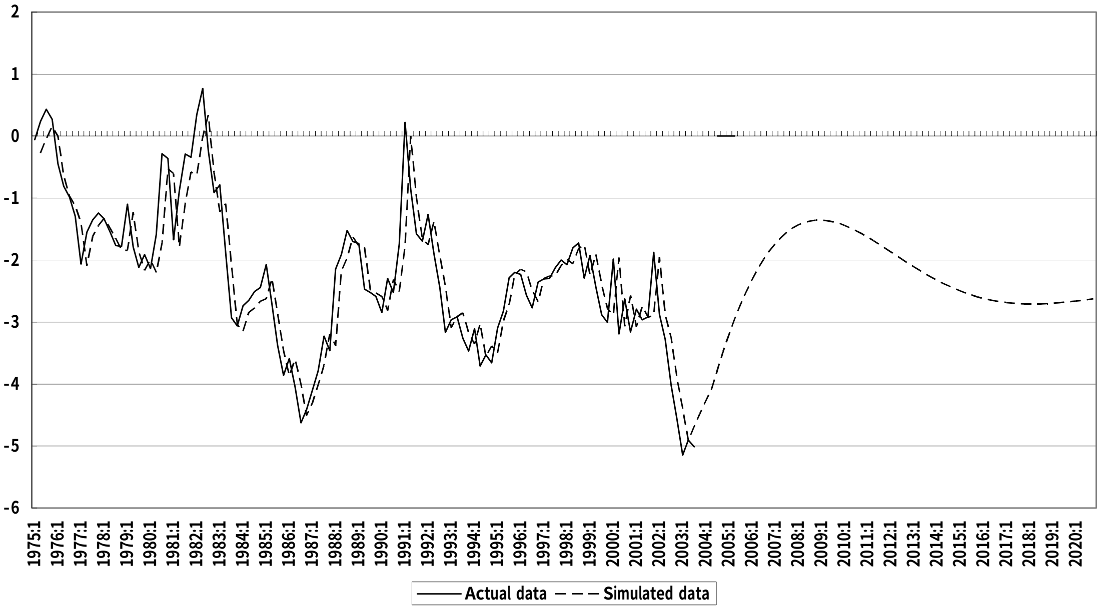


Figure 8: Simulated Current Account Based on Model 1
(Case 3: 50% exchange rate depreciation in 2004:2)

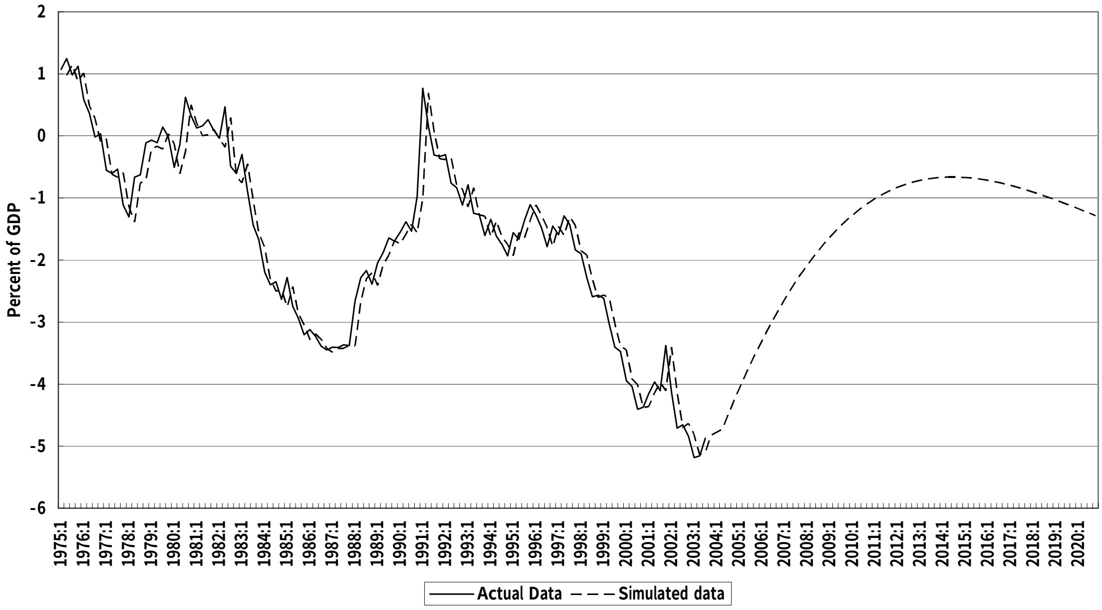


Figure 9: Simulated Current Account Based on Model 2
(Case 3: 50% exchange rate depreciation in 2004:2)

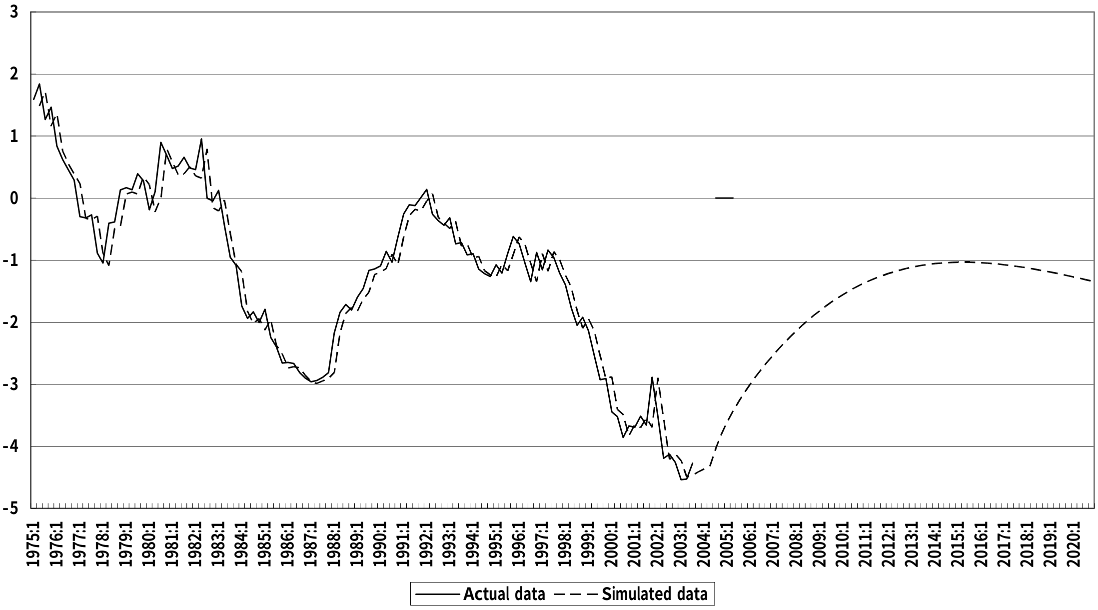


Figure 10: Simulated Current Account Based on Model 3
(Case 3: 50% exchange rate depreciation in 2004:2)

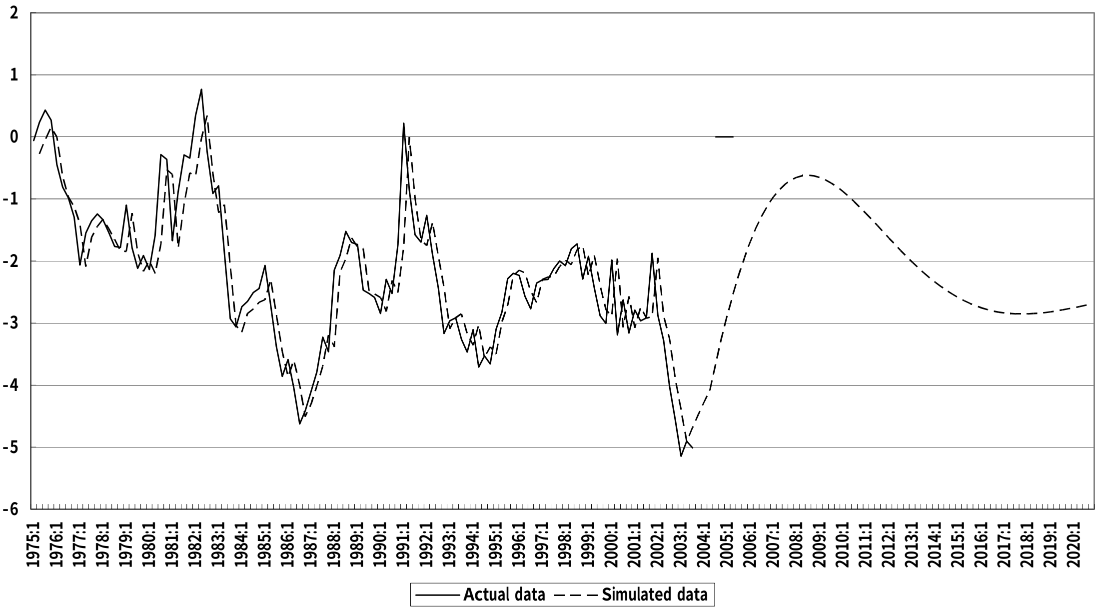
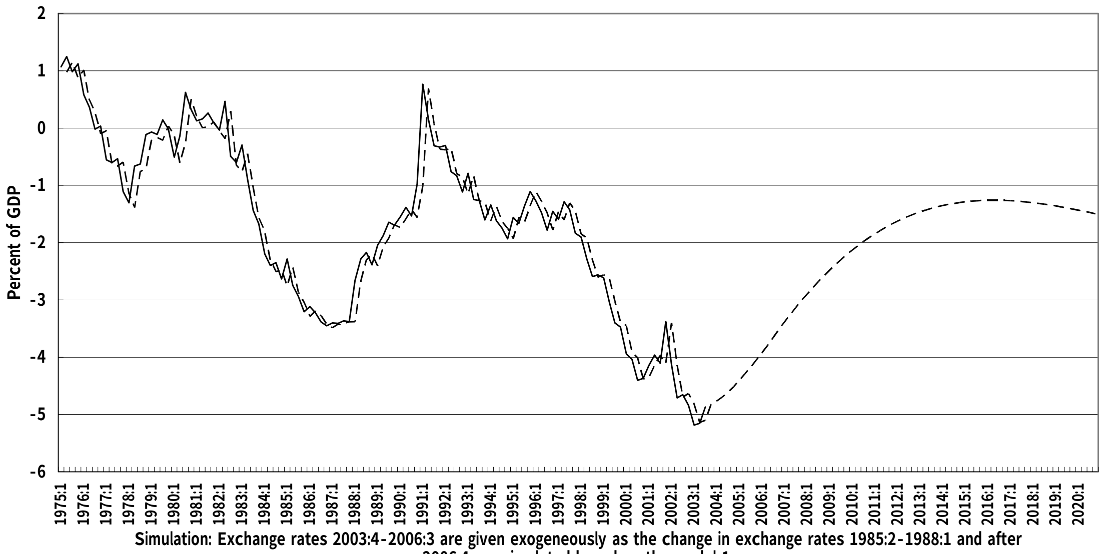


Figure 11: Simulated Current Account Based on Model 1
(Case 4: Exchange rate depreciation as after the Plaza Accord)



Simulation: Exchange rates 2003:4-2006:3 are given exogeneously as the change in exchange rates 1985:2-1988:1 and after 2006:4 are simulated based on the model 1.

Figure 12: Simulated Current Account Based on Model 2
(Case 4: Exchange rate depreciation as after the Plaza Accord)

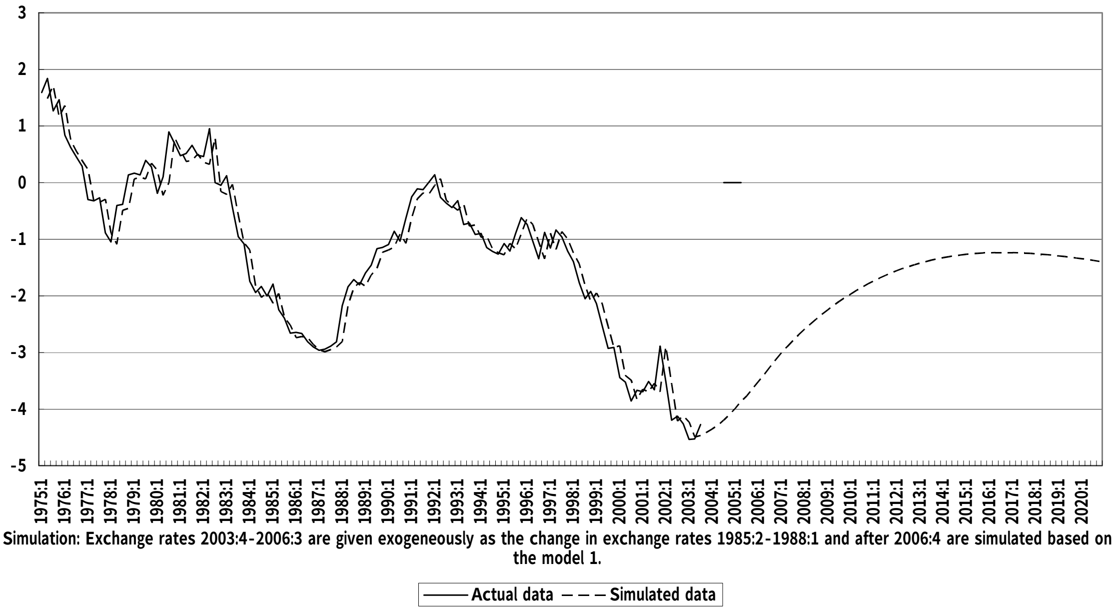


Figure 13: Simulated Current Account Based on Model 3
(Case 4: Exchange rate depreciation as after the Plaza Accord)

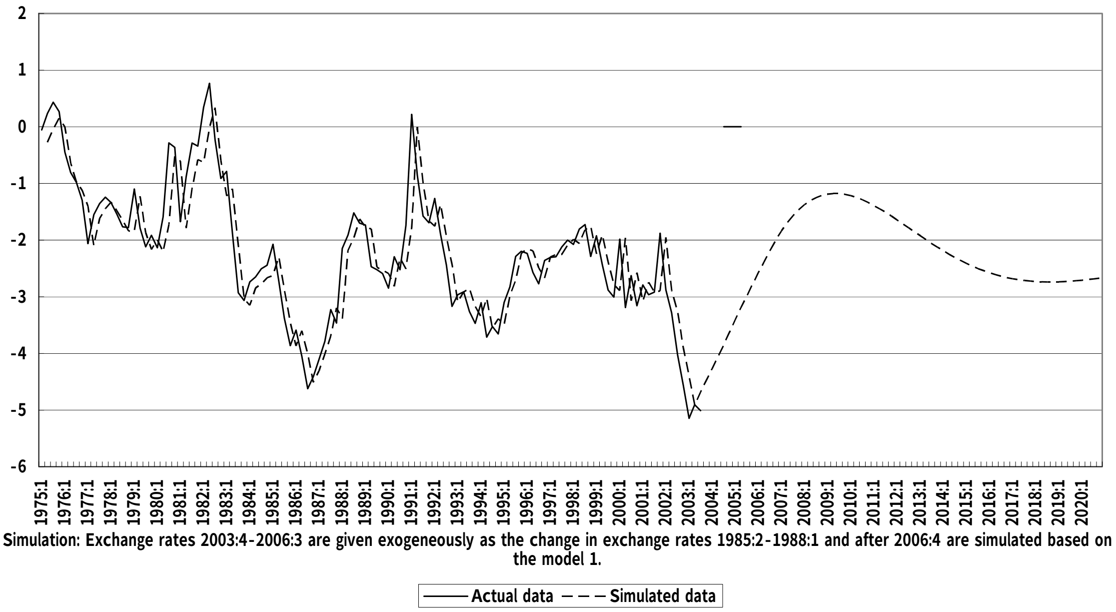
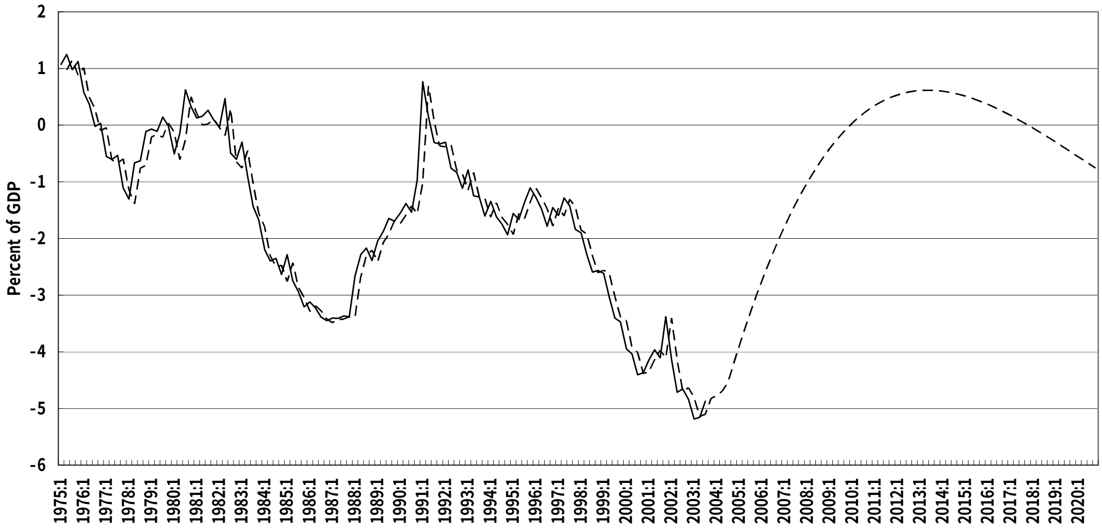


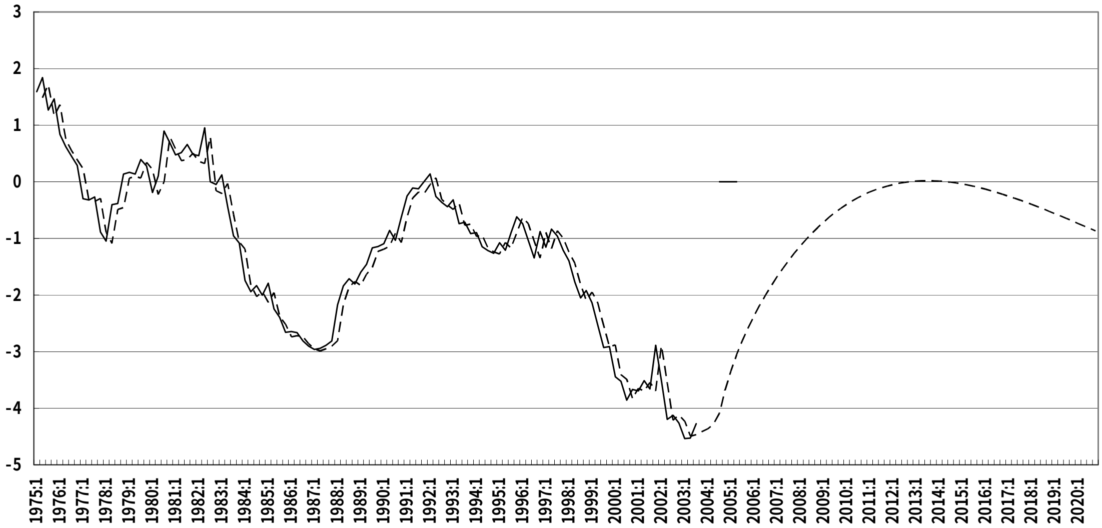
Figure 14: Simulated Current Account Based on Model 1
(Case 5: Exchange rate depreciation as in the Indonesian Currency Crisis)



Simulation: Exchange rates 2003:4-2004:3 are given exogeneously as the change in exchange rates 1997:3-1998:2 in Indonesia and after 2004:4 are simulated based on the model 1.

Actual data – – – Simulated data

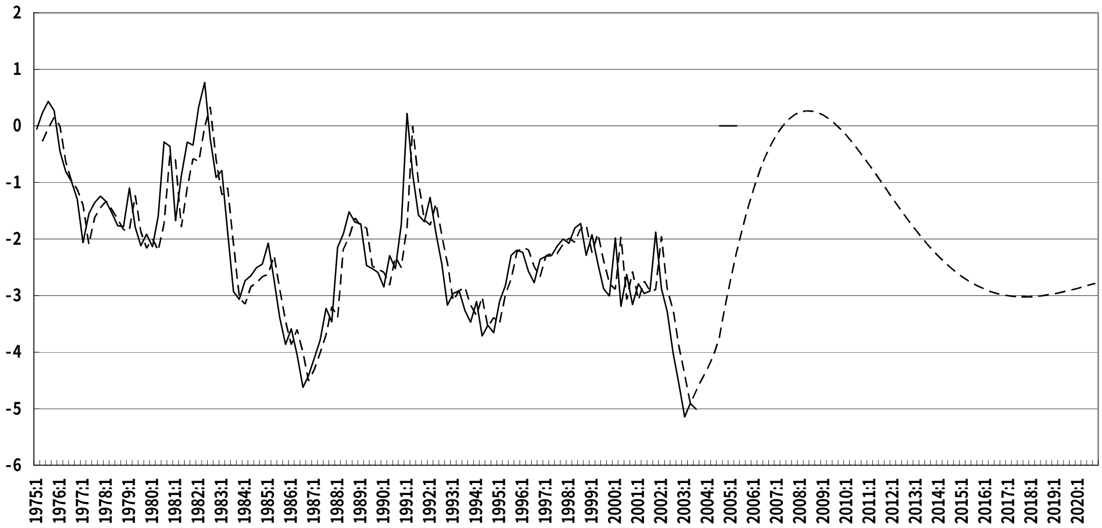
Figure 15: Simulated Current Account Based on Model 2
(Case 5: Exchange rate depreciation as in the Indonesian Currency Crisis)



Simulation: Exchange rates 2003:4-2004:3 are given exogeneously as the change in exchange rates 1997:3-1998:2 in Indonesia and after 2004:4 are simulated based on the model 1.

Actual data – – – Simulated data

Figure 16: Simulated Current Account Based on Model 3
(Case 5: Exchange rate depreciation as in the Indonesian Currency Crisis)



Simulation: Exchange rates 2003:4-2004:3 are given exogeneously as the change in exchange rates 1997:3-1998:2 in Indonesia and after 2004:4 are simulated based on the model 1.

Table 10: The Sustainability of the Simulated Current Account Based on Each Models

	Actual data	Model 1	Model 1 (differenced)	Model 2
Level	-0.643	-0.620	-0.889	-0.518
p-value	0.928	0.931	0.874	0.946
Number of lags	2	2	3	2
Difference	-3.357 **	-5.355 ***	-4.905 ***	-3.875 ***
p-value	0.013	0.000	0.000	0.003
Number of lags	5	2	2	4

	Model 2 (differenced)	Model 2 (error-correction)	Model 3	Model 3 (differenced)
Level	-0.681	-0.677	-2.271	-2.386
p-value	0.919	0.920	0.188	0.148
Number of lags	5	5	2	2
Difference	-3.905 ***	-3.855 ***	-5.909 ***	-6.077 ***
p-value	0.003	0.003	0.000	0.000
Number of lags	4	4	2	2

1) Sample period: 1976:1-2003:3
2) Testing models are with constant terms but without trend terms.
3) Number of lags are determined by Akaike's Information Criteria (AIC).
4) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.

Table 11: The Sustainability of the Forecast of the Simulated Current Account

(Model 1)

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4
Level	-2.144	-2.288	-2.377	-2.292	-2.318
p-value	0.231	0.172	0.143	0.171	0.162
Number of lags	10	10	10	10	10
Difference	-3.744	-3.701	-4.194	-3.629	-3.902
p-value	0.004 ***	0.005 ***	0.001 ***	0.006 ***	0.003 ***
Number of lags	9	9	5	9	5

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4
Level	-5.944 ***	-6.449 ***	-9.001 ***	-0.616	-9.439 ***
p-value	0.000	0.000	0.000	0.905	0.000
Number of lags	10	10	10	10	10
Difference	-7.191 ***	-9.416 ***	-13.326 ***	-15.858 ***	-6.227 ***
p-value	0.000	0.000	0.000	0.000	0.000
Number of lags	10	9	8	10	10

(Model 2)

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4	1976:1-2020:4
Level	-1.899	-2.051	-2.224	-2.108	-2.323
p-value	0.365	0.282	0.202	0.254	0.165
Number of lags	6	6	6	6	6
Difference	-4.248 ***	-4.210 ***	-4.122 ***	-4.125 ***	-3.917 ***
p-value	0.001	0.001	0.001	0.001	0.003
Number of lags	5	5	5	5	5

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4
Level	-10.952 ***	-7.300 ***	-7.814 ***	-0.905	-9.033 ***
p-value	0.000	0.000	0.000	0.828	0.000
Number of lags	9	9	10	10	10
Difference	-12.628 ***	-10.027 ***	-13.360 ***	-2.138	-8.346 ***
p-value	0.000	0.000	0.000	0.207	0.000
Number of lags	10	9	10	10	10

(Model 3)

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	1976:2-2020:4	1976:2-2020:4	1976:2-2020:4	1976:2-2020:4	1976:2-2020:4
Level	-3.367 **	-3.268 **	-3.006 **	-3.153 **	-2.863 **
p-value	0.013	0.017	0.034	0.023	0.048
Number of lags	2	2	2	2	6
Difference	-7.446 ***	-7.313 ***	-7.085 ***	-7.317 ***	-6.786 ***
p-value	0.000	0.000	0.000	0.000	0.000
Number of lags	2	2	2	2	2

	Case 1	Case 2	Case 3	Case 4	Case 5
Sample	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4	2003:4-2020:4
Level	-7.787 ***	-6.503 ***	-9.036 ***	-1.914	-8.611 ***
p-value	0.000	0.000	0.000	0.307	0.000
Number of lags	10	10	10	10	9
Difference	-9.256 ***	-8.783 ***	-9.933 ***	-3.525 ***	-16.525 ***
p-value	0.000	0.000	0.000	0.008	0.000
Number of lags	10	10	9	10	8

1) Testing models are with constant terms but without trend terms.
2) Number of lags are determined by Akaike's Information Criteria (AIC).
3) *, **, *** mean that the null hypotheses are rejected by 10%,5%,1%.
4) Each case is used by the simulated data from the exogeneous change in exchange rate after 2003:3 as follows.
Case 1: 10% exchange rate depreciation in 2004:2
Case 2: 30% exchange rate depreciation in 2004:2
Case 3: 50% exchange rate depreciation in 2004:2
Case 4: The exchange rate follows for 3 years after the Plaza accord.
Case 5: The exchange rate follows as Indonesian currency crisis in 1997:3-1998:2.