ABSTRACT

GÖĞEBAKAN ÖNDER, N. ANIL. A VAR Analysis of the Current Account. (Under the direction of Barry Goodwin).

The objective of this paper is to characterize the interaction of the current account with its determinants using quarterly time series data for Japan, the United Kingdom and the United States from 1970 to 2005. The empirical work adopts a VAR (Vector Autoregressive) framework to capture the dynamic relationships among variables. The model contains the standard determinants of the current account accepted in the literature – average real GDP growth, terms of trade, the openness ratio and the government budget balance as a percentage of GDP. Impulse response functions and forecast error variance decompositions indicate that the mentioned macroeconomic variables explain the current account reasonably well and play an important role in current account adjustment process. Real GDP growth shocks create a negative and terms of trade shocks create a positive (confirming the HLM effect) adjustment to current account in all countries. On the other hand, while a shock to government balance brings about a positive response in the current account both in Japan and in the U.S., this shock does not bring about any significant response to the current account in the U.K.

A VAR ANALYSIS OF THE CURRENT ACCOUNT

by

N. ANIL GÖĞEBAKAN ÖNDER

A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the Degree of
Master of Arts

ECONOMICS

Raleigh
2006

APPROVED BY

_____ _____

_____
Chair of Advisory Committee

BIOGRAPHY

N. Anıl GÖĞEBAKAN ÖNDER

Born November 9, 1978 in İskenderun, TURKEY

Education

M.A., Economics, August 2006, North Carolina State University, Raleigh, NC

B.A., Business Administration, May 2000, Hacettepe University, Ankara, TURKEY

TABLE OF CONTENTS

Page

LIST OF TABLES……iv

LIST OF FIGURES……v

I. INTRODUCTION……1

II. LITERATURE REVIEW……5

III. EVOLUTION OF VIEWS ON THE CURRENT ACCOUNT……10

Deficits Matter……10
Current Account Deficits are Irrelevant if the Public Sector is in Equilibrium……11
Deficits may Matter……12

IV. DATA……14

Average Real GDP Growth……14
Terms of Trade……14
Government Budget Balance as a Percentage of GDP……16
Openness to International Trade Ratio……16
Current Account Balance as a Percentage of GDP……17

V. DATA CHARACTERISTICS……18

Japan……19
The United Kingdom……21
The United States……23

VI. EMPIRICAL METHODOLOGY……26

Stationarity – Cointegration……27
VAR Order……29
Residual Correlation……30

VII. EMPIRICAL RESULTS……31

1. Granger Causality Test Results……31
2. Impulse Response Analysis……34
   Japan……34
   The United Kingdom……40
   The United States……45
   Comparison Across Countries……51
3. Forecast Error Variance Decomposition……54

VIII. IMPULSE RESPONSE ANALYSIS WITH VECM……58

IX. CONCLUSION……67

LIST OF REFERENCES……69

LIST OF TABLES

Page

Table 1. Summary of the Empirical Literature…..…….. ……..…..……9

Table 2. Simple Statistics…….…….…….……18

Table 3. Results of Dickey-Fuller Unit Root Test….……...……..28

Table 4. Cointegration Rank Test Using Trace.……..……..29

Table 5. Granger Causality Testing Results for Five - Variable VAR Model…....……33

Table 6. Directions and Periods of Adjustments.……..…….……..53

Table 7.1 Forecast Error Variance Decomposition - Japan……..…….....55

Table 7.2 Forecast Error Variance Decomposition - The United Kingdom…..……56

Table 7.3 Forecast Error Variance Decomposition - The United States…..…….……...57

LIST OF FIGURES

Page

Figure 1. Current Account as a Percentage of GDP –G7 Countries……..……2

Figure 2. Japan - Current Account and Budget Balance, 1970 – 2005…..……20

Figure 3. Japan - Current Account and Terms of Trade, 1970 – 2005…..……..……21

Figure 4. The United Kingdom - Current Account and Budget Balance, 1970 – 2005.....22

Figure 5. The United Kingdom - Current Account and Terms of Trade, 1970 – 2005…..…23

Figure 6. The United States - Current Account and Budget Balance, 1970 – 2005…..…..…24

Figure 7. The United States - Current Account and Terms of Trade, 1970 – 2005…..…..25

Japan

Figure 8. Current Account Responses to One Standard Deviation Shocks - Japan…….....36

Figure 9. Gov. Budget Balance Responses to One Standard Deviation Shocks - Japan...37

Figure 10. Real GDP Growth Responses to One Standard Deviation Shocks - Japan…….38

Figure 11. Openness Responses to One Standard Deviation Shocks - Japan ..……..39

Figure 12. Terms of Trade Responses to One Standard Deviation Shocks - Japan ..……..40

The United Kingdom

Figure 13. Current Account Responses to One Standard Deviation Shocks - The U.K.…….41

Figure 14. Gov. Budget Balance Responses to One Standard Deviation Shocks - The U.K.……..……42

Figure 15. Real GDP Growth Responses to One Standard Deviation Shocks - The U.K…..43

Figure 16. Openness Responses to One Standard Deviation Shocks - The U.K.…..……44

Figure 17. Terms of Trade Responses to One Standard Deviation Shocks - The U.K.…..…45

The United States

Figure 18. Current Account Responses to One Standard Deviation Shocks - The U.S…….47

Figure 19. Gov. Budget Balance Responses to One Standard Deviation Shocks - The U.S……..……48

Figure 20. Real GDP Growth Responses to One Standard Deviation Shocks - The U.S…..49

Figure 21. Openness Responses to One Standard Deviation Shocks - The U.S ..……...50

Figure 22. Terms of Trade Responses to One Standard Deviation Shocks - The U.S.…….....51

Japan

Figure 23. VECM - Current Account Responses to One Standard Deviation Shocks……...59
Figure 24. VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks..60
Figure 25. VECM – Real GDP Growth Responses to One Standard Deviation Shocks…...60
Figure 26. VECM – Openness Responses to One Standard Deviation Shocks…….61
Figure 27. VECM – Terms of Trade Responses to One Standard Deviation Shocks…….61

The United Kingdom

Figure 28. VECM – Current Account Responses to One Standard Deviation Shocks……...62
Figure 29. VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks..62
Figure 30. VECM – Real GDP Growth Responses to One Standard Deviation Shocks……63
Figure 31. VECM – Openness Responses to One Standard Deviation Shocks……..63
Figure 32. VECM – Terms of Trade Responses to One Standard Deviation Shocks…….64

The United States

Figure 33. VECM – Current Account Responses to One Standard Deviation Shocks……...64
Figure 34. VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks..65
Figure 35. VECM – Real GDP Growth Responses to One Standard Deviation Shocks…...65
Figure 36. VECM – Openness Responses to One Standard Deviation Shocks…….66
Figure 37. VECM – Terms of Trade Responses to One Standard Deviation Shocks…….66

I. INTRODUCTION

Due to globalization, technological innovation and financial deregulation, the importance of international trade and investment has increased in the last thirty years. Countries started to establish closer relationships with each other as either a debtor or a creditor. The growing level of cross-border integration in financial markets also gave rise to this trend, which results in bigger external imbalances reflected in balance of payments statistics of countries.

The balance of payments of a country is the projection of all international economic transactions between residents of that country and those of the rest of the world. Therefore, it is one of the main tools that informs government authorities of their country's international economic position and allows them to judge the international implications of each of their commercial, monetary and fiscal policy options. (Pestieau 1974)

The current account balance item in the balance of payments statistics is also one of the main leading indicators for the future decision-making process of a country. Therefore, it is important to understand the sources of the current account deficit. Is it a result of rising investment needs owing to productivity growth? Or is it just a reflection of an increase in public consumption? Actually, there is no common agreement among economists about the explanation of external imbalances. Generally declines in saving rates and/or surges in productivity growth are attributed to the widening of the deficit. Productivity growth represents an increase in the rates of return on investment, so that domestic investment is stimulated generating capital inflows to the country. Commonly, a deficit created by a reduction in savings is regarded as more worrisome than a deficit created by an increase in investment. The reason is that increased rate of return is perceived as a guarantee for the payment of external debt in the future, although this is not always the case.

Along with domestic factors, like a decline in savings rates and surge in productivity growth, Bernanke (2005) emphasizes a global perspective. He brings up the notion of a 'global saving glut' as an explanation for the large external imbalance in the United States (U.S.). Emerging nations have experienced a surge in the supply of saving in response to several crises over the last decade. This excess saving flows from emerging markets to more secure advanced economies. As a result, emerging markets shift from being net importers of financial capital to being net exporters. On the other hand, key industrial countries either

move from current account surplus towards deficit - like France and Italy - or start to run higher current account deficits - like the United Kingdom and the U.S. - since 1998. This current pattern of external imbalances has deserved significant attention since this story seems to be inconsistent with the classic view of the stage of development hypothesis. According to this hypothesis, advanced economies have current account surpluses, as they export capital to developing countries and emerging economies have deficits, as they need investment to reach a higher stage of development. Nevertheless, as it is indicated in Figure 1, there is quite a contrary process in G-7[1] countries, with the exception of Germany and Japan.

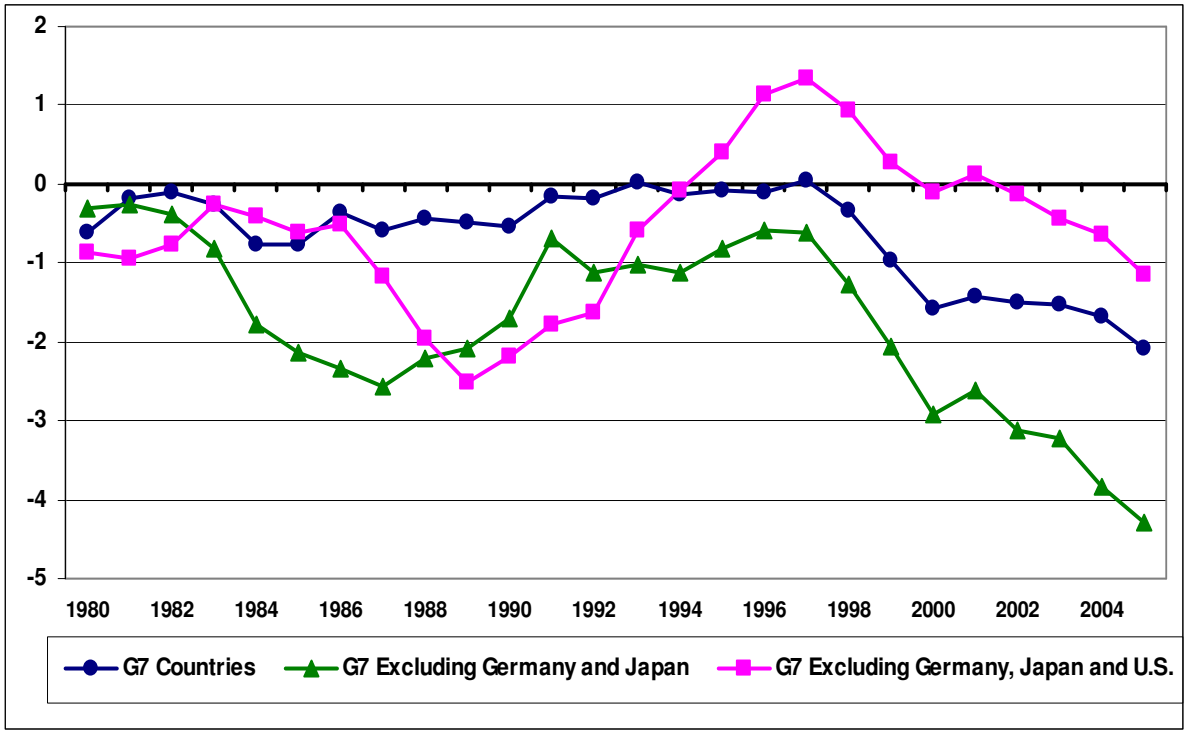

Figure 1: Current Account Balance as a Percentage of GDP - G7 Countries

Source: IMF, World Economic Outlook Database.

Along with this strange trend over the last decade, another reason of increased attention to global external imbalances is that they are generally considered as bothersome. It is possible that a deficit is giving a signal for an approaching crisis period. Although there are many other reasons for crises, many authors emphasize the connection between deficit and crises. Here is the statement of Fisher (1988): the "primary indicator [of a looming crisis] is

[1] Canada, France, Germany, Italy, Japan, United Kingdom, United States.

the current account deficit". Indeed, both the 1994 Mexican crisis and the 1997 East Asian crisis were preceded by large current account deficits. Undoubtedly, industrial countries should be considered differently from emerging countries. However, as a result of global integration and liberalization of financial markets, the size and persistence of current account imbalances in industrial countries also started to entertain a number of worrisome features.

When G-7 data are examined thoroughly, it can be seen that current account balances in United Kingdom and United States have been negative since 1992. In addition to this, France and Italy moved from surplus to deficit in recent years. There are noteworthy differences across countries. While the U.S. ran a 6.1% current account deficit in 2005, at the opposite pole, we see that Germany had a 4.3% surplus. Still, as indicated in Figure 1, the collective current account of the G-7 countries has been declining since 1998. But what are the reasons for these polar situations? Why do some major economies start to run current account deficits, although Germany and Japan still continue to have surpluses? What are the underlying reasons behind this scene?

The objective of this paper is to characterize the interaction of the current account with its determinants using quarterly time series data for Japan, the United Kingdom and the United States from 1970 to 2005. Only major industrialized countries are included in the sample because of the availability of quarterly data. The empirical work adopts a VAR (Vector Autoregressive) framework to capture the dynamic relationships among variables. The model contains the standard determinants of the current account accepted in the literature – average real GDP growth, terms of trade, the openness ratio and the government budget balance as a percentage of GDP.

The rest of the paper is organized as follows: Section II makes a short review of the literature. Section III explains the different approaches to current account and summarizes the opinions of economists about current account deficits. The discussion shows that, as countries passed through crisis periods, approaches to the current account balance have evolved and undergone considerable changes. Section IV specifies the data; Section V summarizes the data characteristics for each country. Section VI explains the empirical VAR methodology that will be applied to figure out the behaviors of current account and its determinants in the face of exogenous shocks. Section VII presents the detailed VAR results

including Granger causality tests, impulse response analysis and forecast error variance decomposition. Next Section VIII uses vector error correction model (VECM) to report impulse response figures of the same variables, which can be considered as a robustness check. Finally, Section IX concludes the study.

II. LITERATURE REVIEW

An intertemporal approach is the basic reference for theoretical understanding of the current account. It was mainly developed by Obstfeld and Rogoff (1994, 1996). According to the intertemporal approach, the current account balance is the outcome of forward-looking dynamic saving and investment decisions. Consumers smooth their consumption over time by lending and borrowing in international capital markets to maximize their lifetime utility. It is not always optimal for countries to have a current account balance. If desired investment exceeds national savings, then the country can close the gap by borrowing from abroad, which causes a current account deficit. On the other hand, if savings exceeds investment, then the country lends abroad and runs a current account surplus. In short, a positive current account balance represents the fraction of domestic savings invested abroad and a negative current account balance represents the fraction of domestic investment financed by foreign savings. Within this framework, the intertemporal approach provides an appropriate tool for analysis of current account dynamics.

Razin (1993) presents a combination of theoretical and empirical work about the logic and empirical validity of the intertemporal approach. He specifies how various shocks affect saving and investment behavior. Shocks can be transitory or persistent in duration, country-specific or global in nature. He found that through the saving-investment balance mechanism these shocks affect the trend and volatility of the current account position. For example, a permanent country - specific productivity shock may worsen the current account deficit because it generates a surge in investment and a decline in savings (since consumption rises more than output). On the other hand, a transitory country-specific productivity shock may cause current account to move into surplus, since investment and consumption respond weakly to temporary shocks. Furthermore, the response of the current account to a global shock is much smaller than to a country-specific shock.

The empirical literature on the current account can be divided into two groups based on the econometric approach taken. The first group of writers, Calderòn, Chong and Loayza (1999), Chinn and Prasad (2000) and Gruber and Kamin (2005), try to explain the determinants of current account balance using comprehensive cross-country panel regression models. On the other hand, the second group of writers, Bachman (1992), Dibooğlu (1997) and Cashin and McDermott (2002), try to explain the impact of fiscal policy,

the real exchange rate, terms of trade fluctuations and productivity shocks on the current account balance using vector autoregressive and vector error correction models.

Calderòn, Chong and Loayza (1999) focus on developing countries. They outline an econometric model that distinguishes between the transitory and permanent components of current account deficits. They use annual data in the study of transitory effects and non-overlapping five-year averages in the study of permanent effects. They include lagged current account, public and private saving, domestic output growth, real exchange rate and terms of trade as independent variables. Calderòn, Chong and Loayza (1999) find that current account deficits are moderately persistent. Higher domestic output growth rates tend to worsen the current account deficit in both the transitory and permanent effect models. Transitory increases in public and private saving have a favorable impact on the current account, but their permanent changes have insignificant effects. Furthermore, they also find a positive significant relationship between temporary changes in terms of trade and the current account balance, which is consistent with Harberger-Laursen-Metzler (HLM) effect.

Chinn and Prasad (2000) view current account balances as the outcome of variations in structural and macroeconomic determinants that influence the saving – investment balance. They provide a detailed analysis of the medium term determinants of current account balances for 89 industrial and developing countries over the 1971 – 1995 period. Since their interest is primarily in the medium-term, they construct a panel that contains non-overlapping 5-year averages of the data for each country. They include the government budget balance, relative income, dependency ratios, average GDP growth, terms of trade volatility, measures of capital controls, degree of openness, and financial deepening as independent variables. Chinn and Prasad (2000) find that government budget balances and initial stocks of net foreign assets are positively correlated with current accounts. In addition to this, they find a strong positive relationship between average output growth and the current account for industrial countries. On the other hand, they find that the degree of openness is negatively related to current account position in developing countries, although there appears to be no association between these two variables among industrial countries.

Bussière, Fratzscher and Müller (2004) provide an analysis of the current account dynamics for 21 OECD countries and all EU acceding countries. Their empirical model includes lagged current account, the change in net output, income per head, private investment and

the government budget balance. Bussière, Fratzscher and Müller (2004) find that current account balances are highly persistent and the fiscal balance has significant positive effects on the current account.

Gruber and Kamin (2005) evaluate some of the explanations that have been put forward for the global pattern of current account imbalances in recent years: in particular, the large U.S. current account deficit and the large surpluses of the Asian developing economies. They base their paper on Chinn and Prasad (2000)'s approach, using data from 61 countries during the 1982-2003 period and including the standard determinants of current account – per capita income, relative growth rates, fiscal balance, demographic variables and openness. Gruber and Kamin (2005) find that larger current account balances are associated with higher per capita incomes, lower changes in growth, higher fiscal balances and greater degrees of economic openness. However, their model cannot explain the large U.S. deficit and large Asian surpluses of the 1997 – 2003 period. Therefore, they include variables representing financial crises, growth performance and a favorable institutional environment. With a model incorporating these factors, Gruber and Kamin (2005) can explain much of Asian surpluses since 1997, but still they cannot explain why these capital outflows from Asia are being channeled primarily into the U.S. Hence, their model supports half of the global savings glut hypothesis, suggesting that the U.S. deficit owes partly to an autonomous rise in the quantity of saving made available to the U.S by its trading partners.

The second group of writers investigates the impact of shocks in a number of macroeconomic variables on the current account balance. Dibooğlu (1997) analyzes the sources of the current account deficit in the U.S. using a vector error correction model. His variable set includes quarterly government spending, federal government's budget balance, productivity, domestic and foreign real income, terms of trade, and real long term interest rates series over the 1957 – 1992 period. Dibooğlu (1997) concludes that the real interest rate, the government budget balance, productivity and terms of trade innovations play an important role in the U.S. current account adjustment process. He also points out that the effect of government budget balance shock conforms to the twin deficit hypothesis and the effect of terms of trade shock conforms to the traditional HLM effect.

Cashin and McDermott (2002) examine the impact of terms of trade shocks on output and the current account balance in five OECD countries – Australia, Canada, New Zealand, the

United Kingdom and the United States – using a structural vector autoregressive (SVAR) model. They find that terms of trade shocks explain a significant proportion of the variation in the current account balances. Bussière, Fratzscher and Müller (2005) develop a comprehensive theoretical framework to analyze the role of the government budget balance and productivity shocks in the determination of the current account. They use annual data from 21 OECD countries over the 1960 – 2003 periods. Bussière, Fratzscher and Müller (2005) find that the effect of the budget balance on the current account is very small, whereas the impact of productivity shocks is comparatively much larger. The summary of the empirical literature is also demonstrated in Table 1.

Table 1: Summary of the Empirical Literature			
Paper (see References)	**Variables**	**Sample and Methodology**	**Main Results**
Calderòn, Chong and Loayza (1999)	* Lagged current account * Public and private saving * Domestic output growth * Real exchange rate * Terms of trade	* 44 Developing countries * 1966 - 1995 period * Generalized Method of Moments (GMM)	* Current account deficit is moderately persistent * Negative relationship between output growth rate and current account balance *Positive relationship between terms of trade and current account balance
Chinn and Prasad (2000)	* Government budget balance * Relative income * Dependency ratios * Average GDP growth * Terms of trade volatility * Measures of capital controls * Degree of openness * Financial deepening	* 71 Developing - 18 Industrial countries * 1971 - 1995 period * Panel regressions	* Positive relationship between government budget balance and current account balance * Positive relationship between average output growth rate and current account balance * No association between openness and current account among industrial countries
Bussière, Fratzscher and Müller (2004)	* Lagged current account * Change in net output * Income per head * Private investment * Government budget balance	* 21 OECD countries and all EU acceding countries * 1980 - 2002 period * Panel regressions, Instrumental variable (IV) and Generalized Method of Moments (GMM)	* Current account balances are highly persistent * Positive relationship between fiscal balance and current account balance
Gruber and Kamin (2005)	* Per capita income * Relative growth rates * Fiscal balance * Demographic variables * Openness ratio * Dummy variables representing financial crises, growth performance and a favorable institutional environment	* 61 countries - focus on the U.S. * 1982 - 2003 period * Panel regressions	* Positive relationship between government budget balance and current account balance * Negative relationship between growth rate and current account balance * Positive relationship between openness and current account * Findings support the global savings glut hypothesis for the U.S.
Bachman (1992)	* Federal Government Surplus * Gross Domestic Investment * U.S. Relative to Foreign Productivity * Estmated Risk Premium	* U.S. * 1974 - 1988 period * Bivariate VARs	* Only the Federal budget deficit explains the evolution of the current account
Dibooğlu (1997)	* Government spending * Federal government's budget balance * Productivity * Domestic and foreign real income * Terms of trade * Real long term interest rates	* U.S. * 1957 – 1992 period * Vector error correction model (VECM)	* Positive relationship between terms of trade and current account balance * Positive relationship between government budget balance and current account balance
Cashin and McDermott (2002)	* Terms of trade * Growth of real output	* Australia, Canada, New Zealand, the United Kingdom and the United States * 1970 -1997 period * Structureal vector autoregressive (SVAR)	* Terms of trade shocks explain a significant proportion of the variation in the current account balances
Bussière, Fratzscher and Müller (2005)	* Government budget balance * Productivity * Government consumption * Private investment	* 21 OECD countries * 1960 - 2003 period * Panel regressions	* The effect of the budget balance on the current account is very small, whereas the impact of productivity shocks is comparatively much larger.

III. EVOLUTION OF VIEWS ON THE CURRENT ACCOUNT

The perception of current account deficits has evolved and undergone many changes during the last fifty years. Edwards (2001) classifies these changes according to economists' views on the subject. When exchange rate regimes were mostly fixed throughout the world, current account deficits absolutely mattered. On the other hand, as countries adopted flexible exchange rate regimes, it turns out that deficits may not matter. Briefly, today countries might want to run either current account deficits or surpluses, but they always monitor its behavior closely. The determination of the current account and its interaction with other macroeconomic variables can be identified by four accounting identities, each of which represents a different approach to current account. This section explains these different approaches to the current account and reviews the opinions about external imbalances based on the classification of Edwards (2001).

- Deficits matter:

From immediately after the Second World War until the mid 1970s, the elasticity approach dominated the discussions of external balance. The elasticity approach sees the current account balance as the summation of trade balance and net factor payments from abroad (CA = NX + NFP). Since foreign asset holdings of countries had been limited until very recently, authors tended to emphasize the trade balance component of the current account. Therefore, relative international prices started to be viewed as the basic determinant of current account balance. Influences of the real exchange rate were stressed among other factors. During this era, exchange rates were mostly fixed throughout the world and running large current account deficit was considered to be a problem for a nation. The reason behind this belief was that countries had to devaluate their currencies to improve their trade and in the end their current account balance.

In this time period, an alternative to the elasticity approach was the absorption approach, which is defined as the difference between real income and domestic absorption[2] (CA = Y – A). The absorption approach emphasizes changes in real domestic income as a determinant of current account. Under this approach, an increase in the value of real income relative to

[2] The domestic demand for goods, C + I + G, is known as absorption, which is the quantity of aggregate output that is absorbed by the domestic economy.

the value of domestic demand must be accompanied by an improvement in the country's current account balance.

- Current account deficits are irrelevant if the public sector is in equilibrium:

After the mid 1970s, most countries experienced large current account deficits as a result of oil price shocks. This development resulted in the recognition that the current account is also equal to savings minus investment; and since savings and investment decisions are based on intertemporal factors, the current account is necessarily an intertemporal phenomenon. Therefore, economists started to give more emphasis to the intertemporal dimensions of the current account. Under the intertemporal approach, the current account is viewed as the difference between national saving and investment ($CA = S - I + (T - G)$). This equation decomposes national saving into private sector saving (S) and government saving ($T - G$), where $T - G$ denotes the difference between taxes (T) and government spending (G). If desired investment exceeds national savings, then the country can close the gap by borrowing from abroad, which causes current account deficit. Lending and borrowing are the means by which a nation smoothes consumption. If a country runs a current account deficit when aggregate income is low and runs a current account surplus when aggregate income is high, this allows the residents of that country to smooth consumption over time.

The view that current account deficits do not matter, if the public sector is in equilibrium is strongly supported by Corden (1977). When the public budget is in balance, the current account is determined by private-sector savings-investment decisions. Corden (1977) argues: "the private sector can take care of itself... if private firms choose to increase their spending and finance this by borrowing abroad, and so generate a current account deficit, this does not call for any public concern or intervention". As long as public sector accounts are under control and domestic savings are increasing, there is no reason to worry about current account deficits. The argument that current account deficits that result from a shift in private sector saving-investment decision should not be a public policy concern is known as the Lawson Doctrine. This is because the U.K. Chancellor Nigel Lawson advocated the above-mentioned argument in his speech to the IMF regarding the U.K.'s current account deficit. In fact, during the 1988-1989 period the UK's fiscal position was strengthening and the external deficit thus had private sector origins. Nevertheless, neither the UK nor the

Nordic countries avoided currency depreciation, although their current account deficit primarily was a consequence of private sector saving-investment imbalance. Therefore, the Lawson Doctrine was discredited because of its failure to describe the above-mentioned crises and many other crises thereafter. However, it should also be noted that, since flexible exchange rate regimes have a shock-absorbing characteristic, transition to a lower level of current account deficit would be much smoother today.

- Deficits may matter:

During the last ten years, the focal point of events has shifted to the examination of current account sustainability. Milesi-Ferreti and Razin (1996) argue about the level of current account deficits that can be considered sustainable. According to them, "Conventional wisdom is that current account deficits above 5% of GDP flash a red light; in particular, if the deficit is financed with short-term debt or foreign exchange reserves and if it reflects high consumption spending." However, to get at the truth is not so simple, since there are some countries running a persistent current account deficit and having an economy going on its way, like Australia, on the other hand there are some other countries that experienced several crisis periods although their current account deficit was less than 5%.

The main point is that the level of a sustainable current account is different across countries and depends on a country's intertemporal solvency, willingness to pay and the rest of the world's willingness to lend. Those three factors are mostly interrelated with each other and with the reasons of current account deficit. Especially, perception of foreign lenders', whether a country is able to meet its external obligations, is based on that country's current account determinants.

Finally, the current account started to be defined as the changes in net foreign assets ($CA = \Delta NFA$), which indicate the rate at which an economy is accumulating external assets. As a result of global integration and liberalization of financial markets, all countries are exposed to capital movements in and out of the country after 1990s. When a nation saves less than it invests, a current account deficit arises and the difference between saving and investments is met with inflows of foreign capital. Therefore, capital inflows into a country are the mirror image of its current account deficit. This definition is particularly useful in studying long-run determination of current account.

In sum, each of these alternative perspectives – elasticity, absorption, intertemporal, net foreign assets approaches - chooses a different way towards explaining the current account movements. This paper adopts an intertemporal approach, which plays a role over the medium term, arguing current account acts as a shock absorber adjusting savings to shocks to maintain a stable consumption path. The variables that will be used in the empirical framework – average real GDP growth, terms of trade, government budget balance as a percentage of GDP, and openness ratio - are defined in the next section.

IV. DATA

All the data are gathered from the OECD web site, the Economic Outlook Database. The time period included in the empirical analysis starts from the first quarter of 1970 and ends at the last quarter of 2005. The following are detailed explanations of the variables used in the analysis:

- Average Real GDP Growth:

Average real GDP growth is included in the model to be used as a proxy to productivity shocks. In addition to this, GDP growth is an important determinant of the savings and investment rates. Higher growth affects the current account for two reasons. First, an increase in output growth increases the import demand and hence results in higher current account deficit (or lower current account surplus). Second, if a positive productivity shock occurs, the rate of return on investment increases, so that domestic investment is stimulated generating capital inflows to the country. Therefore, GDP growth causes current account balance to worsen. Both reasons predict that there is a negative relationship between GDP growth and the current account.

- Terms of Trade:

The terms of trade represents the relative price of exports in terms of imports. If the terms of trade fall, the country receives less in return for each unit of the good it exports, so that its real income decreases. Likewise, if the terms of trade improve, then the country receives more and its real income level increases. It means the purchasing power of its exports increases.

But the question is how the current account responds to shocks resulting from changes in a country's terms of trade. The initial explanation to this question is known as the Harberger-Laursen-Metzler (HLM) effect. HLM predicts a positive relationship between exogenous changes in the terms of trade and the current account through consumption smoothing behavior. For example, deterioration in the terms of trade would result in a decrease in real income. Since consumption smoothing over time necessitates a lowering of savings, current account balance must worsen.

Later on, this work was extended according to the intertemporal optimization framework, which points out that what happens to the current account position depends on the duration of the terms of trade shock. For example, a permanent deterioration in terms of trade would lower both income and consumption by similar amounts. Given that the marginal propensity to consume from a permanent change in income is unity, there would be no change in savings and hence no changes in the current account. On the other hand, a temporary deterioration in terms of trade has two opposing effects. While 'consumption smoothing' effect leads individuals to dissaving to maintain their spending, 'consumption-tilting' effect leads individuals to substitute away from the imported good and consume less of it. Hence, the net effect of a temporary reduction in terms of trade is ambiguous. If the correlation between terms of trade and current account is positive, this implies that the consumption-smoothing motive dominates the consumption-tilting motive.

More recently, the analytical perspective considering the current account impact of terms of trade changes has also been broadened by inclusion of investment decisions. The effect of investment works in the opposite direction to the consumption-smoothing effect. If there is a shock in the terms of trade, there will be an incentive to alter the investment decisions in time. Therefore, investment has stronger effect in permanent shocks relative to temporary ones. Indeed, empirical studies demonstrate that countries exhibit a positive relationship between terms of trade shocks and the current account, if shocks are temporary. It means consumption smoothing dominates. On the other hand, if shocks are permanent, there is a negative relationship between the two variables. For example, Kent and Cashin (2003) identify two groups of countries based on the degree of persistence of their terms of trade shocks and they find that while consumption smoothing effect dominates for short-lived temporary shocks, investment effect dominates for long-lived shocks. For developing countries, Calderòn, Chong and Loayza (1999) find a negative and significant relationship between temporary changes in the terms of trade and current account deficits, which is consistent with the HLM effect. However, according to their work, permanent changes do not have significant effects.

The following VAR analysis in this paper will bring some light on the direction of the relationship between terms of trade shocks and current account, as well as the relative importance of terms of trade shocks in explaining fluctuations in the current account.

- Government budget balance expressed as a ratio to GDP:

Government budget balance, % GDP is measured by total receipts of government, % GDP minus total disbursement of government, % GDP. Generally, higher government budget deficits are associated with larger current account deficits, since any expansion of the government deficit that lowers public saving should lower the current account balance. This relationship may also be interpreted in a more sophisticated way. Fiscal expansion increases domestic spending, which causes domestic interest rates to rise relative to foreign rates. This attracts foreign investors and widens the current account deficit. On the other hand, Ricardian Equivalence suggests that government budget imbalances do not affect the total level of demand in an economy and hence cannot affect the current account balance.

The simultaneous deficit in fiscal and current accounts is known as 'twin deficits'. Although both economic theory and empirical observation suggested a link between fiscal deficit and current account deficit, there is no reason that twin deficits need always appear together. For example, according to the World Economic Outlook Database published by IMF, Japan has experienced a deficit on budget balance but a surplus on current account balance since 2000. Still, there are some disagreements among economists, even if a country experiences a deficit on both accounts. While some economists see the budget deficit as an important factor in causing external imbalance (Chinn 2005), others suggest that fiscal balance may not play a central role.

Bussière, Fratzscher and Müller (2004) find a strong positive relationship between current account and government budget balances for 21 OECD and all EU acceding countries. A positive relationship between fiscal balance and current balance indicates that there is no complete Ricardian offset. This means that the extra savings of households does not exactly finance the extra spending of government. Chinn and Prasad (2000) also find that the budget balance of a country is positively related to its current account positions.

- Openness ratio:

Recent studies on current account have emphasized the role of trade openness, which can be defined as imports plus exports (of both goods and services) at current prices as a

percentage of GDP. International trade in goods and services is a principal channel of economic integration, which has an impact on the determination of current account. Gruber and Kamin (2005) mentioned that more open economies are likely to have larger tradable goods sectors and thus be able to adjust their external balances more flexibly. In addition to this, economies that are more open to international trade have more capacity to generate foreign exchange earnings. However, the expected sign of the openness ratio is ambiguous. Gruber and Kamin (2005) find that larger current account balances are associated with greater degrees of economic openness.

- Current Account as a percentage of GDP:

This objective of this paper is to find the sources of the current account movements and to characterize the interaction of the current account with the above-mentioned variables. Since the empirical part employs a VAR approach, the impacts of shocks on current account balance will mainly be examined. Many empirical studies find that the current account is persistent and influenced by its lagged value. For example, Bussière, Fratzscher and Müller (2004) find a strong effect of the lagged current account; Calderòn, Chong and Loayza (1999) also find that current account deficits are moderately persistent.

V. DATA CHARACTERISTICS

Before doing the VAR analysis, it is worthwhile to have basic information about the characteristics of the data for each country. Simple data statistics for each of the variables are summarized in Table 2. According to the results, there appears to be a negative relationship between the openness ratio and current account. Chinn and Prasad (2000) discuss the idea that the degree of openness can be correlated with attributes that make a country attractive to foreign capital. For example, countries with more liberalized trade tend to allow other countries to undertake more investment and finance the resulting current account deficits with capital from abroad. The United Kingdom (U.K.) has considerably higher openness to international trade ratio than both Japan and the United States (U.S.). In addition to this, although Japan has a greater mean value of openness ratio than the U.S, the U.S. exhibits substantially higher degree of openness to foreign trade since 1986. This picture may help to explain the surplus in Japan and the deficit in the U.K and in the U.S.

In the following section, data characteristics since 1970 will be discussed for each country.

Table 2: Simple Statistics

	Variable	N	Mean	Std. Dev	Minimum	Maximum	Correlation with Current Account
Japan							
	curracc	140	1.8885	1.4165	-2.3090	4.5640	1.0000
	open	140	0.2153	0.0387	0.1562	0.2958	-0.5228
	govbal	140	-2.4763	2.9765	-8.1910	2.0560	-0.1401
	trmstrd	140	1.0276	0.1644	0.7140	1.4573	0.1759
	gdpgrwt	140	0.6041	0.9468	-3.6982	2.9765	0.0575
The United Kingdom							
	curracc	140	-1.1226	1.8197	-5.7200	4.4980	1.0000
	open	140	0.5296	0.0465	0.3991	0.6150	-0.2611
	govbal	140	-2.5479	2.6878	-8.5050	7.0100	-0.0950
	trmstrd	140	0.9291	0.0548	0.7690	1.0138	0.1054
	gdpgrwt	140	0.5362	0.9804	-2.4606	5.1858	0.0476
The United States							
	curracc	140	-1.5852	1.7200	-6.2810	1.2490	1.0000
	open	140	0.1945	0.0394	0.1061	0.2683	-0.6395
	govbal	140	-2.9157	2.0573	-7.1940	1.9320	0.0202
	trmstrd	140	1.0562	0.1234	0.9082	1.4400	0.3711
	gdpgrwt	140	0.5005	0.8562	-2.2463	3.6631	-0.1130

- Japan

Japan is one of the world's largest net capital exporters; its current account has been in surplus since 1981. Although the relative size of the surplus has been fluctuating a lot, the tendency is to remain between 1% and 4% of GDP. On the other hand, Japan has been facing government balance deficits since 1993. The deficit reached at its peak in 2002, when it amounted to more than 8% of GDP. The relationship between current account and fiscal balance is illustrated in Figure 2. Japan has experienced a deficit on budget balance but a surplus on current account balance since 1993. The overall picture demonstrates the fact that private sector saving in Japan is so large that it outweighs public sector dissaving. This substantial private sector savings seek higher rate of returns abroad. Strong demand for foreign assets causes capital outflow from Japan and favors a current account surplus.

However, a number of studies investigate the impact of the demographic profile in Japan on saving rates and current account balances. As a result of low fertility rates and increased life expectancy in Japan, the working-age population has been diminishing and the share of the elderly population has been increasing. According to the life-cycle theory of consumption and saving, there is a negative connection between saving rates and age profile of the population. Therefore, the current level of current account surplus in Japan is likely to decrease in the future. The empirical model in this paper does not take into account the impact of demographic indicators on current account.

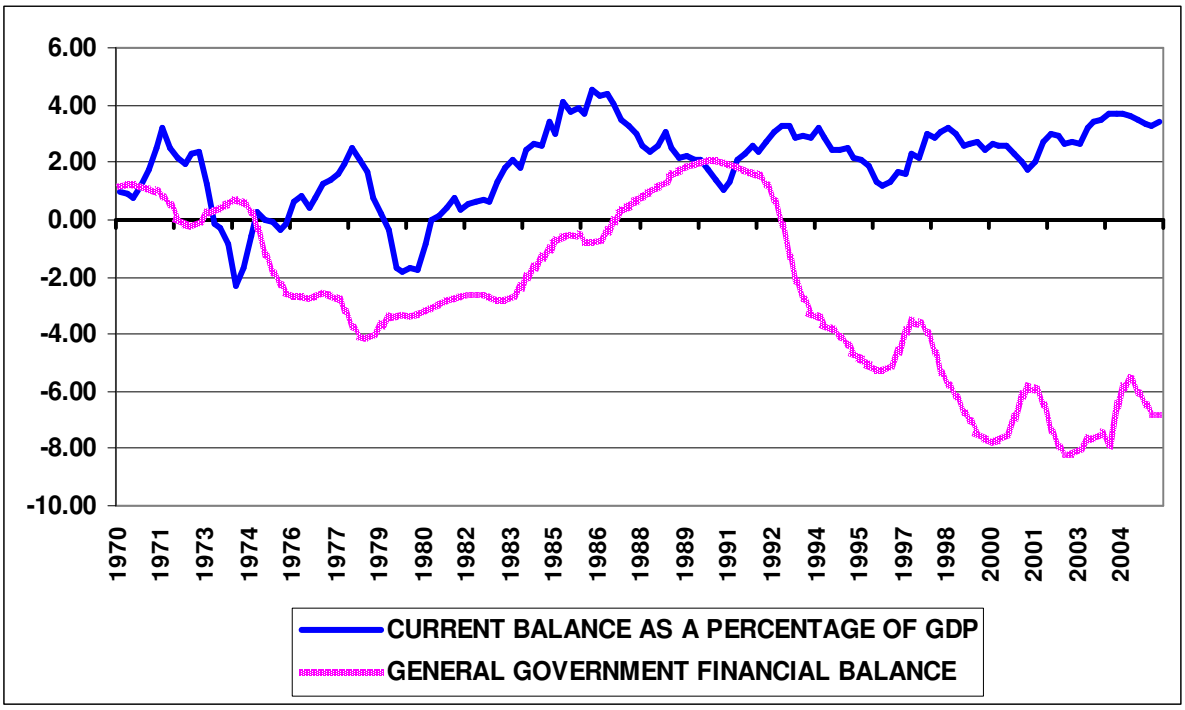

Figure 2: Japan - Current Account and Budget Balance, 1970 - 2005

Source: OECD, Economic Outlook Database.

Figure 3 demonstrates the relationship between terms of trade and the current account balance as a percentage of GDP for Japan. The fluctuations of the two variables seem to be positively correlated during the 1970-1995 period. Current account tends to lead the movements in terms of trade; large movements in current account are associated with movements in the terms of trade in the same direction. However, they are moving in opposite directions during the last decade. The terms of trade index has tended to decrease since 1998, implying a decrease in nations' purchasing power. The Pearson correlation coefficient between current account and terms of trade is calculated as 0.18 and it is different than zero at 5% significance level.

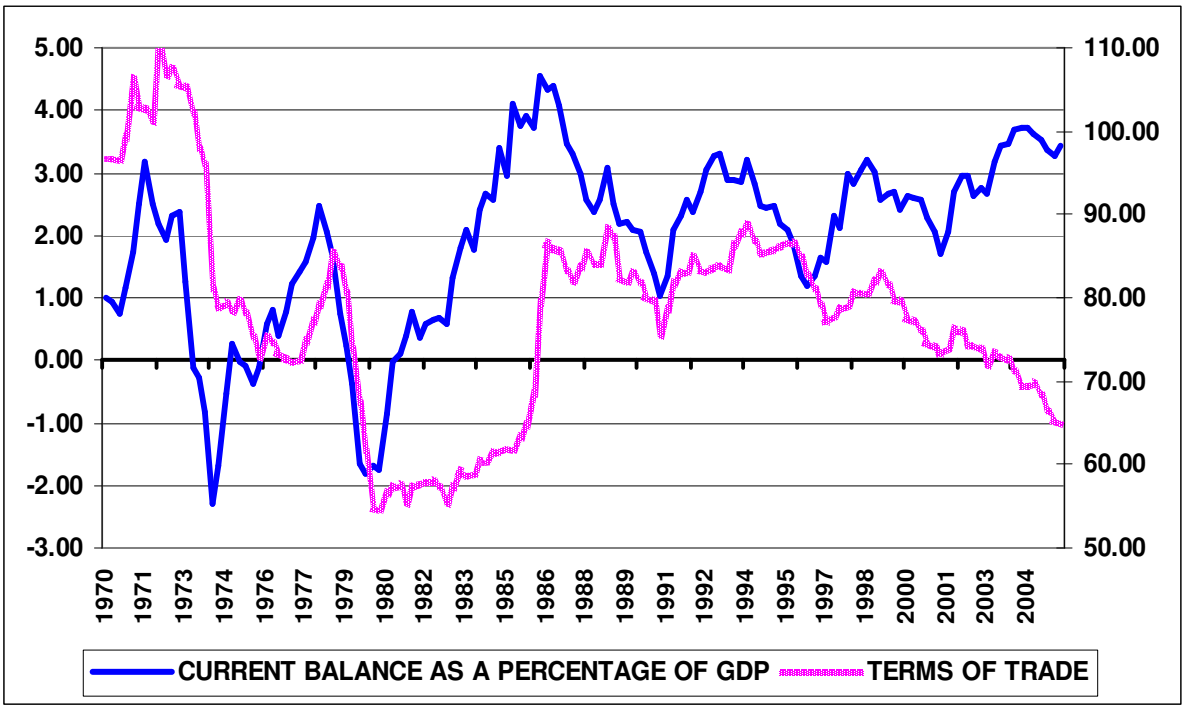

Figure 3: Japan – Current Account and Terms of Trade, 1970 – 2005

Source: OECD, Economic Outlook Database.

- The United Kingdom

The United Kingdom is one of the world's largest net capital recipients. It appears that developments in the oil sector had significant effects in the UK's current account fluctuations. Until 1975, during when the U.K. was an oil importer, the UK's current account was in deficit. However, the rapid development of North Sea oil fields improved oil output so sharply in the latter part of 1970's that the U.K. became an oil exporter. This caused a sharp improvement in the current account balance up to the early 1980's. Large oil exports accompanied by high oil prices contributed to current account balance in the first half of the 1980's. However, the oil price fell down in 1986. Therefore, the current account balance deteriorated thereafter, which revealed the fact that non-oil current account had been in deficit. Especially in the 1988-1990 period, the deficit exceeded 5% of GDP, which is considered large compared to the standards in the UK. In this period the UK's fiscal position was strengthening and the external deficit thus had private sector origins. This relationship between government budget balance and current account is demonstrated in Figure 4. The U.K. experienced a sharp deterioration in its government budget balance, which exceeded

8% in 1993; and then a sharp improvement, which exceeded 6% in 2000. Although both budget and current account deficits have hovered around 2% and 3% of GDP respectively since 2002, the movements in budget balance seems to be independent from that of current account, especially after 1990. The appreciation in the value of the pound, sustained economic growth and hence rising demand for imports can be counted as the causes of the current account deficit in the U.K.

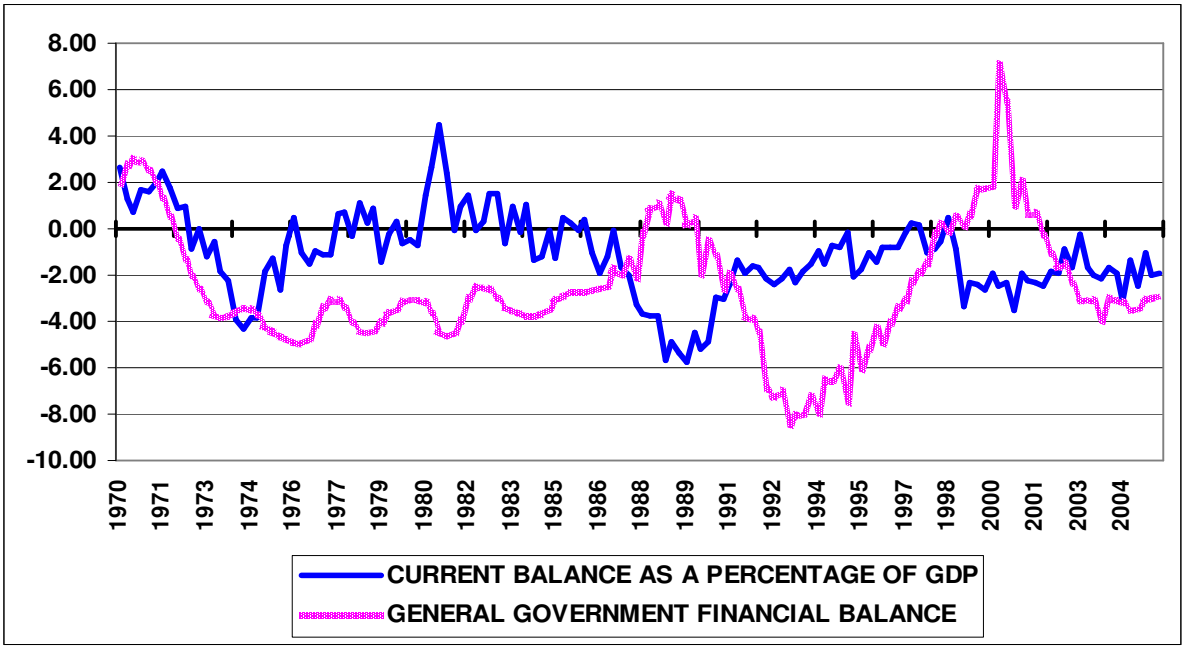

Figure 4: The United Kingdom - Current Account and Budget Balance, 1970 – 2005

Source: OECD, Economic Outlook Database.

The relationship between current account and terms of trade is illustrated in Figure 5. The fluctuations of the two variables seem to be positively correlated during the 1970-1986 period. Large movements in current account are associated with movements in the terms of trade in the same direction. However, this almost one-to-one relationship between these two variables seems to disappear in 1986. There has been a sustained improvement in the UK's terms of trade index since 1995, implying an increase in the nations' purchasing power.

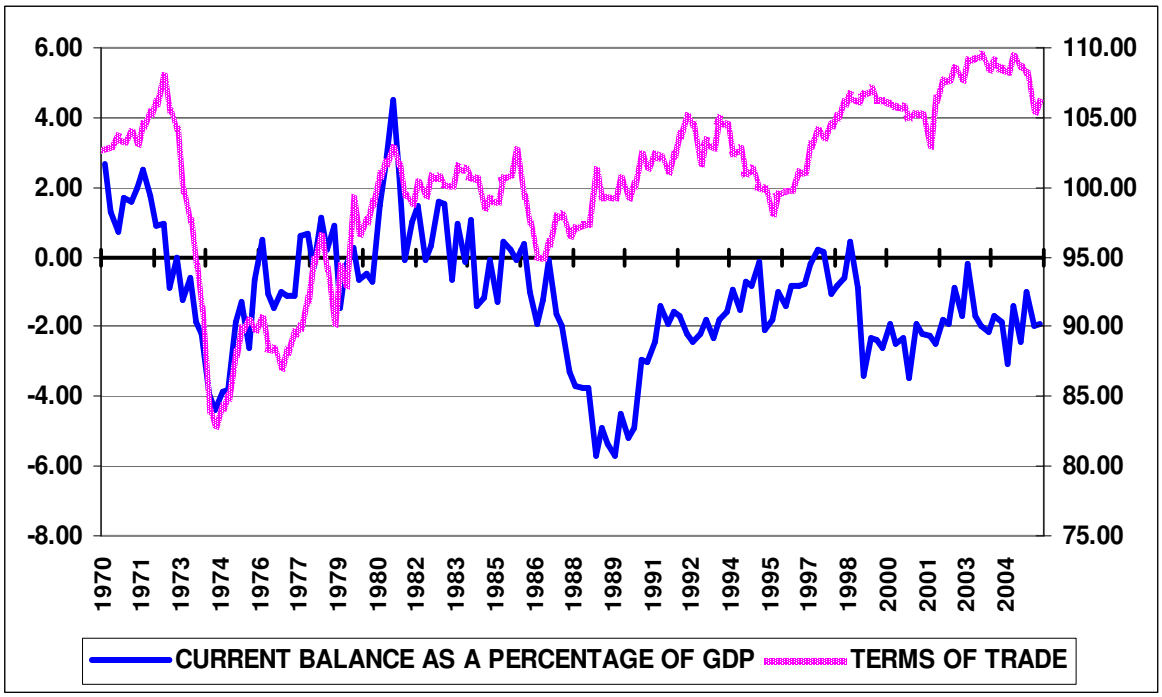

Figure 5: The United Kingdom – Current Account and Terms of Trade, 1970 – 2005

Source: OECD, Economic Outlook Database.

- The United States

The United States is the world's largest net capital recipient; its current account deficit has widened from $114 billion in 1995 to $760 billion in 2005, an increase from 1.5 percent of GDP to 6.1 percent of GDP. The deficit in the U.S. reflects the fact that domestic saving is not sufficient to finance domestic investment. The gap between the two is financed by net capital inflow from abroad.

Figure 6 shows the current account balance as a percentage of GDP and government budget balance as a percentage of GDP during the 1970-2005 periods. These two variables are often used together to study the twin deficit hypothesis; that is, other things being equal, an increase in government deficit leads to an increase in current account deficit. Since 1982 the United States has experienced large and persistent current account deficits, which are generally associated with budget deficits. Such a positive relationship is perceived in 1982 - 1985 periods and in recent years, during 2000 – 2004 periods, from Figure 6. However, for the other periods in the sample, it is hard to find evidence that supports the twin deficit hypothesis. Indeed, during the 1990 – 2000 period the current account balance and the

government balance tend to move in opposite directions. Although there is no one-to-one relationship, most economists agree that fiscal deficit is a public sector dissaving, which reduces the availability of domestic resources required for investment funding.

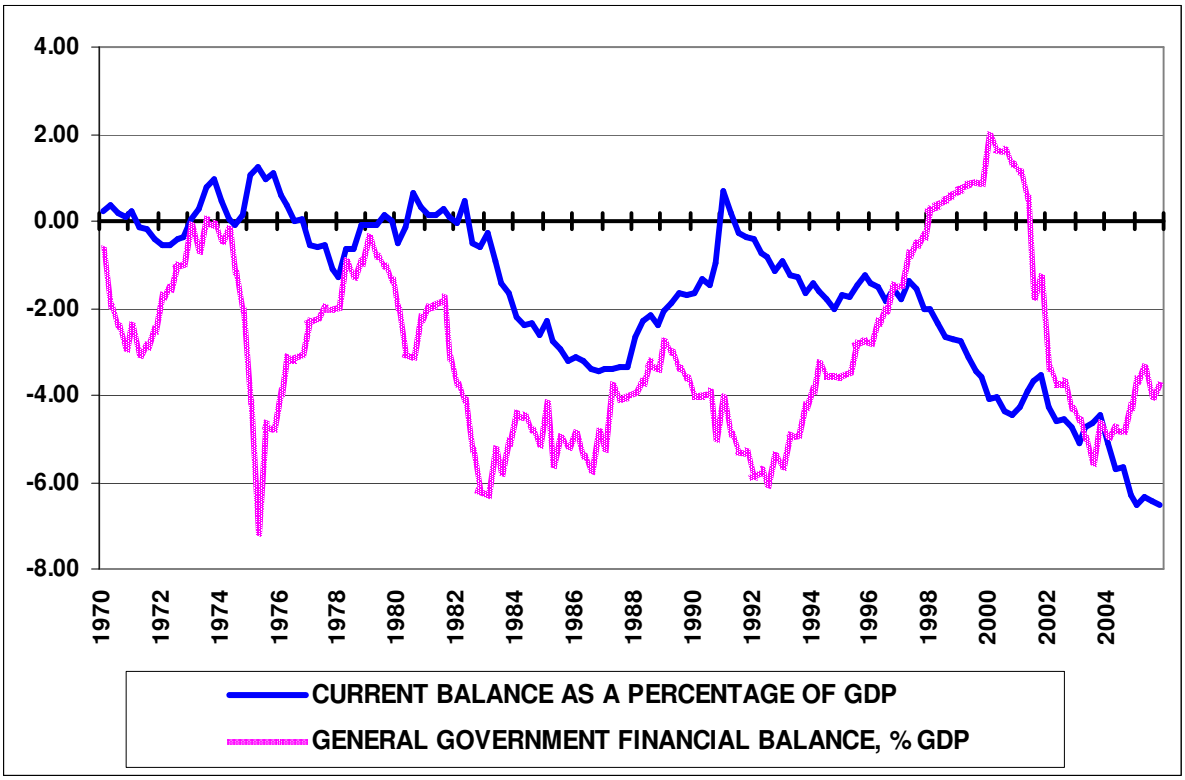

Figure 6: The United States - Current Account and Budget Balance, 1970 - 2005

Source: OECD, Economic Outlook Database.

The relationship between current account and terms of trade is illustrated in Figure 7. The Unites States has experienced sizeable shifts in its terms of trade. Although current account seems to decrease independently from terms of trade for the last ten years, terms of trade tend to lead the movements in current account during the 1970 – 1995 periods. The overall picture illustrates that large movements in the terms of trade are associated with movements of the current account in the same direction. The Pearson correlation coefficient is calculated as 0.37 and it is different than zero at 1% significance level. This seems to be consistent with HLM effect and dominating consumption-smoothing effect.

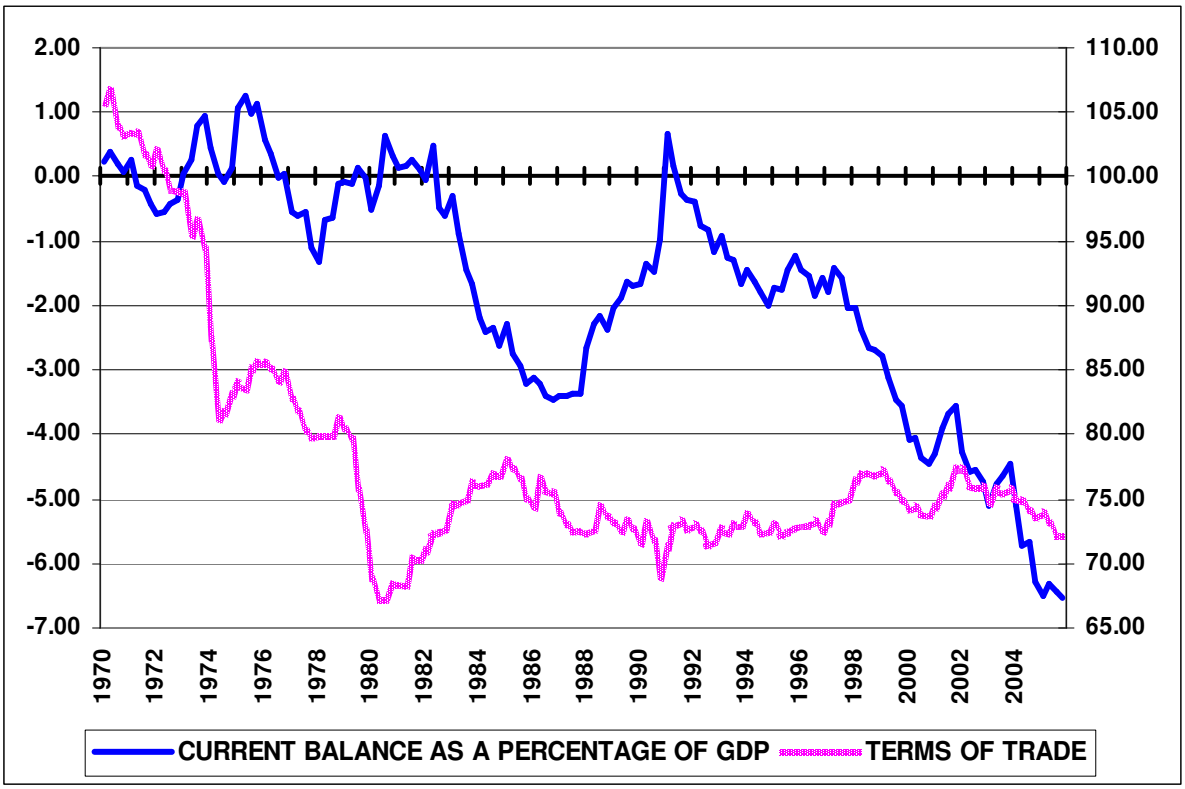

Figure 7: The United States – Current Account and Terms of Trade, 1970 – 2005

Source: OECD, Economic Outlook Database.

VI. EMPIRICAL METHODOLOGY

The determination of the current account and its interaction with the variables proposed in the literature can be expressed by considering various approaches to the current account. Each approach adopts a different accounting identity, all of which must be satisfied so as not to constitute a theoretical conflict, since each one can be derived from national account framework. The intertemporal approach achieves a synthesis of the elasticity and absorption view. Unlike earlier approaches, it focuses on intertemporal optimization and in this approach, consumption smoothing across periods is regarded as the one of the main motives for the current account imbalances. In addition to this, the current account acts as a shock absorber to maintain a stable consumption path.

This paper estimates a current account model based on saving - investment balance. The current account deficit is reduced if a nation raises its saving rate or if it reduces investment. Therefore, it is certain that any variable affecting these two components would lead to a movement in the current account balance. Empirical studies in the literature mostly estimate either cross-sectional or panel regression models for the ratio of the current account balance to GDP. The contribution of this paper is to provide a dynamic vector autoregressive analysis, which is based on the idea that changes in the determinants of current account will only gradually materialize and have an impact. The VAR model provides a useful methodology for this subject, since it focuses on dynamic interrelationships among the variables. This dynamic property is captured by the lagged variables used to describe current and future movements of endogenous variables. The general VAR (p) model (vector autoregressive model of order p) in matrix notation can be written as:

$$y_t = v + A_1 y_{t-1} + ... + A_P y_{t-p} + u_t$$

where $y_t = (y_{1t},..., y_{nt})'$ is a n-dimensional time series vector of random variables, v is a (n x 1) vector of intercept terms, the A_i are (n x n) coefficient matrices and $u_t = (u_{1t},..., u_{nt})'$ is a n-dimensional white noise or innovation process. The white noise process u_t satisfies $E(u_t) = 0$, $E(u_t u_t') = \Sigma$ and $E(u_t u_s') = 0$ for s ≠ t.

Thus, each element of u_t has zero mean, the variance-covariance matrix of u_t is constant over time and the elements of u_t have zero autocorrelations and zero cross-correlations over time.

Several variables are included in the vector $y_t = (y_{1t},..., y_{nt})'$. For example, the model regarding current account balance expressed, as a ratio to GDP will be estimated is as follows:

$$y_{1t} = \delta + \alpha_1 y_{1t-1} + \ldots + \alpha_p y_{1t-p} + \ldots + \beta_1 y_{nt-1} + \ldots + \beta_p y_{nt-p}$$

Here, y_{1t} stands for the current account balance expressed as a ratio to GDP, which is normalized to control for scale effects. A negative value of this variable represents a current account deficit. The model is dynamic in nature because it includes a lagged dependent variable, y_{1t-1} and lags of other explanatory variables.

The data vector, $y_t = (y_{1t},..., y_{nt})'$ includes five variables discussed above (GDPGRWT, TRMSTRD, GOVBAL, OPEN, CURRACC), where GDPGRWT is the average real GDP growth, TRMSTRD is terms of trade, GOVBAL is government budget balance as a percentage of GDP, OPEN is the openness ratio and CURRACC is the current account as a percentage of GDP.

- Stationarity – Cointegration

Before, studying the effect of shocks, the stochastic properties of the series are investigated. Initially, the stationarity properties of the five variables are considered using Dickey Fuller unit root tests. According to the results, the hypothesis of a unit root cannot be rejected for terms of trade, government balance, openness ratio and current account balance, which indicate that they are non-stationary. On the other hand, average real GDP growth is clearly stationary for all countries, even at a 99% significance level. Results of Dickey Fuller tests for each country are summarized in Table 3.

Table 3: Results of Dickey-Fuller Unit Root Tests

	Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Japan	-7.12***	-2.05	-2.38	-2.59	-3.05
The United Kingdom	-7.78***	-2.79	-2.47	-3.25	-3.09
The United States	-6.12***	-2.88	-1.97	-2.91	-1.53

In the models with constant and trend, the rejection of the null hypothesis: -4.32 (1%), -3.78 (5%) and -3.50 (10%).
One/two/three asterisks denote the rejection of the null hypothesis at 10% - 5% -1% critical levels.

Next, Johansen's cointegration analysis is employed to see whether the linear combination of the series is stationary. Table 4 reports the results of the cointegration analysis for the VAR model with 4 lags. The table includes Johansen's trace statistic that is used to determine the cointegration rank. Results of trace tests suggest that the rank is two for Japan and one for the United States, since the null hypothesis of r = 2 and r = 1 are not rejected at 90% respectively. On the other hand, the rank for the United Kingdom is five. In this case, the system can be estimated by applying VAR in levels because each variable in y_t must be considered as stationary.

If data series are I (1) processes and if there are any cointegrating relations, then the dynamic model is generally estimated by using error correction models to overcome the spurious regression problem. However, there are some conflicting opinions about the subject in the literature.

For example, Sims, Stock and Watson (1990) show that the common practice of transforming models to stationary form by difference or cointegration operators whenever the data are integrated is in many cases unnecessary. Dickey (1988) also argues that if the error series is stationary, a regression in levels is appropriate. On the other hand, Phillips (1998) compares unrestricted VARs with reduced rank regressions (RRR) and error correction models (ECM). He finds that estimated impulse responses and forecast error decompositions are inconsistent at very long horizons in unrestricted VARs with some unit roots. On the other hand, reduced rank regressions produce impulse responses and forecast error variance estimates that are consistent provided the cointegrating rank is correctly specified. In contrast to Phillips, Mitchell argues that when the data are nearly

cointegrated, then not only does the VAR in levels provide misleading inference about long-run impulse responses but so does a reduced rank VAR.

Table 4: Cointegration Rank Test Using Trace

		Japan		**The United Kingdom**		**The United States**		10%
H_0: Rank=r	H_1: Rank>r	Eigenvalue	Trace	Eigenvalue	Trace	Eigenvalue	Trace	Critical Value
0	0	0.3200	125.5466	0.3258	122.1935	0.3957	108.8866	73.62
1	1	0.2806	73.0922	0.2030	68.5879	0.1268	40.384	50.67
2	2	0.1287	28.3085	0.1292	37.7282	0.0895	21.9442	31.57
3	3	0.0502	9.5695	0.0903	18.9101	0.0465	9.1985	15.94
4	4	0.0187	2.5634	0.0434	6.0319	0.0198	2.7219	2.71

Apart from these theoretical discussions, Dibooğlu (1997) tests the robustness of his error correction model for the U.S. considering a VAR in levels and he finds that the results of VAR in levels are very similar to the VECM results. Therefore, based on the Dickey (1988)'s and Sims, Stock and Watson (1990)'s argument and the empirical study in Dibooğlu (1997)'s paper, although the four data series appear to be non-stationary and there are cointegrating relations, this paper estimates the dynamic model using unrestricted VAR. However, taking into consideration the discussions mentioned above, in addition to unrestricted VARs, impulse responses of error correction models will also be reported.

- <u>VAR Order</u>

There are various VAR order (p) selection criteria determined by the literature, like the Akaike Information Criterion (AIC), Hannan-Quinn (HQ) Criterion and Schwarz Bayesian Criterion (SBC). Lütkepohl (1985) found that Schwarz's Bayesian Criterion is more effective in terms of choosing the right model order when it is compared to other selection criteria, since this criterion imposes the highest penalty for including too many terms in a regression model. Therefore, in this paper to find the correct VAR order Schwarz's Bayesian Criterion is used. According to the result, it is optimal to include two lags in the model for Japan and just one lag in the model for the United Kingdom and the United States.

- Residual Correlation

However, it is sometimes necessary to increase the number of lags included in the model, if there is autocorrelation between residuals. Error terms are often serially correlated or auto correlated, when time series data are used. In this case the efficiency of ordinary least-squares (OLS) parameter estimates is adversely affected and standard error estimates are biased. Portmanteau tests are applied to check the whiteness of the residuals, in other words to test nonzero residual autocorrelations. More clearly, Portmanteau test checks the null hypothesis

$$H_o: E(u_t u_s') = 0$$

against the alternative that at least one autocorrelation is nonzero. Lütkepohl (1993) states that it may be helpful to increase lag orders in order to remove significant residual autocorrelation. To eliminate the autocorrelation problem, four lags are included in the VAR model for all countries. In addition to this, a linear time trend is added to the regressors to account for trend effects not captured by five variables. Quarterly seasonal dummy variables were not significant. Therefore, they were removed from the models.

VII. EMPIRICAL RESULTS

There are three ways to interpret VAR model results; Granger causality test, impulse response analysis and forecast error variance decomposition. In the following subsection you will find the detailed application of these three methods for each of the three major industrialized countries, Japan, The United Kingdom and the United States.

1. Granger Causality Test Results

Once a linear model is assumed and the number of lags that will be included in the model is decided, the ordering of variables in the system must be determined. Due to the orthogonalization method[3], the results of impulse response analysis and error variance decomposition are dependent on the ordering of variables. Contemporaneously exogenous variables should be ordered first. The first variable is the only one that has potential immediate impact on all other variables. However, this impact is one-sided, the rest of the variables do not have an impact on the variable ordered first. Likewise, the second variable affects contemporaneously the other variables, with the exception of the first one. However, this effect is again one-sided.

Granger causality test results are used to determine the ordering of variables in the VAR model. Granger causality test shows the F-statistics for exclusion of the past lags of each variable in each equation of the five separate systems. The related test statistics are reported in Table 5. These test statistics depict whether a set of variables contains useful information in explaining another set of variables. In other words, the null hypothesis that all four lags of the variable indicated in the column head are jointly zero in the equation regarding the corresponding dependent variable is tested. Based on the results, the following ordering is assumed: average real GDP growth (GDPGRWT), terms of trade (TRMSTRD), government budget balance as a percentage of GDP (GOVBAL), openness ratio (OPEN) and current account as a percentage of GDP (CURRACC). It should be noted that alternative orderings might give different results for impulse response analysis and error variance decomposition.

[3] If innovations within a VAR model are contemporaneously correlated, then innovations can be orthogonalized by using Choleski decomposition. Since the resulting matrix is lower triangular, ordering of variables matters.

The Granger causality test results and the ordering of the variables should not be in contradiction with the structure suggested by the economic theory and the goal of this paper. Undoubtedly, country experiences are varied. For example, for the United States although average real GDP growth is Granger-caused by terms of trade, it is considered as the most exogenous variable and is ordered first, because it is the basic macroeconomic variable that shows the general performance of the economy. Any improvement or deterioration in real GDP stimulates the other variables in the economy. Real GDP growth is followed in the system by terms of trade, which is expected to be relatively exogenous. This is because, although the economies analyzed here are rather large, they have little influence on world prices. Government budget balance is Granger-caused by itself as well as by lagged GDP growth and lagged terms of trade. Meanwhile, Granger causality results suggest that openness ratio is Granger-caused by itself as well as GDP growth, terms of trade and current account. Finally, current account is expected to be the most endogenous of the five variables and hence ordered last. Since this VAR model includes the standard determinants of current account, it is likely that current account is endogenously affected by the other four variables.

The Granger causality test demonstrates pretty different results for the current account equation. For example, the current account is not Granger caused by any of the hypothesized causal variables for the United States. On the contrary, all variables as well as their four lags are significant in explaining the current account for the United Kingdom. According to the results for Japan, current account is Granger-caused by itself and real GDP growth.

Table 5: Granger causality testing results for five-variable VAR model

Japan	Lagged Independent Variables				
Dependent Variables	Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average GDP Growth	11.89	4.38	1.39	2.86	10.46
	(0.0182)*	(0.3565)	(0.8464)	(0.5822)	(0.0334)*
Terms of Trade	12.98	508.10	0.32	11.09	25.92
	(0.0114)*	(0.0001)*	(0.9886)	(0.0255)*	(0.0001)*
Government Balance % GDP	28.12	5.74	9999.99	8.23	1.83
	(0.0001)*	(0.2192)	(0.0001)*	(0.0835*)	(0.7661)
Openness Ratio	6.35	2.48	6.38	331.99	19.48
	(0.1742)	(0.6474)	(0.1726)	(0.0001)*	(0.0006)*
Current Account % GDP	8.25	1.32	7.00	4.26	321.81
	(0.0828)*	(0.8580)	(0.1359)	(0.3720)	(0.0001)*

The United Kingdom	Lagged Independent Variables				
Dependent Variables	Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average GDP Growth	5.99	2.87	0.54	2.27	11.96
	(0.2001)	(0.5804)	(0.9695)	(0.6871)	(0.0177)*
Terms of Trade	14.97	200.54	9.69	2.85	4.32
	(0.0048)*	(0.0001)*	(0.0460)*	(0.5827)	(0.3650)
Government Balance % GDP	2.84	2.39	685.28	0.58	5.29
	(0.5849)	(0.6636)	(0.0001)*	(0.9652)	(0.2590)
Openness Ratio	9.85	6.62	1.62	228.11	11.10
	(0.0431)*	(0.1572)	(0.8043)	(0.0001)*	(0.0254)*
Current Account % GDP	11.27	14.16	7.83	15.80	59.04
	(0.0237)*	(0.0068)*	(0.0980)*	(0.0033)*	(0.0001)*

The United States	Lagged Independent Variables				
Dependent Variables	Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average GDP Growth	0.81	19.33	6.83	6.60	5.68
	(0.9368)	(0.0007)*	(0.1453)	(0.1585)	(0.2246)
Terms of Trade	10.51	1074.51	1.78	5.82	6.56
	(0.0327)*	(0.0001)*	(0.7768)	(0.2134)	(0.1608)
Government Balance % GDP	10.38	10.12	296.42	4.64	2.47
	(0.0344)*	(0.0384)*	(0.0001)*	(0.3264)	(0.6509)
Openness Ratio	15.91	8.64	6.66	324.21	19.43
	(0.0031)*	(0.0708)*	(0.1549)	(0.0001)*	(0.0006)*
Current Account % GDP	5.87	1.59	5.24	1.56	653.48
	(0.2088)	(0.8110)	(0.2635)	(0.8152)	(0.0001)*

Numbers in parenthesis are p-values. Asterisks are statistical significance at the 0.10 level

2. Impulse Response Analysis

The response of one variable to an impulse in another variable is also one type of relationship that is generally analyzed in VAR models. Impulse response functions are used to trace out the effect of an exogenous shock or innovation in one of the variables on other variables. Here, you will find the responses of each variable to orthogonal (uncorrelated) impulses. Generally, innovations are not contemporaneously independent of each other. In other words, an innovation in one variable is likely to be accompanied by an innovation in another variable. Therefore, innovations can be orthogonalized to find a better way of representing actual dynamic relationships between the variables. With orthogonal impulses, a shock to the variable placed higher in the ordering implies a shock to the variables lower in the ordering, but not vice versa. For example, a shock to average real GDP growth will contemporaneously change terms of trade, but a shock to terms of trade will not contemporaneously change average real GDP growth. Although in real economic systems almost everything depends on everything else, an assumed causal ordering of the variables is specified above.

Three industrialized countries are analyzed separately in order to investigate whether there is any systematic pattern in their responses. Star variables indicate statistically significant impulse responses at the 10% level. Standard errors for impulse responses are calculated by SAS using the asymptotic interval method (see Lütkepohl (1993)), which is an approximation appropriate for large samples.

- Japan

Orthogonalized impulse responses for Japan are presented in Figure 8 through 12.

Figure 8 illustrates the response of current account to one standard deviation innovation in each of the variables. A positive shock to current account brings about an immediate, significant increase in itself. This positive response is significant for four quarters following the shock. A positive shock to real GDP growth creates small but statistically significant negative adjustment to current account in the second through fourth quarters. This adjustment implies that the positive productivity shock increases either investment or imports and worsens current account. This finding is consistent with Gruber and Kamin's

(2005) result, which states that larger current account balances are associated with lower growth rates.

An exogenous increase in terms of trade brings about a positive adjustment in current account balance that lasts six quarters. According to the intertemporal framework, the response of current account to terms of trade shocks depends on the degree of consumption tilting and consumption smoothing effects. If consumption smoothing effect dominates, there will be a positive relationship between the shock and the current account. This is because, as terms of trade improve, the purchasing power of a country's exports increases and consumption smoothing effect leads individuals to save more and consume later. This positive relationship between terms of trade and current account is consistent with Calderòn, Chong and Loayza (1999)'s findings, which confirms Harberger-Laursen-Metzler effect.

An exogenous increase in the government budget balance brings about a positive adjustment in current account. This response is significant in the fifth through the twelfth quarters following the shock. Chinn and Prasad (2000) also find strong positive relationship between these two variables from cross-sectional regressions for industrial countries.

An exogenous positive shock to openness leads to an immediate increase in current account balance. This increase is also significant in the eight quarter. Since openness is equal to the sum of imports and exports over GDP, this positive impulse in current account implies that the shock in openness mainly reflects an increase in exports rather than an increase in imports. Although Chinn and Prasad (2000) find no association between openness and current account in industrial countries, this positive relationship between openness and current account is consistent with Gruber and Kamin (2005)'s result.

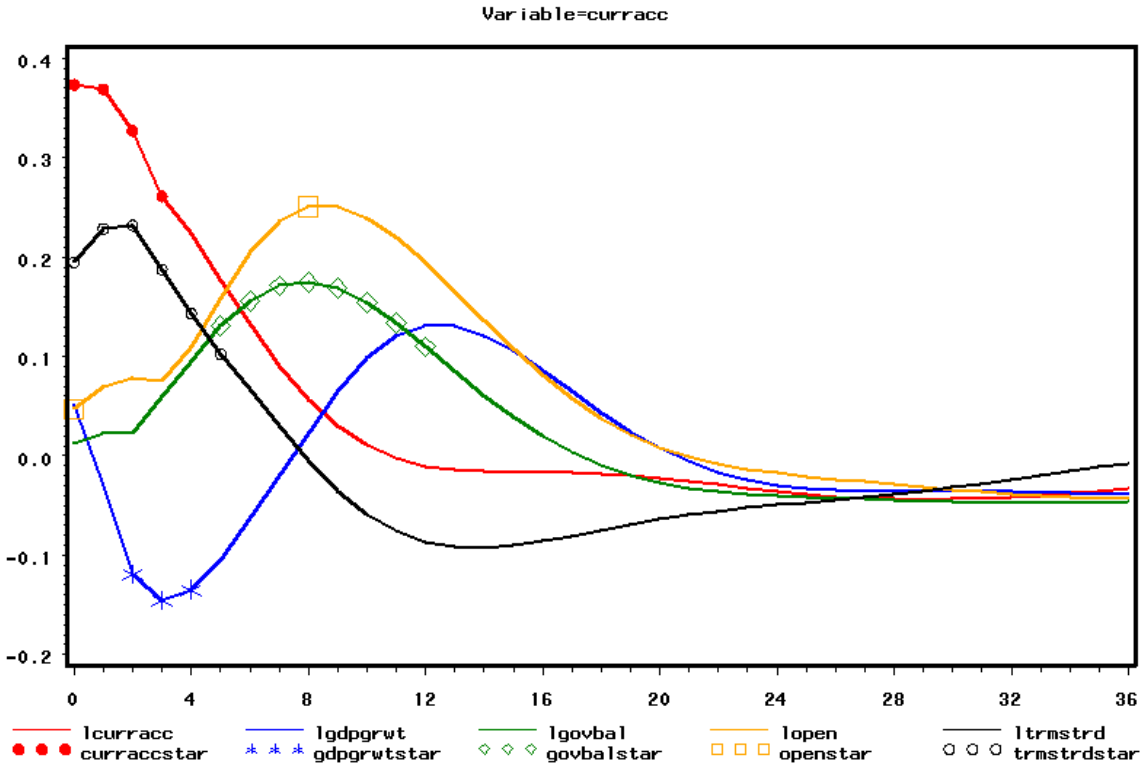

Figure 8: Current Account Responses to One Standard Deviation Shocks - Japan

Star variables indicate statistical significance at the 10% level.

Figure 9 illustrates the dynamic adjustments of government budget balance to one standard deviation innovations in each of the variables. Government budget balance has significant responses to innovations in itself and average real GDP growth. A positive shock to fiscal balance brings about an adjustment in itself that persists for twenty-one quarters. Real GDP growth shock also draws attention. This is because an increase in GDP growth results in an immediate significant increase in fiscal balance that persists for twenty-five quarters. This adjustment implies that output increases during economic booms improve the government budget balance.

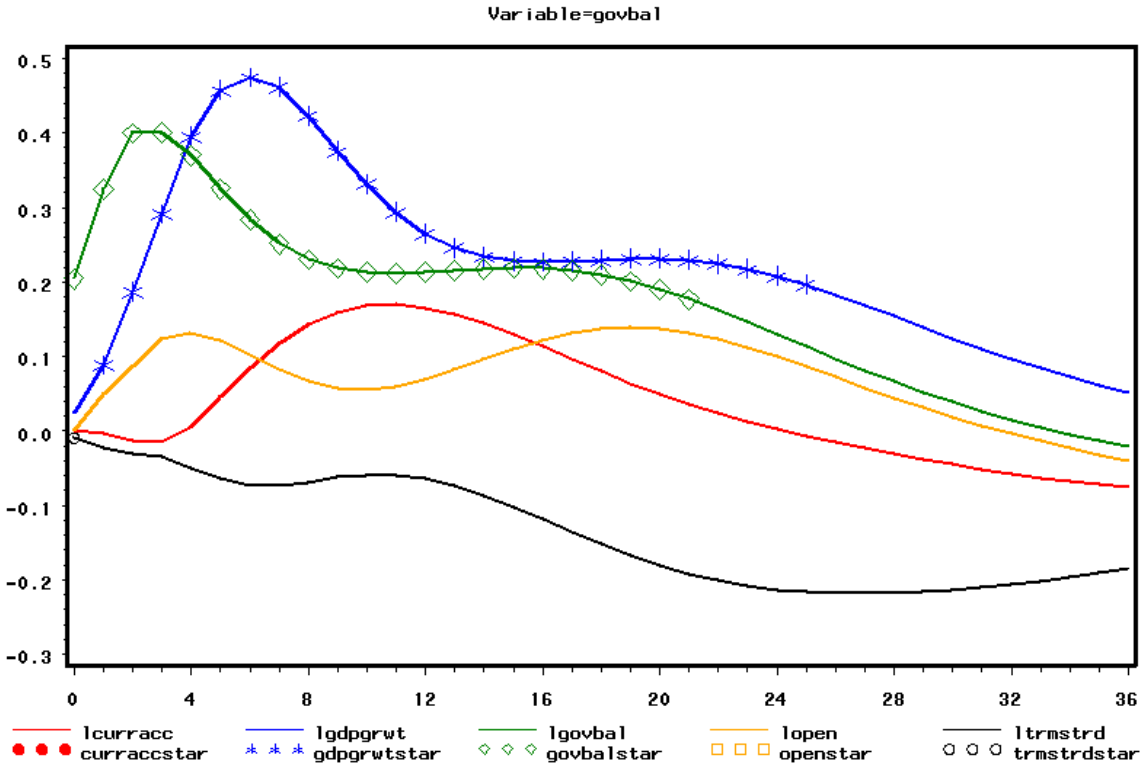

Figure 9: Gov. Budget Balance Responses to One Standard Deviation Shocks - Japan

Star variables indicate statistical significance at the 10% level.

Figure 10 illustrates the real GDP growth responses to shocks in each of the variables in the system. An exogenous increase both in GDP growth and in current account leads to a significant positive adjustment in GDP growth. These responses are significant in the first and fourth quarters for GDP growth and first and sixth quarters for the current account. Since this figure illustrates the response of a growth variable, impulse responses are not as smooth as that of other variables. But the direction of the responses is very similar to those that are found with the VAR model when a level variable – real GDP per capita – is used instead of average real GDP growth.

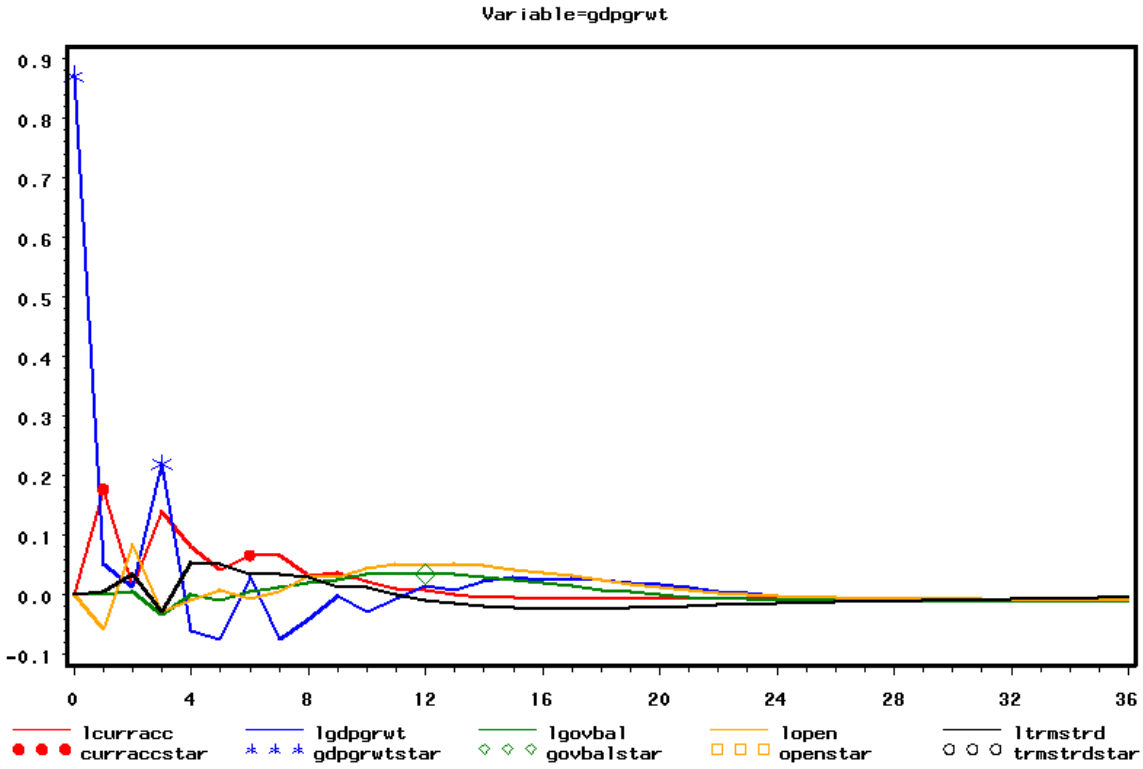

Figure 10: Real GDP Growth Responses to One Standard Deviation Shocks - Japan

Star variables indicate statistical significance at the 10% level.

Figure 11 illustrates openness responses to exogenous shocks. Innovations in openness bring about a positive significant response in the three quarters following the innovation. An increase in fiscal balance results in a significant increase in openness ratio that dies off gradually in time. However, the openness ratio displays a negative adjustment to fiscal balance shocks in the eight through twentieth quarter. On the other hand, a positive shock to terms of trade and current account brings about a decrease in the openness ratio, which is significant in the first through ninth quarters and second through fifth quarters respectively. Innovations in GDP growth rate also create a negative significant response in the thirteenth through twentieth quarters.

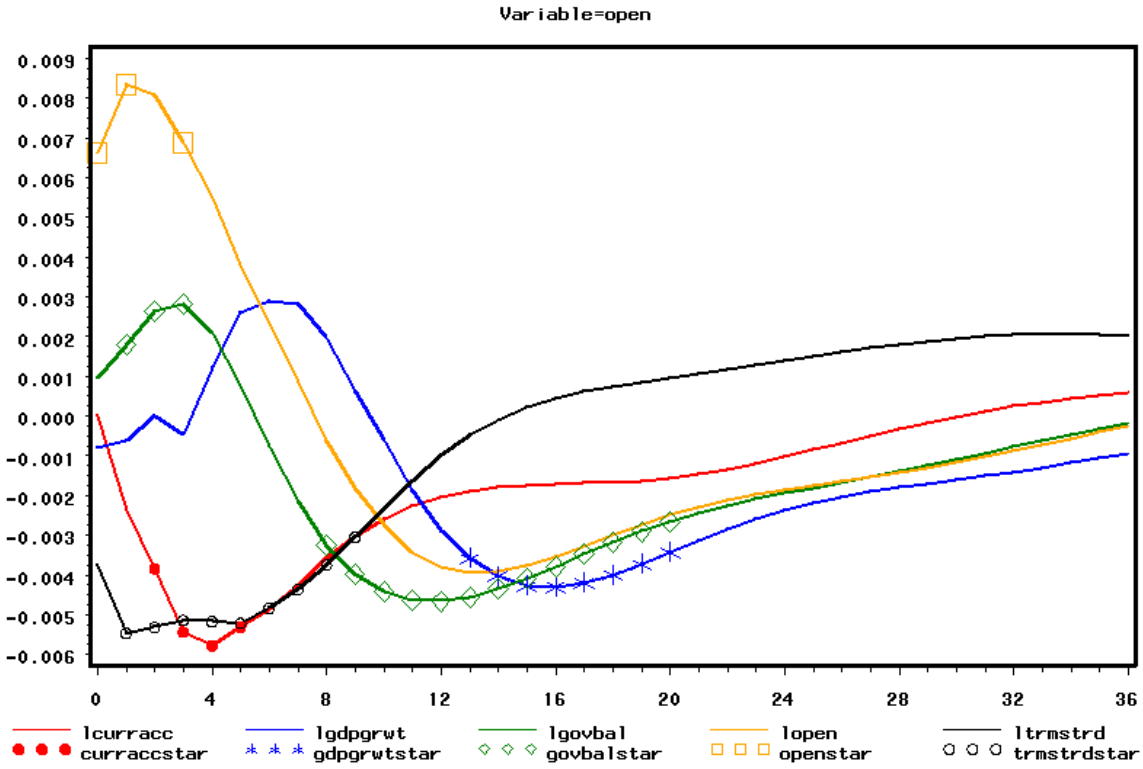

Figure 11: Openness Responses to One Standard Deviation Shocks - Japan

Star variables indicate statistical significance at the 10% level.

Figure 12 contains terms of trade responses to shocks in each of the variables in the VAR model. A positive shock to terms of trade brings about a positive adjustment that gradually dies off after thirteen quarters. Innovations both in current account and in fiscal balance also lead to an increase in terms of trade, which is significant in the second through fifth quarters and in the eighth through twentieth quarters respectively.

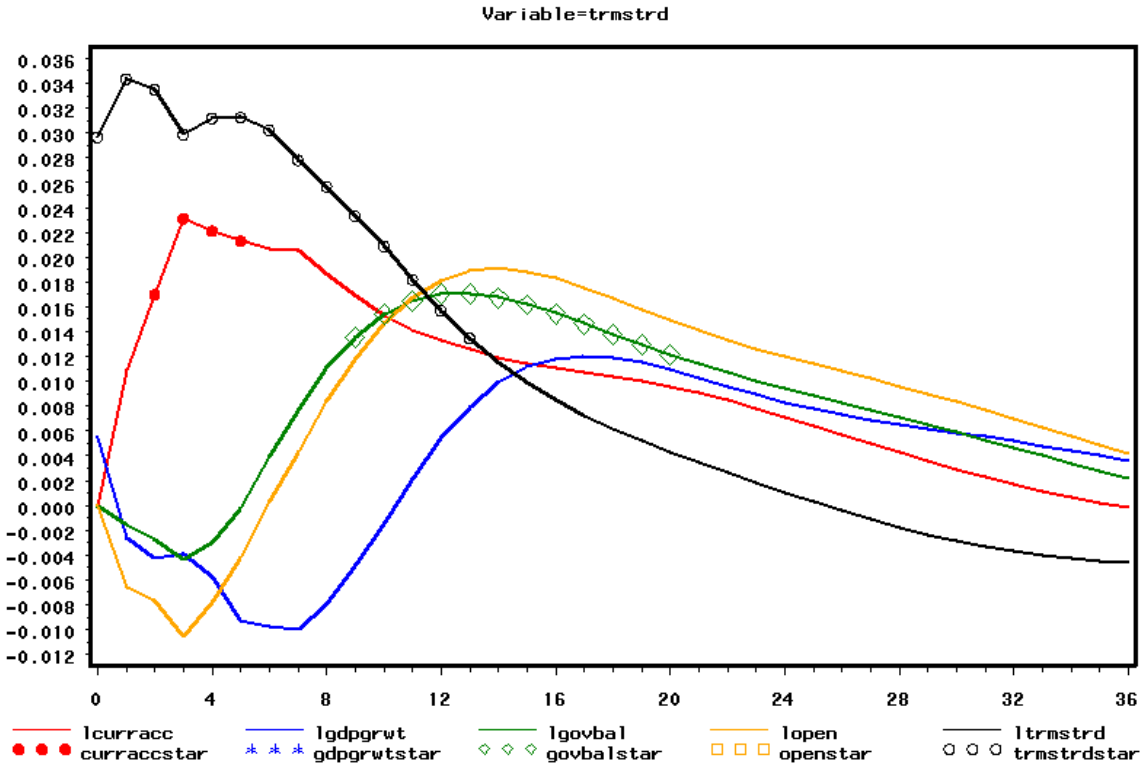

Figure 12: Terms of Trade Responses to One Standard Deviation Shocks - Japan

Star variables indicate statistical significance at the 10% level.

- The United Kingdom

Orthogonalized impulse responses for the United Kingdom are presented in Figure 13 through 17. Figure 13 demonstrates the dynamic adjustments of current account to one standard deviation innovation in each of the variables. A positive innovation in current account results in an adjustment in itself that persists for eight quarters. The immediate response of current account in the U.K. is considerably higher relative to Japan and the U.S. A positive shock to real GDP growth creates statistically significant negative adjustment to current account, implying that the positive productivity shock increases investment (or import) and worsens the current account.

An exogenous increase in terms of trade brings about a positive adjustment in current account balance that lasts seven quarters. This positive relationship demonstrates that the consumption smoothing effect dominates the consumption-tilting effect. As terms of trade improve, the purchasing power of a country's exports increase and consumption smoothing

effect leads individuals to save more and consume later. The positive relationship between the two variables is again in accordance with Harberger-Laursen-Metzler effect.

On the other hand, a shock in government budget balance has no significant effect on current account. This lack of significant relationship implies that the negative impact of budget deficit on current account is offset by private sector saving-investment decisions. This finding in the U.K. is different from both other country experiences - an exogenous shock in budget balance creates a positive adjustment in current account both in Japan and in the U.S. - and literature results including Chinn and Prasad (2000) and Gruber and Kamin (2005).

An exogenous positive shock to openness leads to an immediate small decrease in current account balance. Since openness is equal to the sum of imports and exports over GDP, this positive impulse in current account implies that the shock in openness mainly reflects an increase in imports.

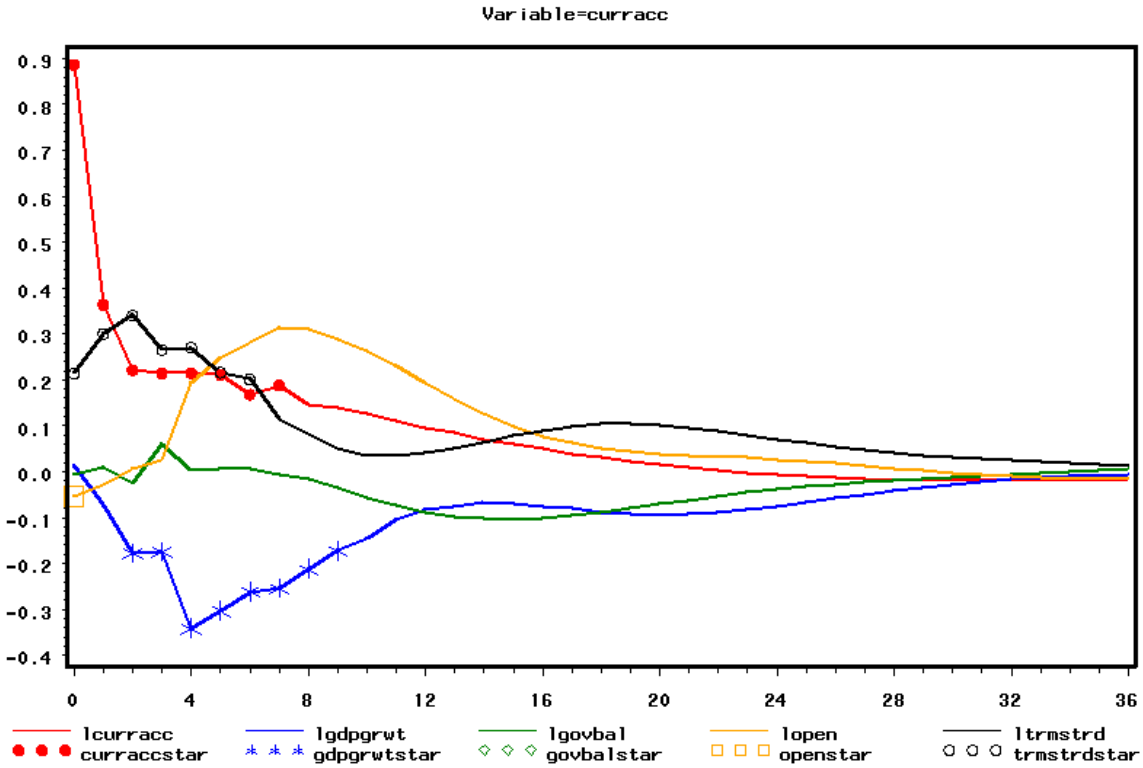

Figure 13: Current Account Responses to One Standard Deviation Shocks - The U.K.

Star variables indicate statistical significance at the 10% level.

Figure 14 contains government budget balance responses to shocks in the variables. Positive innovations in government balance bring about an immediate increase in government balance that gradually dies off in ten quarters. In addition to this, an exogenous positive shock to GDP growth leads to an increase in government balance, which is significant in the third through eleventh quarters. This implies that output increases during economic booms improve the government budget balance. An exogenous increase in terms of trade leads to a decrease in government balance immediately. This response is also significant in the third through seventh quarters following the shock. Furthermore, different from the findings in Japan and in the U.S. innovations in current account creates positive adjustment in government balance, which is significant in the thirteenth through nineteenth quarters following the innovation. In other words, the direction of the relationship flows from current account to government balance, not from government balance to current account.

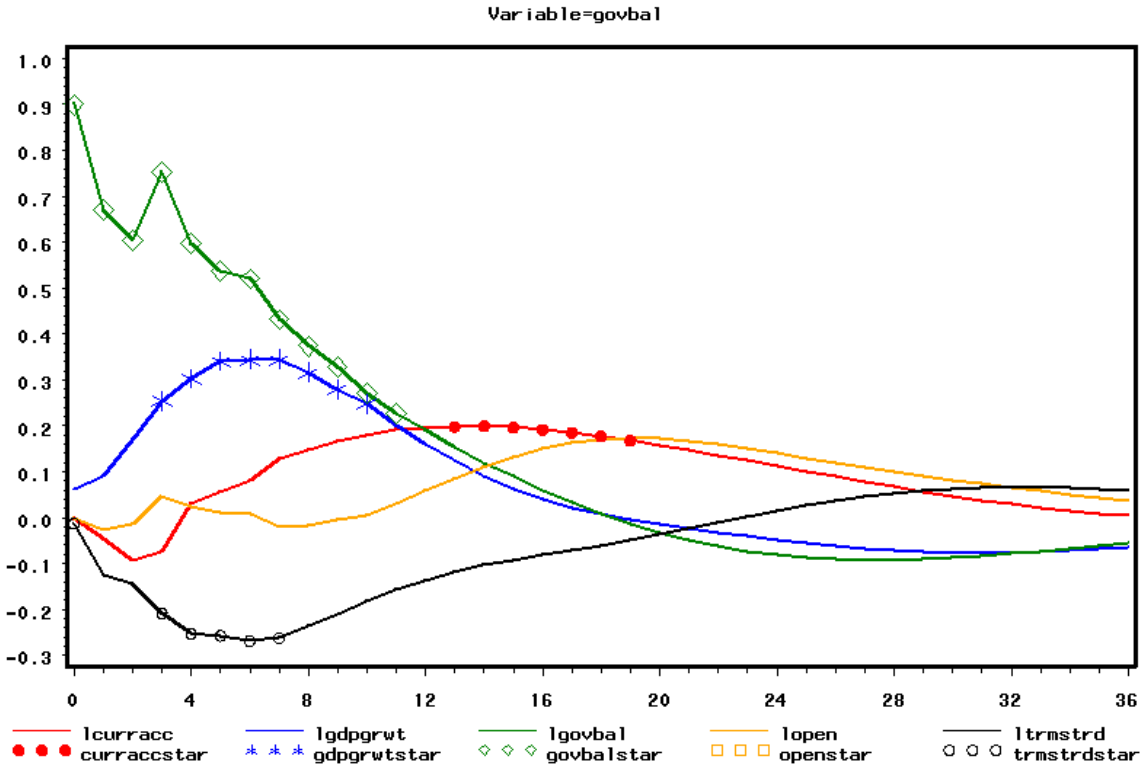

Figure 14: Gov. Budget Balance Responses to One Standard Deviation Shocks – The U.K.

Star variables indicate statistical significance at the 10% level.

Figure 15 illustrates the real GDP growth responses to shocks in each of the variables in the system. GDP per capita responses are only significant in response to innovations in itself

and current account. While an exogenous increase in GDP growth brings about a positive adjustment in itself, a positive shock to current account causes a decrease in GDP growth in the first quarter.

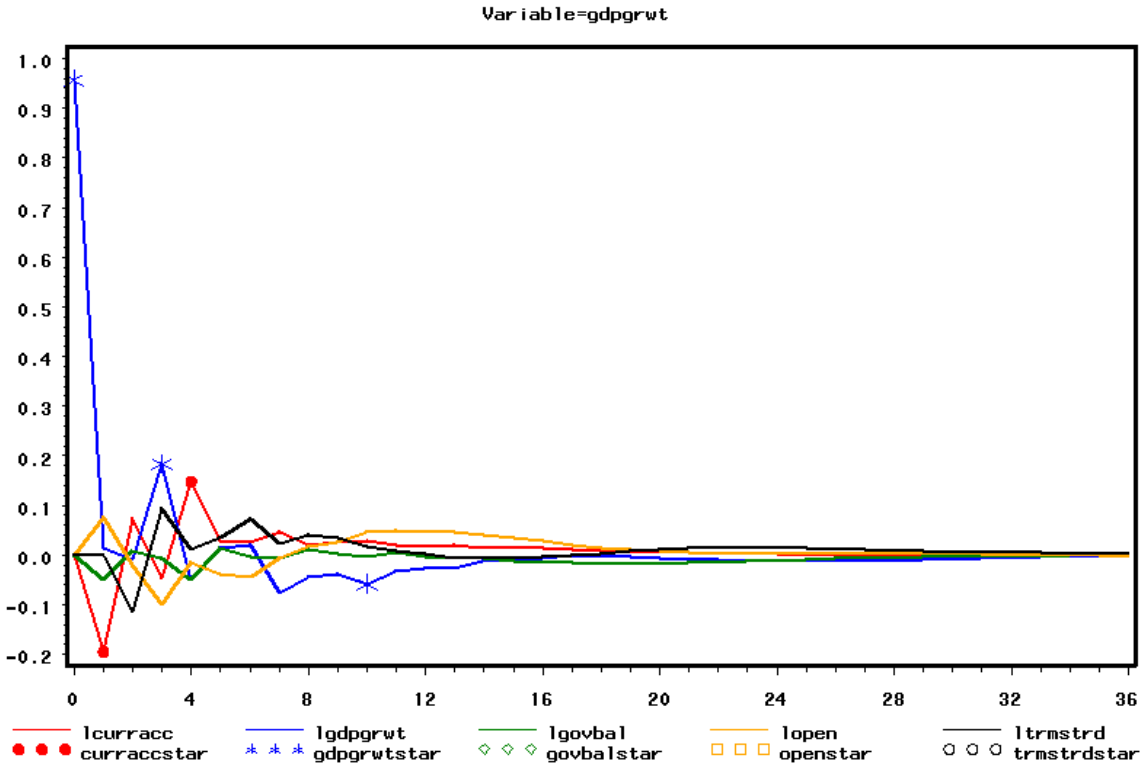

Figure 15: Real GDP Growth Responses to One Standard Deviation Shocks - The U.K.

Star variables indicate statistical significance at the 10% level.

Figure 16 illustrates openness responses to exogenous shocks. An increase in openness ratio results in a significant increase in openness ratio that dies off gradually in time. A positive exogenous shock to current account and GDP growth brings about a positive adjustment in the openness ratio, which is significant in the third and fifth quarters respectively. On the other hand, a positive shock to terms of trade brings about a negative adjustment in the seven quarters following the shock, which implies that, the amount of exports decrease as a result of an increase in the price of exports. In addition to this, a positive shock to government balance brings about a decrease in the openness ratio.

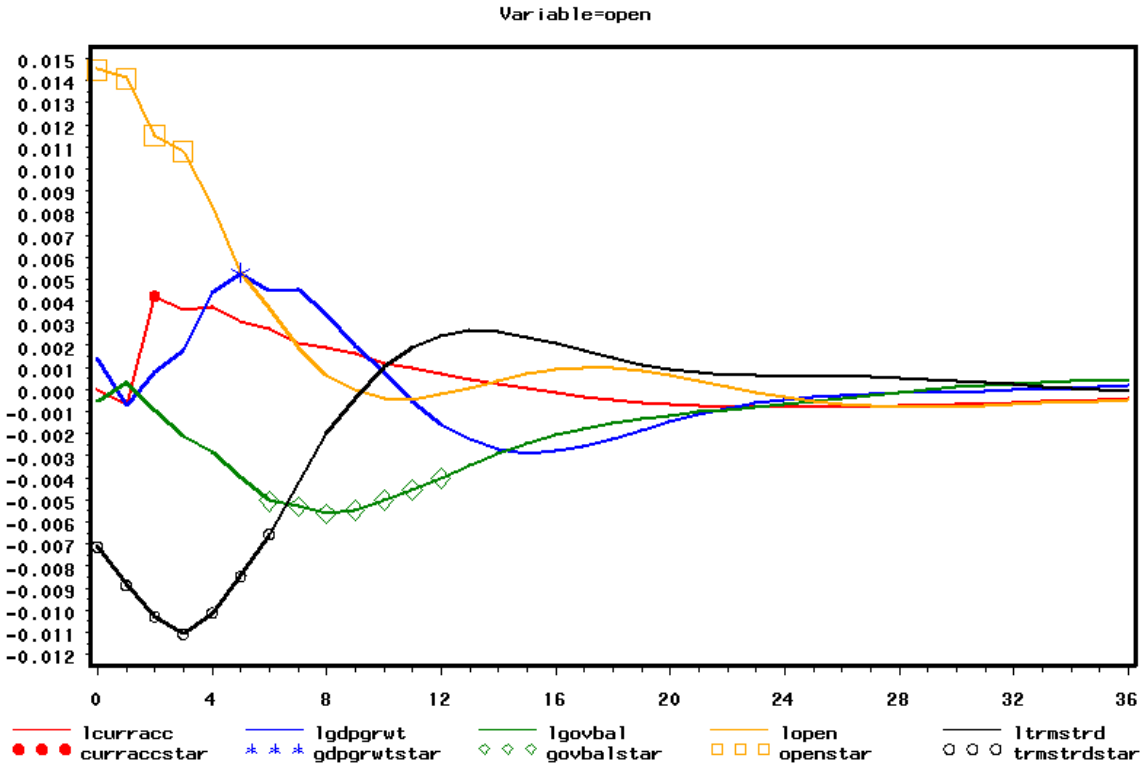

Figure 16: Openness Responses to One Standard Deviation Shocks - The U.K.

Star variables indicate statistical significance at the 10% level.

Figure 17 contains terms of trade responses to shocks in each of the variables. Terms of trade responses are significant only to shocks in itself, government balance and GDP growth. A positive shock to terms of trade brings about a positive adjustment, which is significant eight quarters following the shock. In addition to this, innovations in government balance bring about a significant positive response. On the other hand, an exogenous increase in GDP growth results in a negative adjustment in terms of trade.

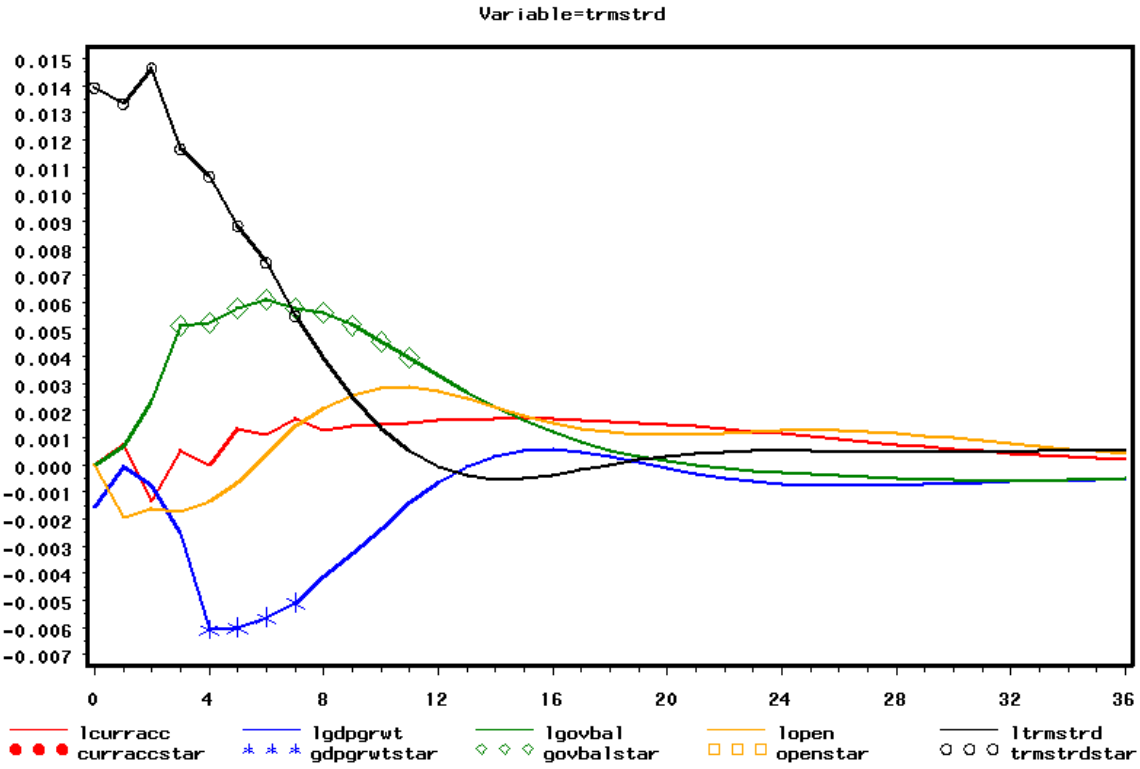

Figure 17: Terms of Trade Responses to One Standard Deviation Shocks - The U.K.

Star variables indicate statistical significance at the 10% level.

- The United States:

Orthogonalized impulse responses for each variable in the system are presented in Figure 18 through 22 for the United States.

Figure 18 demonstrates the dynamic adjustments of current account to one standard deviation innovation in each of the variables. There is a substantial persistence in the current account dynamics, as the economic literature suggests. A positive shock to current account brings about an adjustment in current account that persists for fourteen quarters. A positive shock to GDP growth creates small but statistically significant negative adjustment to current account in the first quarter. This adjustment implies that the positive productivity shock increases investment (or imports) and worsens the current account. This negative relationship between GDP growth and current account is also consistent with Gruber and Kamin (2005)'s result.

An exogenous increase in terms of trade brings about a positive adjustment in current account balance that lasts four quarters. This positive relationship indicates that consumption-smoothing effect dominates consumption tilting effect. As terms of trade improve, the purchasing power of a country's exports increases and consumption smoothing effect leads individuals to save more and consume later. This positive relationship between terms of trade and current account is consistent with Calderòn, Chong and Loayza (1999)'s and Dibooğlu (1997)'s findings.

On the other hand, a shock in government budget balance leads to an increase in current account, which is significant in the seventh through twelfth quarters following the shock. A one standard deviation rise in the government budget balance causes current account balance to rise by almost 0.14% of GDP. This positive relationship between budget balance and current account is consistent with the results of Chinn and Prasad (2000), Gruber and Kamin (2005), Bachman (1992) and Dibooğlu (1997). Among these authors, Bachman (1992) and Dibooğlu (1997) focus on just the current account deficit in the U.S. using VAR models. Although there are still disagreements in the literature about the subject, this adjustment that is found in this paper can be interpreted as a support to `twin deficit` hypothesis in the U.S. case.

An exogenous positive shock to openness leads to an immediate decrease in current account balance. Since openness is equal to the sum of imports and exports over GDP, this negative impulse in current account implies that the shock in openness mainly reflects an increase in imports.

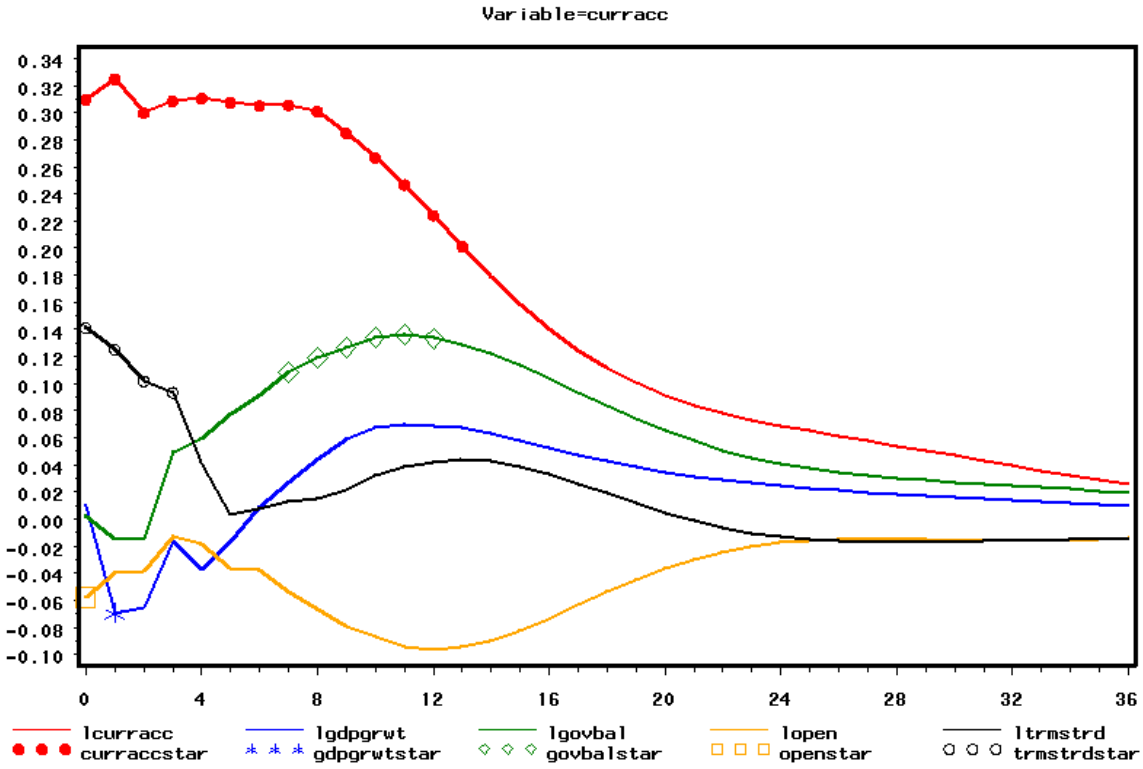

Figure 18: Current Account Responses to One Standard Deviation Shocks - The U.S.

Star variables indicate statistical significance at the 10% level.

Figure 19 contains government budget balance responses to shocks in the variables. Positive innovations in government balance and real GDP growth brings about an immediate increase in government balance that gradually dies off after 7 and 9 quarters respectively. This implies that output increases during economic booms improve the government budget balance. In addition to this, an exogenous increase in terms of trade leads to an increase in government balance immediately. This response is also significant in the fourth through tenth quarters following the shock. These delayed responses may reflect the fact that governmental settlements are often arranged in advance, thus imposing delays in adjustment process. This figure also shows that government budget balance response is not significant to shocks in current account. Considering the significant current account responses to government balance shocks in Figure 18, bi-directional causality between budget and trade deficit can be rejected. According to these two figures, causality seems to work only in one direction, from government balance to current account.

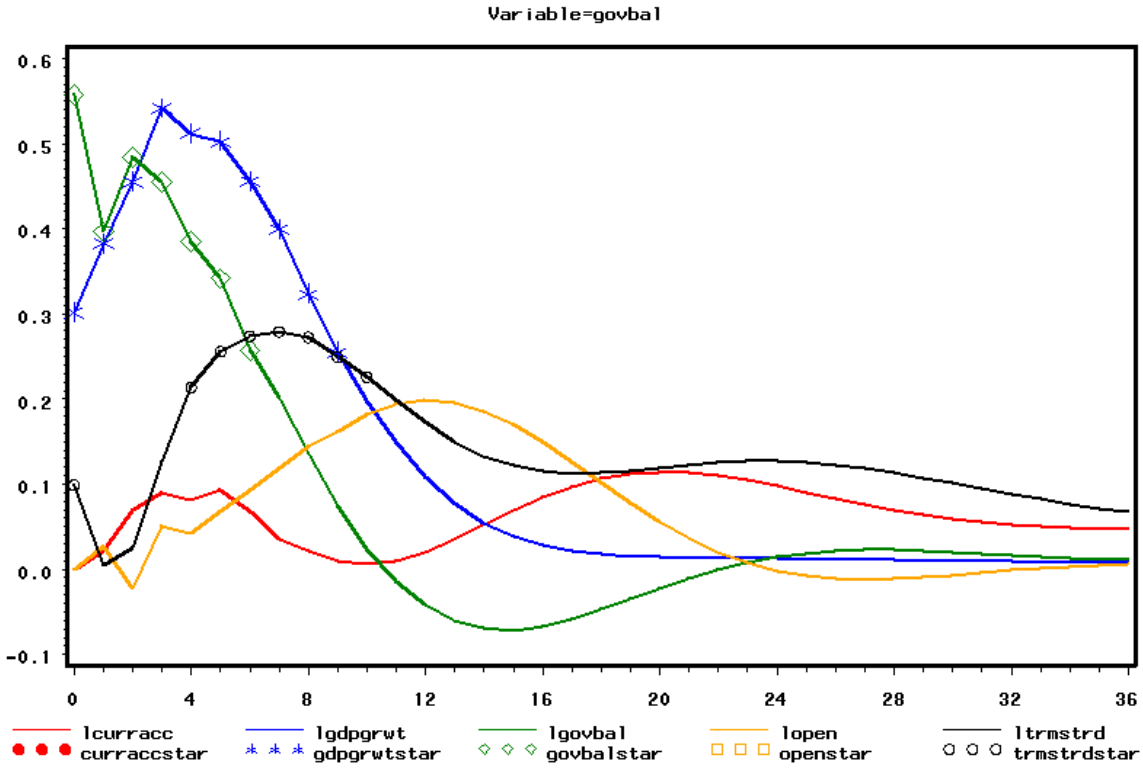

Figure 19: Gov. Budget Balance Responses to One Standard Deviation Shocks - The U.S.

Star variables indicate statistical significance at the 10% level.

Figure 20 illustrates the average real GDP growth responses to shocks in each of the variables in the system. A positive shock to GDP growth leads to a significant positive adjustment in the first two quarters. However, GDP growth displays negative adjustment to shocks in itself in the sixth through ninth quarters. An exogenous increase in current account brings about a negative adjustment in GDP growth. This response is significant in the fourth and sixth quarters. In addition to this, an exogenous increase in terms of trade results in a significant increase GDP growth, which can be interpreted as economic welfare. Positive terms of trade shock moves in favor of a country, since imports become cheaper relative to the goods that are purchased abroad. On the other hand, innovations in government balance bring about a negative significant response in the fourth through tenth quarters following the innovation.

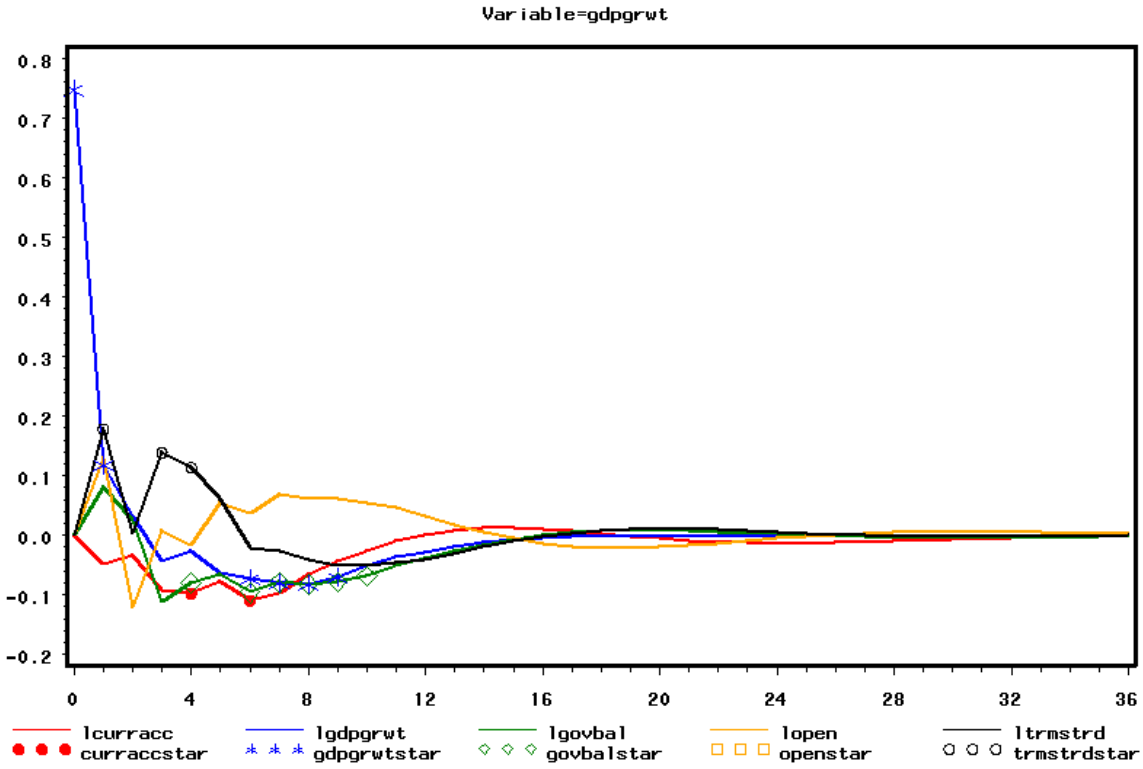

Figure 20: Real GDP Growth Responses to One Standard Deviation Shocks - The U.S.

Star variables indicate statistical significance at the 10% level.

Figure 21 illustrates openness responses to exogenous shocks. An increase in openness ratio and government balance results in a significant increase in openness ratio. In addition to this, a positive shock to GDP growth rate brings about a positive adjustment, which is significant nine quarters following the shock. This adjustment implies that during economic booms foreign trade - mostly imports - increases. On the other hand, a positive shock to terms of trade brings about an immediate decrease in the openness ratio.

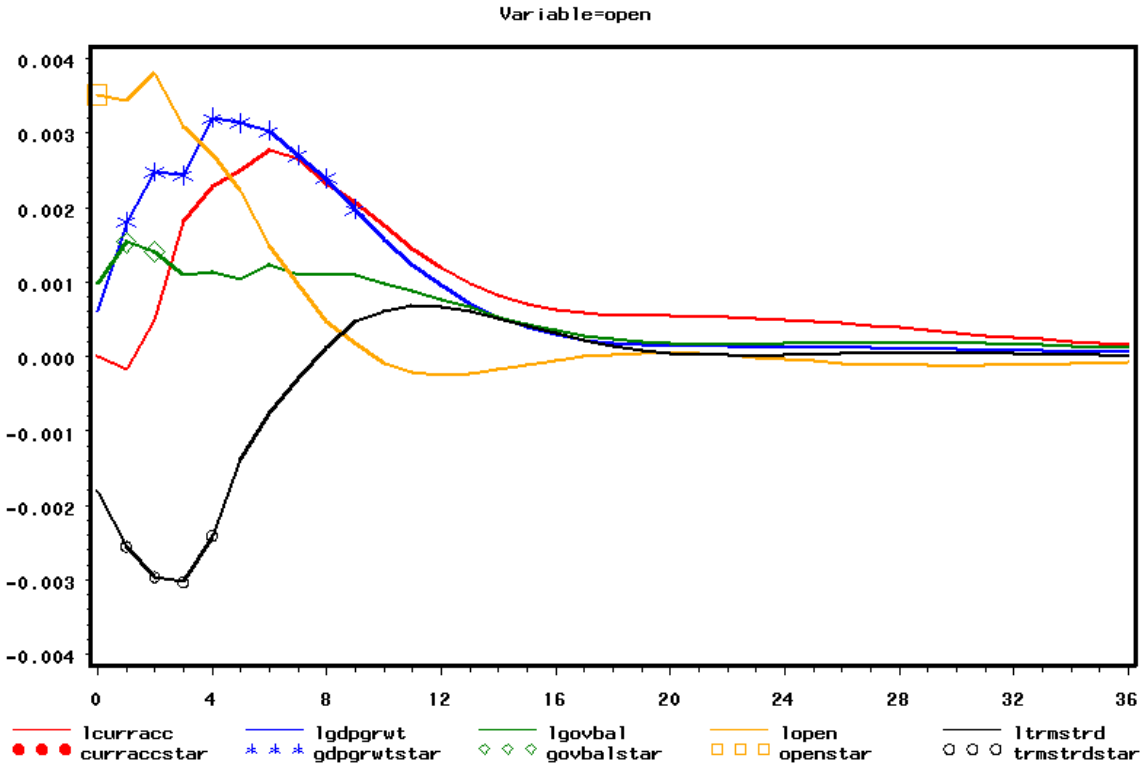

Figure 21: Openness Responses to One Standard Deviation Shocks - The U.S.

Star variables indicate statistical significance at the 10% level.

Figure 22 contains terms of trade responses to shocks in each of the variables. Terms of trade responses are significant only to shocks in itself. A positive shock to terms of trade brings about a sustained, positive adjustment in itself.

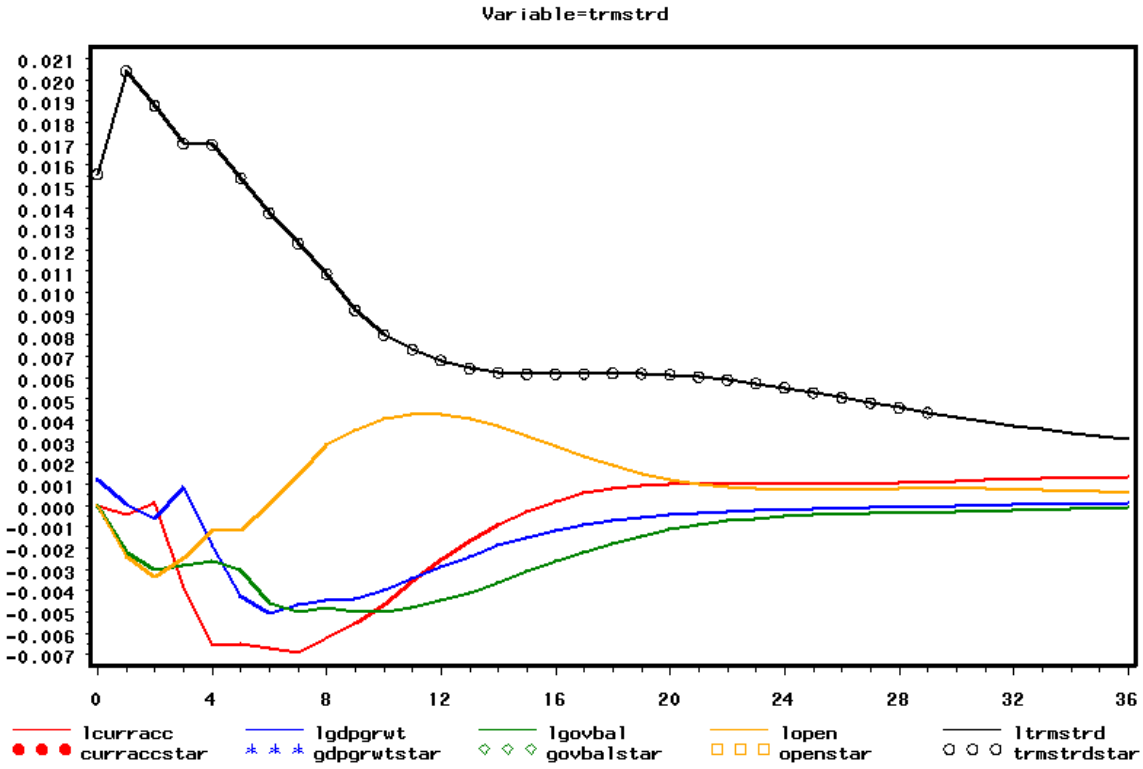

Figure 22: Terms of Trade Responses to One Standard Deviation Shocks - The U.S.

Star variables indicate statistical significance at the 10% level.

- Comparison Across Countries:

The direction and the periods of adjustments to shocks in each variable across countries are summarized in Table 6. The current account responses demonstrate considerable similarities across countries both in the direction and in the periods of adjustments to shocks. For example, innovations in real GDP growth bring about a negative response to the current account balance in each country, which lasts one quarter in the U.S., three quarters in Japan and eight quarters in the U.K. This adjustment implies that the positive productivity shock increases either investment or imports and, hence worsens the current account balance. Compared to other economies, the U.K. has both the longest period of adjustment and the largest extent of responses to real GDP growth shocks.

In addition to this, a one standard deviation shock to terms of trade leads to an immediate positive adjustment to the current account balance in each country, which lasts four quarters in the U.S., six quarters in Japan and seven quarters in the U.K. This positive relationship

demonstrates that the consumption smoothing effect dominates the consumption-tilting effect in all countries examined. As terms of trade improve, the purchasing powers of countries' export increase and consumption smoothing effect leads individuals to save more and consume later. In all countries, the effect of terms of trade shock seems to confirm the Harberger-Laursen-Metzler (HLM) effect. In addition to this, according to the intertemporal framework where an investment effect is included, the response of current account to terms of trade shocks depends on the degree of persistence of these shocks. If shocks are temporary, consumption-smoothing effect tends to dominate investment effect and there will be positive relationship between shock and the current account. In their study, Kent and Cashin (2003) measure the duration of terms of trade shocks in several countries. They identify Japan and the U.K. as one with temporary terms of trade shocks and identify the U.S. as one with permanent terms of trade shocks. Although the relationship between the two variables is still positive, the empirical result shows that both the duration and the extent of the terms of trade shock are smaller in the U.S.

Although a shock to government balance brings about a positive response in the current account both in Japan and in the U.S., which is significant in the fifth through twelfth quarters and seventh through twelfth quarters respectively, this shock does not bring about any significant response to the current account in the U.K. The adjustment process in the U.S. can be interpreted as a support to the `twin deficit` hypothesis.

An innovation in the openness ratio leads to an immediate one period adjustment to current account in each country. However, this adjustment is negative in the U.K and in the U.S., whereas it is positive in Japan. The positive response in Japan implies that the shock in openness mainly reflects an increase in exports. On the other hand, the negative response in the U.K and in the U.S. implies that the shock in openness reflects an increase in imports.

Furthermore, a one standard deviation shock to current account brings about an immediate positive adjustment to itself in each country. However, the persistence and the extent of shocks differ across countries. For instance, there is a substantial persistence in the current account dynamics in the U.S., whereas the effects of the current account shock to itself is rather short-lived in Japan and in the U.K. Considering the extents to which current account shocks affect itself, the impact of the shock in the U.K. exceeds that of Japan and the U.S.

An innovation to current account in the U.K. leads to three times more impact than that of Japan and the U.S.

Table 6 : Direction and Periods of Adjustments

	Response	Impulse				
		Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Japan						
	Average GDP Growth	Positive 0 -3 quarters	-	Positive 12th quarter	-	Positive 1 - 6 quarters
	Terms of Trade	-	Positive 0 - 12 quarters	Positive 8 - 20 quarters	-	Positive 2 - 5 quarters
	Government Balance % GDP	Positive 1 - 25 quarters	Negative Immediate	Positive 0 - 22 quarters	-	-
	Openness Ratio	Negative 13 - 20 quarters	Negative 1 - 9 quarters	Positive-Negative 1-3 and 8-20	Positive 0 - 3 quarters	Negative 2 - 5 quarters
	Current Account % GDP	Negative 2 - 4 quarters	Positive 0 - 5 quarters	Positive 5 - 12 quarters	Positive Immediate	Positive 0 - 3 quarters
The United Kingdom						
	Average GDP Growth	Positive 0 - 10 quarters	-	-	-	Negative 1 - 4 quarters
	Terms of Trade	Negative 4 - 7 quarters	Positive 0 - 7 quarters	Positive 3 - 11 quarters	-	-
	Government Balance % GDP	Positive 3 - 10 quarters	Negative 3 - 7 quarters	Positive 0 - 11 quarters	-	Positive 13 - 19 quarters
	Openness Ratio	Positive 5th quarter	Negative 0 -6 quarters	Negative 6 - 12 quarters	Positive 0 -4 quarters	Negative 2nd quarter
	Current Account % GDP	Negative 2 - 9 quarters	Positive 0 - 6 quarters	-	Negative Immediate	Positive 0 - 7 quarters
The United States						
	Average GDP Growth	Positive-Negative 0-1 and 6-9	Positive 1 - 4 quarters	Negative 4 - 10 quarters	-	Negative 4 - 6 quarters
	Terms of Trade	-	Positive 0 - 28 quarters	-	-	-
	Government Balance % GDP	Positive 0 - 9 quarters	Positive 4 - 10 quarters	Positive 0 - 6 quarters	-	-
	Openness Ratio	Positive 1 - 9 quarters	Negative 1 - 4 quarters	Positive 1 - 2 quarters	Positive Immediate	-
	Current Account % GDP	Negative 1st quarter	Positive 0 - 3 quarters	Positive 7 - 12 quarters	Negative Immediate	Positive 0 - 13 quarters

3. Forecast Error Variance Decomposition

Table 7 presents the results of the forecast error variance decomposition, which shows how much of the forecast error variance of a variable is explained by shocks in other variables. A variable is statistically endogenous, if most of the variance of its forecast error is owing to innovations to other variables in the system. On the contrary, a variable is regarded as statistically exogenous, if most of the variance of its forecast error is owing to its own innovations. Forecast error variance decompositions are not invariant to the ordering of variables in the system.

Table 7 depicts that most of the forecast error variance in a variable is explained by that variable's own past. An unanticipated change in the current account accounts for 76%, 94% and 80% of its own forecast error variance in Japan, the U.K. and the U.S. respectively. Current account also appears to be significantly affected by terms of trade in the short run in all countries. An unanticipated change in terms of trade can explain 21%, 5% and 17% of current accounts' forecast error variance in Japan, the U.K. and the U.S respectively.

At longer time horizons, innovations in all variables have significant effects on current account, which is further evidence of the interrelated nature of the five variables. However, the U.S.' current account seems to be much more persistent than that of Japan and the U.K. Current account innovations can explain 32%, 39% and 75% of its own forecast error variance after 36 quarters. Therefore, the contribution of other four variables to current account is limited for the U.S. at longer time horizons. Current account in the U.S. also appears to be responsive to innovations in government budget balance in the long run. However, innovations in other variables have relatively smaller effects.

At longer time horizons in Japan, all variables can explain substantial fraction of the forecast error variance of current account, which is consistent with Japan's current account impulse responses. Recall that innovations in all variables bring about either positive or negative significant adjustments in current account.

In the U.K, at longer time horizons, while 19% of forecast error variance of current account can be explained by innovations in GDP growth rate and terms of trade; 21 % is explained by innovations in openness ratio. Compared to these high percentages, current account

appears to be quite unresponsive to government budget balance. Only 3% of current account is explained by unanticipated changes in government balance. This picture is again completely consistent with the UK's current account impulse responses. Recall that a shock in government budget balance has no significant effect on current account in the U.K.

Table 7.1: Forecast Error Variance Decomposition - Japan

		Percentage of forecast error explained by:				
Variables	Forecast Horizon	GDP per Capita	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average Real GDP Growth	1	**100.00**	0.00	0.00	0.00	0.00
	4	92.48	0.25	0.14	1.30	5.84
	8	90.00	1.11	0.16	1.26	7.47
	12	88.67	1.22	0.53	1.92	7.67
	24	86.62	1.66	1.01	3.22	7.50
	36	86.25	1.77	1.15	3.26	7.56
Terms of Trade	1	3.28	**96.72**	0.00	0.00	0.00
	4	1.32	76.50	0.55	4.00	17.64
	8	3.40	68.58	1.00	2.75	24.27
	12	3.00	60.91	5.82	6.37	23.90
	24	6.93	42.00	13.31	17.25	20.50
	36	8.06	38.99	14.09	19.29	19.57
Government Balance % GDP	1	1.27	0.20	**98.53**	0.00	0.00
	4	20.45	0.44	75.03	4.01	0.07
	8	48.86	1.06	44.96	3.90	1.23
	12	52.69	1.30	38.19	3.23	4.58
	24	47.28	6.76	34.51	5.76	5.69
	36	43.95	15.61	29.83	5.39	5.22
Openness Ratio	1	1.07	23.81	1.57	**73.56**	0.00
	4	0.31	24.95	4.85	57.26	12.63
	8	3.77	28.66	4.31	40.77	22.50
	12	4.00	26.82	11.44	35.59	22.15
	24	14.67	17.94	18.49	32.07	16.82
	36	15.94	19.32	18.30	30.78	15.66
Current Account % GDP	1	1.43	20.81	0.09	1.22	**76.46**
	4	5.64	25.89	0.67	2.72	65.09
	8	6.73	19.90	7.77	14.18	51.42
	12	6.98	15.51	12.69	26.35	38.48
	24	10.10	16.99	12.31	28.16	32.44
	36	10.45	16.96	13.08	27.53	31.98

Table 7.2: Forecast Error Variance Decomposition - The United Kingdom

		Percentage of forecast error explained by:				
Variables	Forecast Horizon	GDP per Capita	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average Real GDP Growth	1	**100.00**	0.00	0.00	0.00	0.00
	4	91.66	2.09	0.27	1.60	4.39
	8	88.42	2.64	0.51	1.86	6.57
	12	87.62	2.88	0.52	2.31	6.68
	24	86.54	2.92	0.72	3.10	6.73
	36	86.43	3.00	0.75	3.10	6.72
Terms of Trade	1	1.24	**98.76**	0.00	0.00	0.00
	4	1.24	93.02	4.18	1.22	0.33
	8	10.62	75.35	12.35	1.05	0.64
	12	11.62	67.52	17.06	2.71	1.10
	24	11.07	63.65	17.79	4.65	2.84
	36	11.22	62.66	17.66	5.30	3.16
Government Balance % GDP	1	0.49	0.02	**99.49**	0.00	0.00
	4	4.38	3.34	91.48	0.13	0.67
	8	12.92	8.26	77.72	0.10	1.01
	12	15.99	9.82	70.97	0.11	3.11
	24	14.70	9.62	62.59	4.31	8.77
	36	14.85	9.68	60.64	5.73	9.10
Openness Ratio	1	0.72	19.19	0.11	**79.98**	0.00
	4	0.60	33.70	0.53	62.21	2.96
	8	5.85	36.79	5.16	48.05	4.15
	12	6.32	34.32	10.86	44.20	4.31
	24	8.48	33.55	12.98	40.84	4.15
	36	8.44	33.40	12.96	40.79	4.42
Current Account % GDP	1	0.02	5.49	0.00	0.35	**94.14**
	4	4.79	22.86	0.32	0.30	71.73
	8	17.37	21.05	0.20	11.80	49.58
	12	18.07	17.79	0.52	20.29	43.33
	24	18.42	18.32	3.13	21.10	39.02
	36	18.76	18.65	3.22	20.85	38.51

Table 7.3: Forecast Error Variance Decomposition - The United States

		Percentage of forecast error explained by:				
Variables	Forecast Horizon	Average GDP Growth	Terms of Trade	Government Balance % GDP	Openness Ratio	Current Account % GDP
Average Real GDP Growth	1	**100.00**	0.00	0.00	0.00	0.00
	4	83.43	7.42	2.78	4.62	1.75
	8	74.31	8.68	5.67	5.19	6.14
	12	70.61	9.06	7.58	6.27	6.48
	24	69.75	9.35	7.81	6.60	6.50
	36	69.64	9.34	7.82	6.61	6.59
Terms of Trade	1	0.59	**99.41**	0.00	0.00	0.00
	4	0.19	95.41	1.60	1.72	1.08
	8	2.82	85.22	3.28	1.11	7.57
	12	4.33	78.09	5.65	2.62	9.32
	24	4.20	76.64	6.74	4.29	8.14
	36	3.94	77.51	6.36	4.18	8.01
Government Balance % GDP	1	22.12	2.39	**75.49**	0.00	0.00
	4	43.64	1.55	53.81	0.22	0.78
	8	49.70	8.92	39.32	1.01	1.05
	12	47.92	13.43	33.83	3.91	0.91
	24	42.51	16.25	30.24	7.98	3.02
	36	40.76	18.40	29.06	7.66	4.12
Openness Ratio	1	2.15	19.54	5.52	**72.80**	0.00
	4	15.39	27.29	6.38	47.41	3.53
	8	26.99	18.70	5.98	32.94	15.40
	12	28.92	16.38	6.91	28.14	19.66
	24	28.40	16.17	7.37	26.85	21.21
	36	28.20	16.04	7.45	26.67	21.65
Current Account % GDP	1	0.08	16.70	0.00	2.81	**80.41**
	4	2.06	11.89	0.61	1.43	84.01
	8	1.36	6.46	3.68	1.44	87.07
	12	2.07	4.63	7.66	3.06	82.58
	24	3.21	4.03	11.94	5.25	75.58
	36	3.32	4.09	12.18	5.27	75.14

VIII. IMPULSE RESPONSE ANALYSIS WITH A VECTOR ERROR CORRECTION MODEL

It was mentioned above that if variables are non-stationary and if there are any cointegrating relations, then the dynamic model is generally estimated by using error correction models. These models make it possible to deal with non-stationary variables. A VECM can be expressed as:

$$\Delta y_t = \Pi y_{t-1} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + ... + \Gamma_{p-1} \Delta y_{t-p+1} + \Phi D_t + u_t$$

where $\Pi = \alpha \beta'$ is n x n coefficient matrix, α is the vector of adjustment coefficients and β is the vector of cointegrating relations. Since error correction representation depends on the cointegrating relations, cointegration ranks which were calculated in section VI is used to estimate the equation and derive impulse responses. The rank is two for Japan, five for the U.K. and one for the U.S.

Furthermore, Φ in the VECM equation denotes an n x d coefficients matrix of deterministic terms, D_t which might include a constant, a linear trend and seasonal dummy variables. The specification of the deterministic terms D_t plays an influential role in the analysis, because there are five alternative models regarding the different specifications of deterministic components. The model employed in this paper is the case, which seems to be the most relevant for our problem: There is no separate drift in the VECM form, but a constant enters only via the error correction term. If there are any I(0) variables included in the model - here average real GDP growth- then a constant in the cointegration equation will normally be needed.

In this section you will find the impulse response figures of each variable under a vector error correction model (VECM). When the responses in VAR model are compared with the responses in VECM, it is seen that the direction and the extent of responses in VECM are very similar to that of VAR in levels. Especially, the similarity of responses between the two models draws attention for the U.K. case. The rank of the matrix Π is equal to five $(r(\Pi) = 5)$ for the UK's system of equations, which means that all variables are linear

combinations of I(0) processes. Since the matrix Π has full rank, the system for the U.K. can be estimated by using either VAR in levels or VECM. On the other hand, even though the rank is smaller than five for the Japan and the U.S. case, the similarity of the responses between the two models is still obvious.

Comparison of the VAR responses to those obtained from VECM can also be considered as a robustness check.

- Japan:

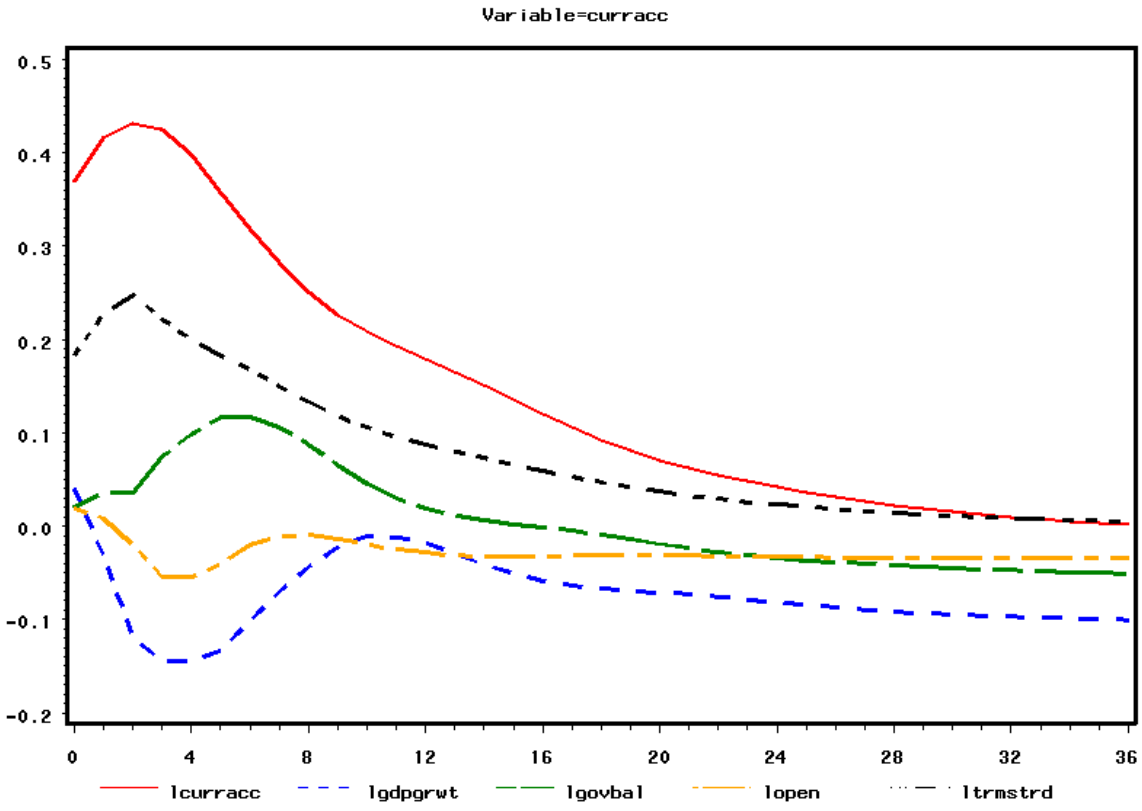

Figure 23: VECM - Current Account Responses to One Standard Deviation Shocks

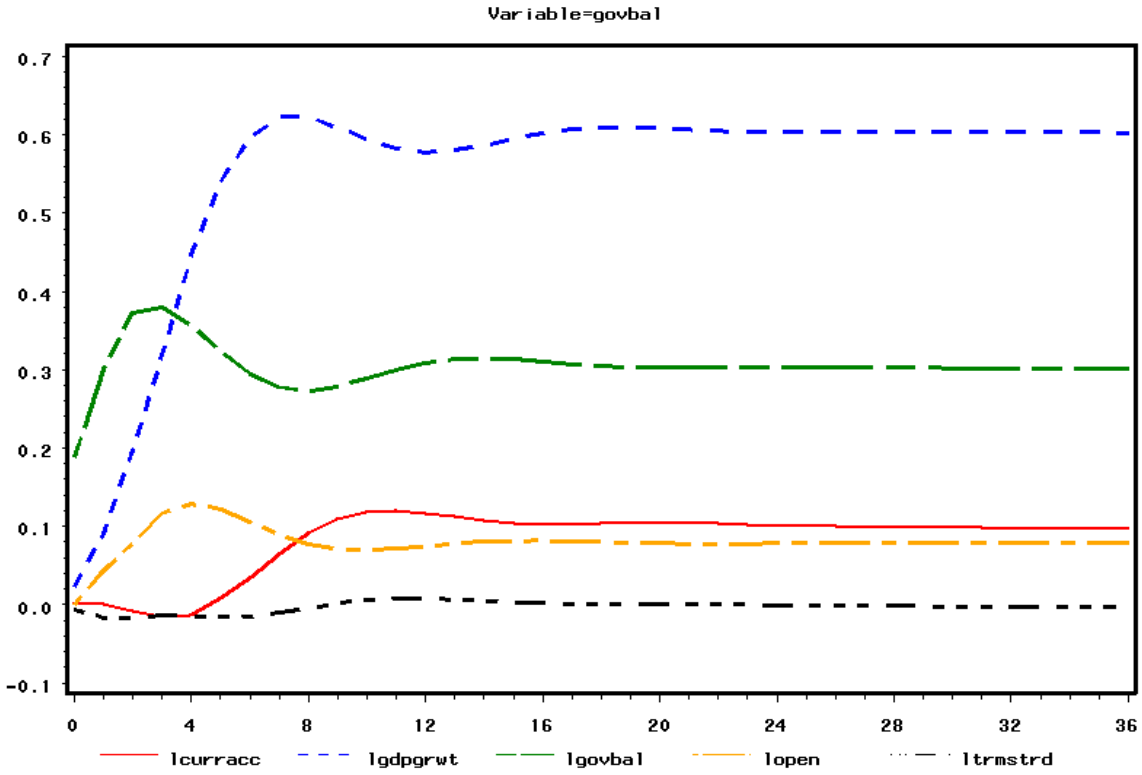

Figure 24: VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks

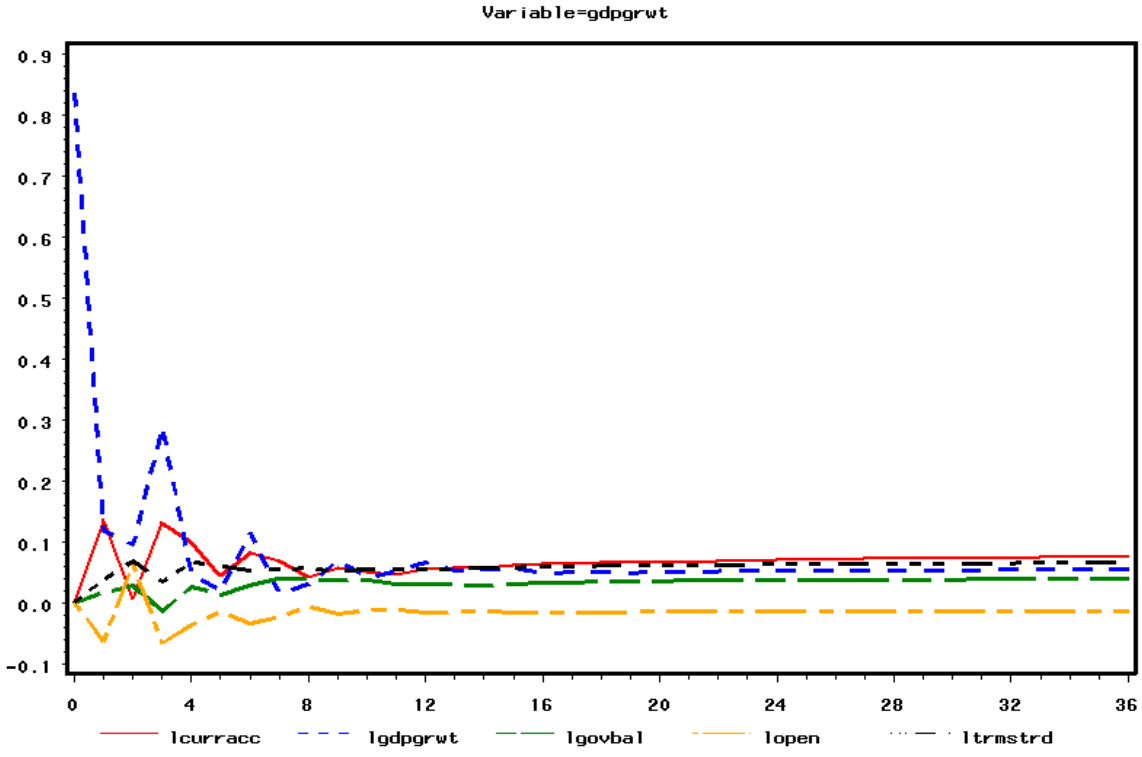

Figure 25: VECM - Real GDP Growth Responses to One Standard Deviation Shocks

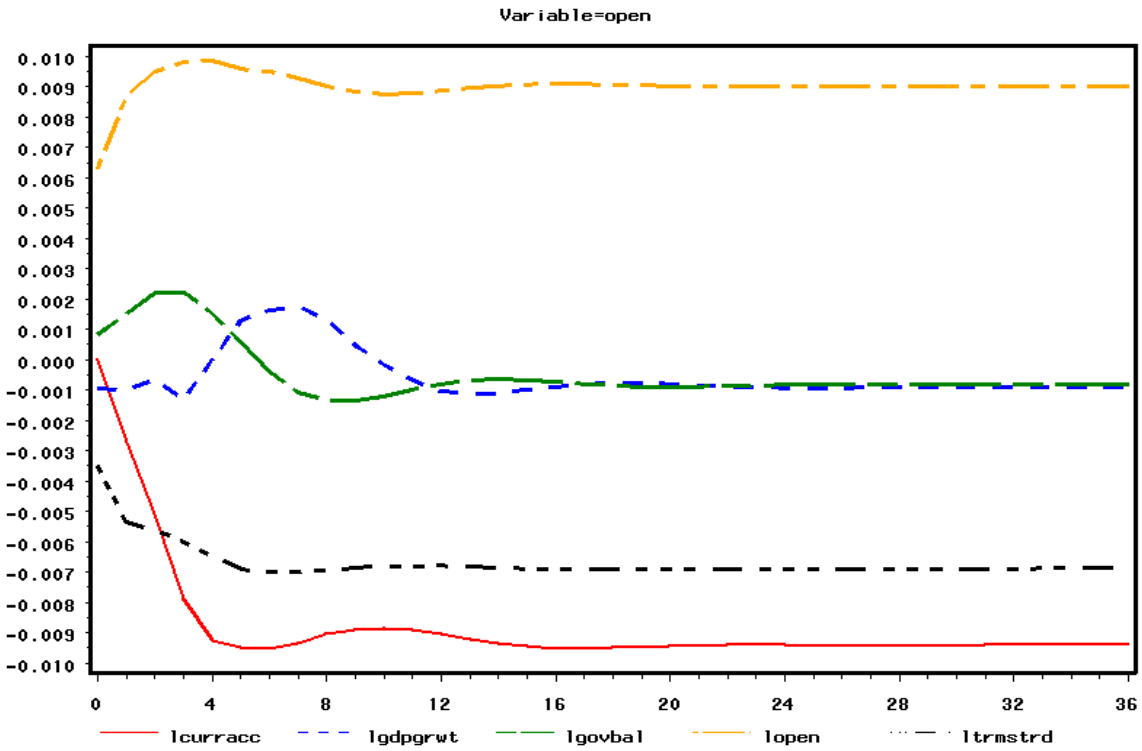

Figure 26: VECM - Openness Responses to One Standard Deviation Shocks

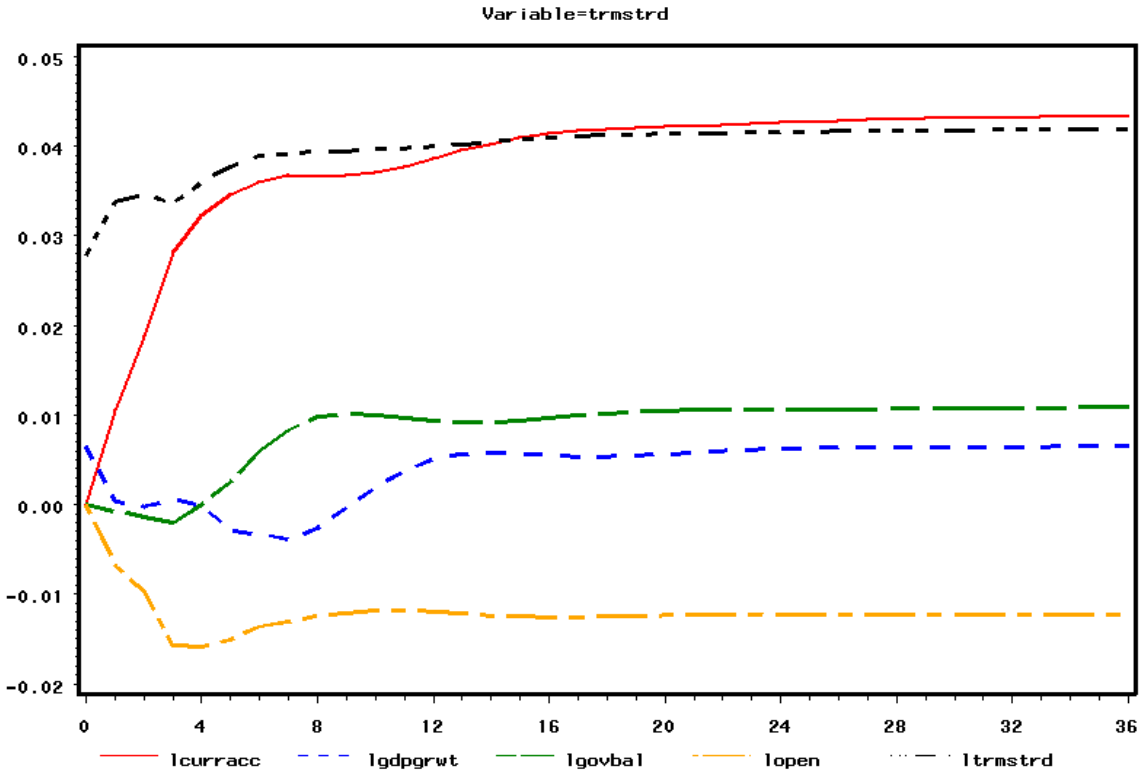

Figure 27: VECM - Terms of Trade Responses to One Standard Deviation Shocks

- The United Kingdom:

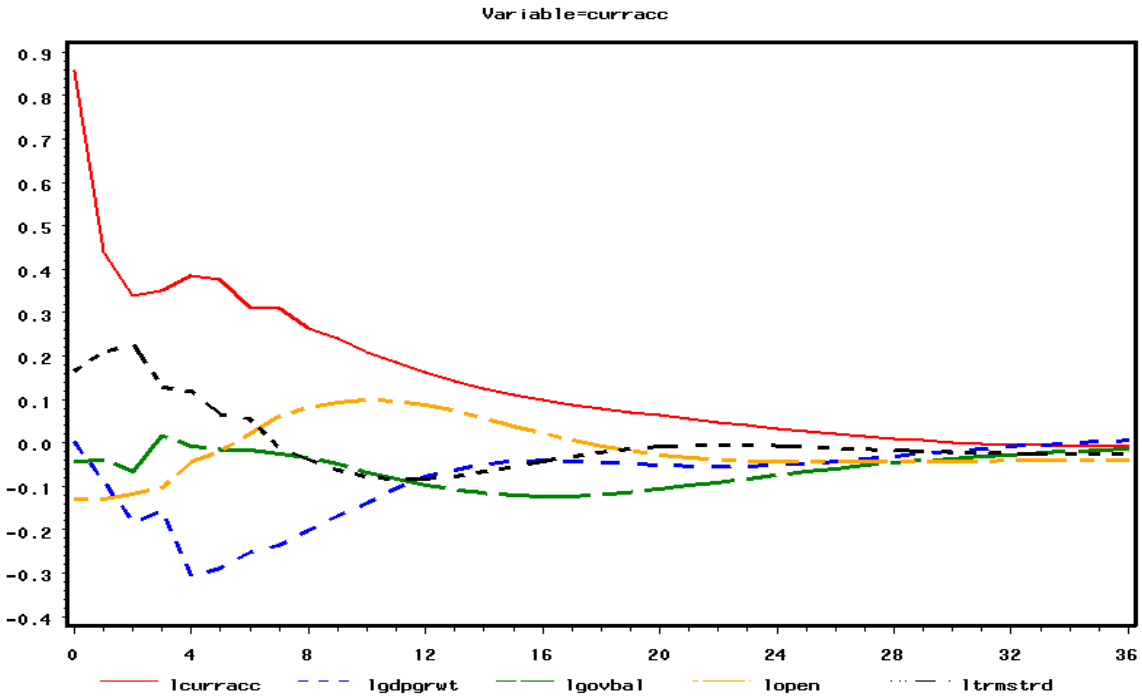

Figure 28: VECM - Current Account Responses to One Standard Deviation Shocks

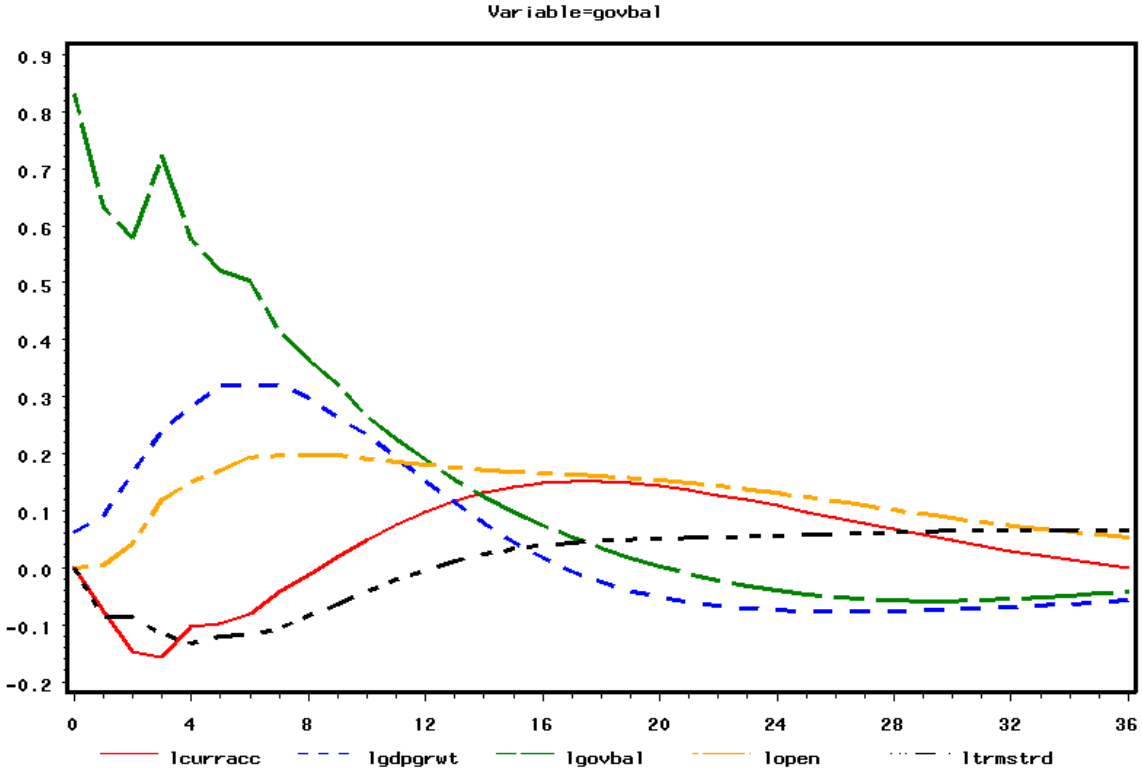

Figure 29: VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks

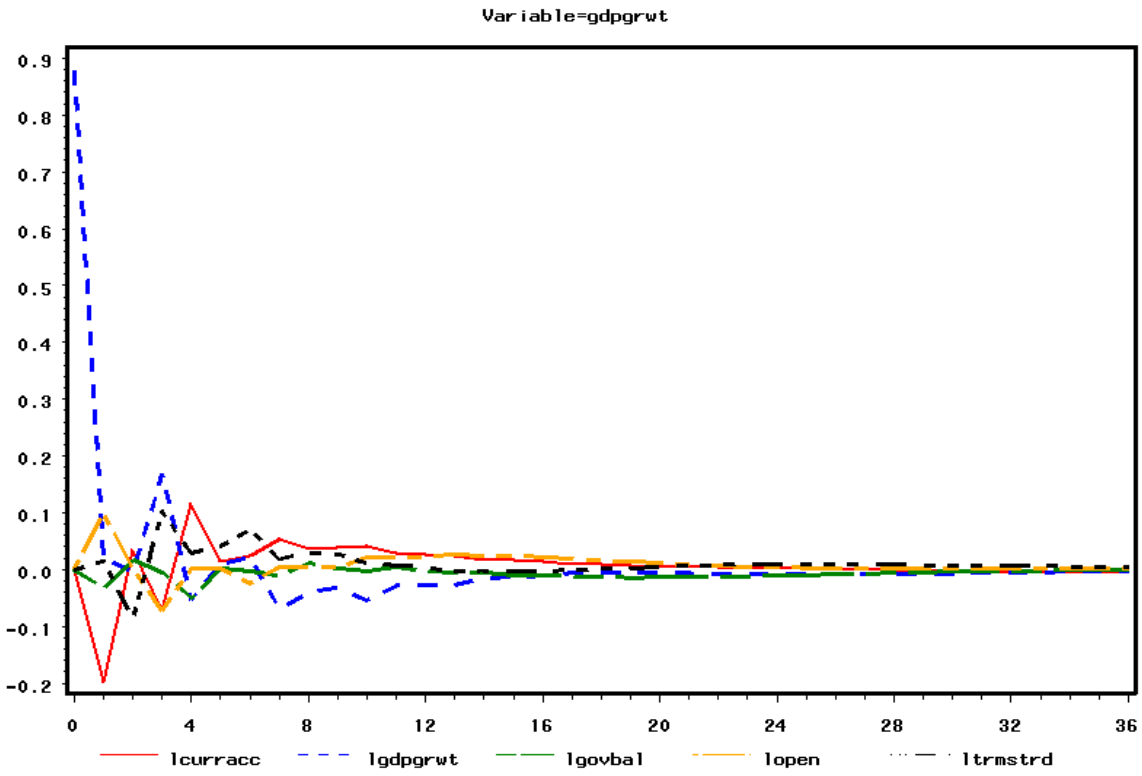

Figure 30: VECM - Real GDP Growth Responses to One Standard Deviation Shocks

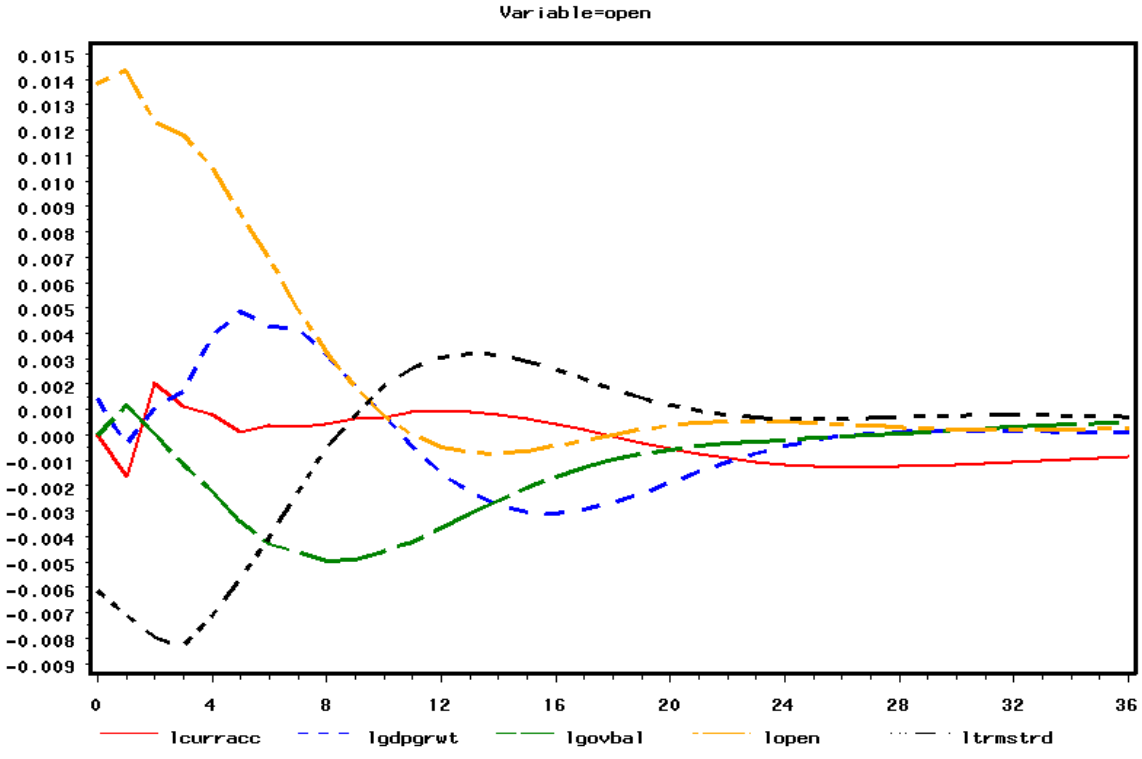

Figure 31: VECM - Openness Responses to One Standard Deviation Shocks

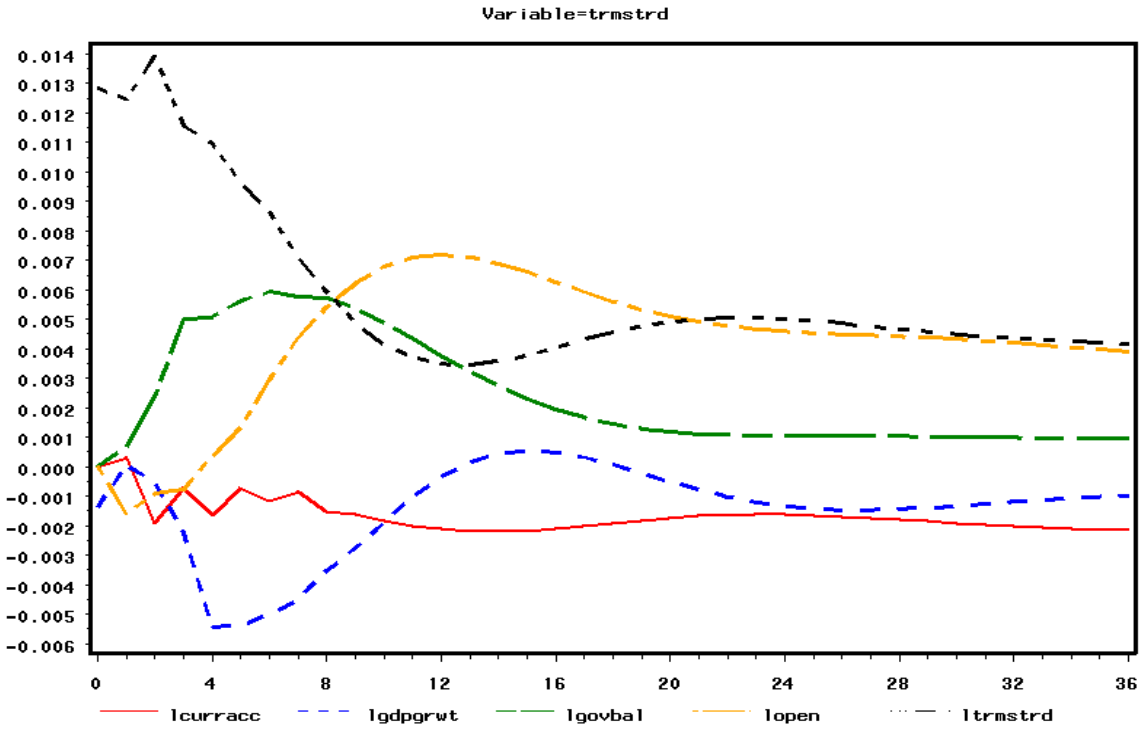

Figure 32: VECM - Terms of Trade Responses to One Standard Deviation Shocks

- The United States:

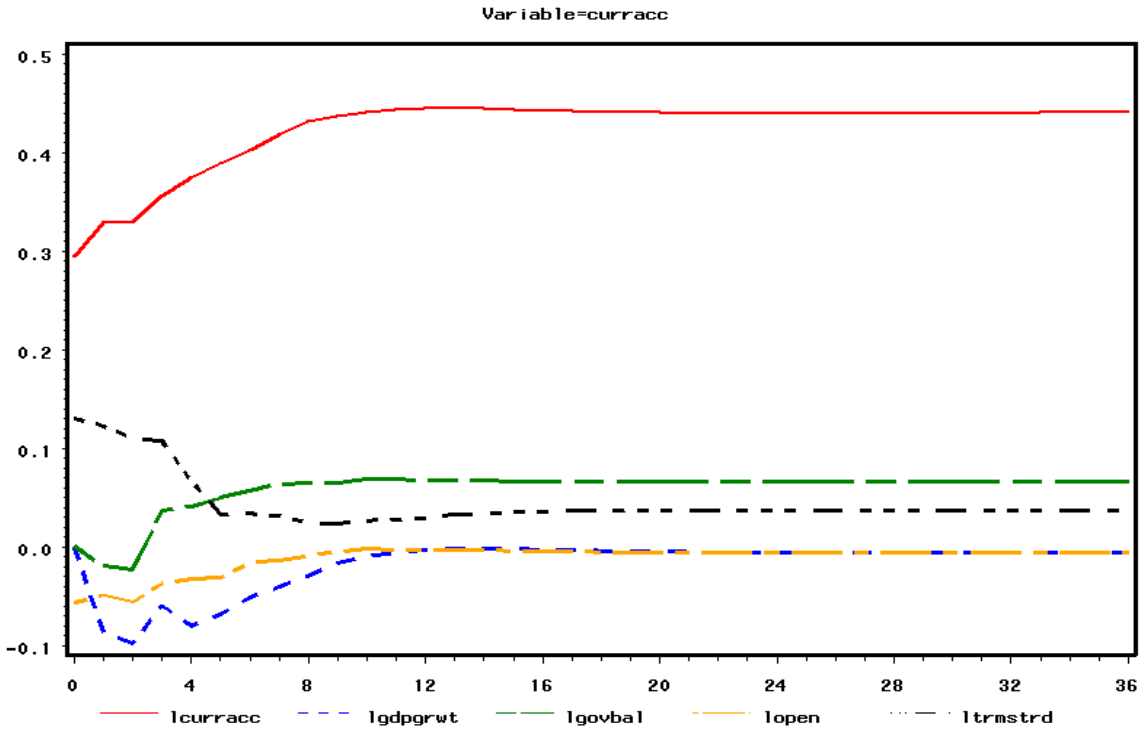

Figure 33: VECM - Current Account Responses to One Standard Deviation Shocks

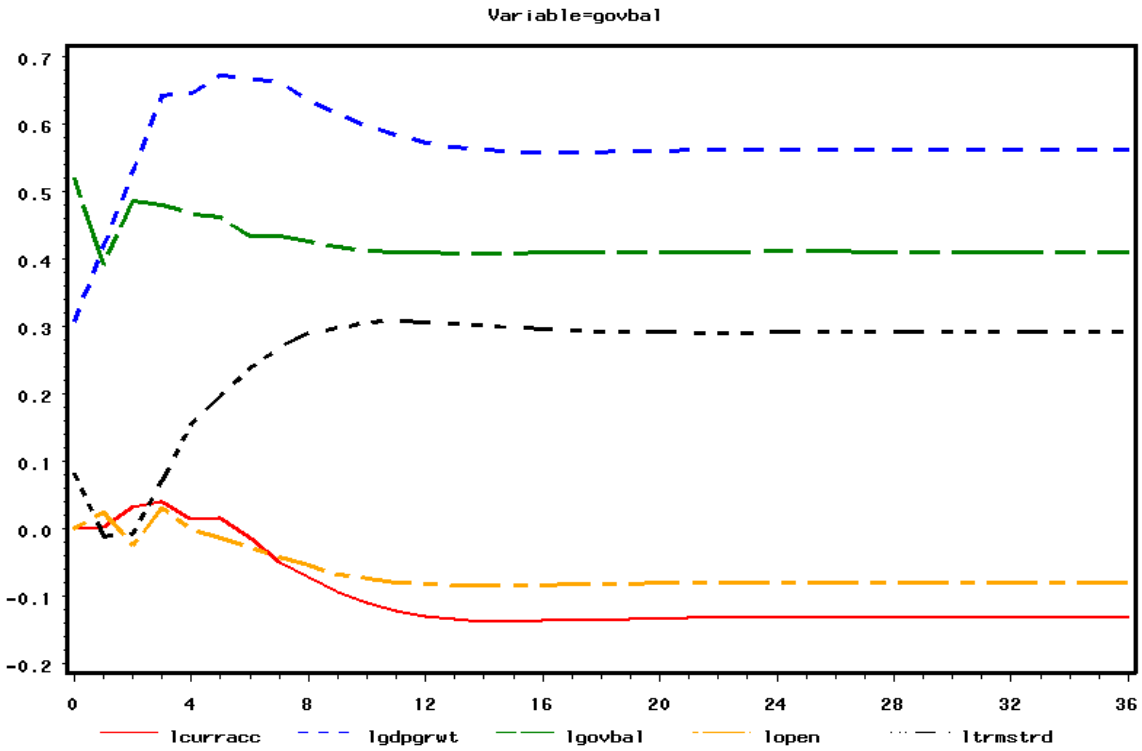

Figure 34: VECM – Gov. Budget Balance Responses to One Standard Deviation Shocks

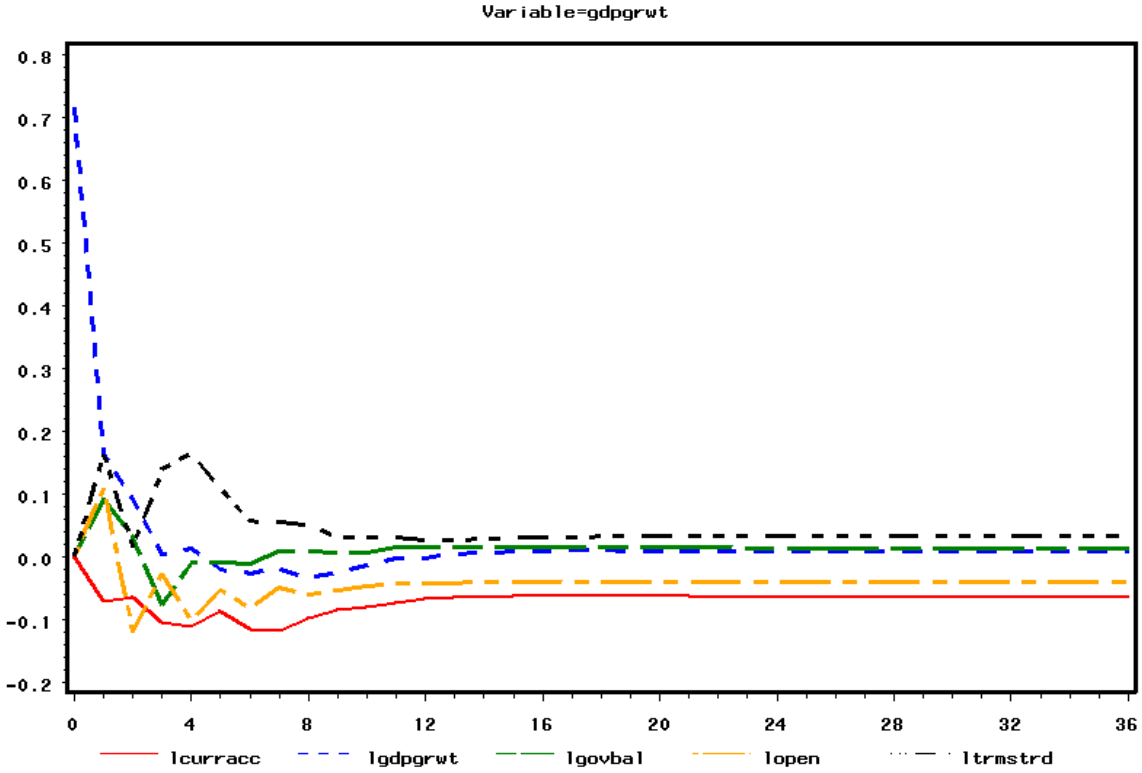

Figure 35: VECM - Real GDP Growth Responses to One Standard Deviation Shocks

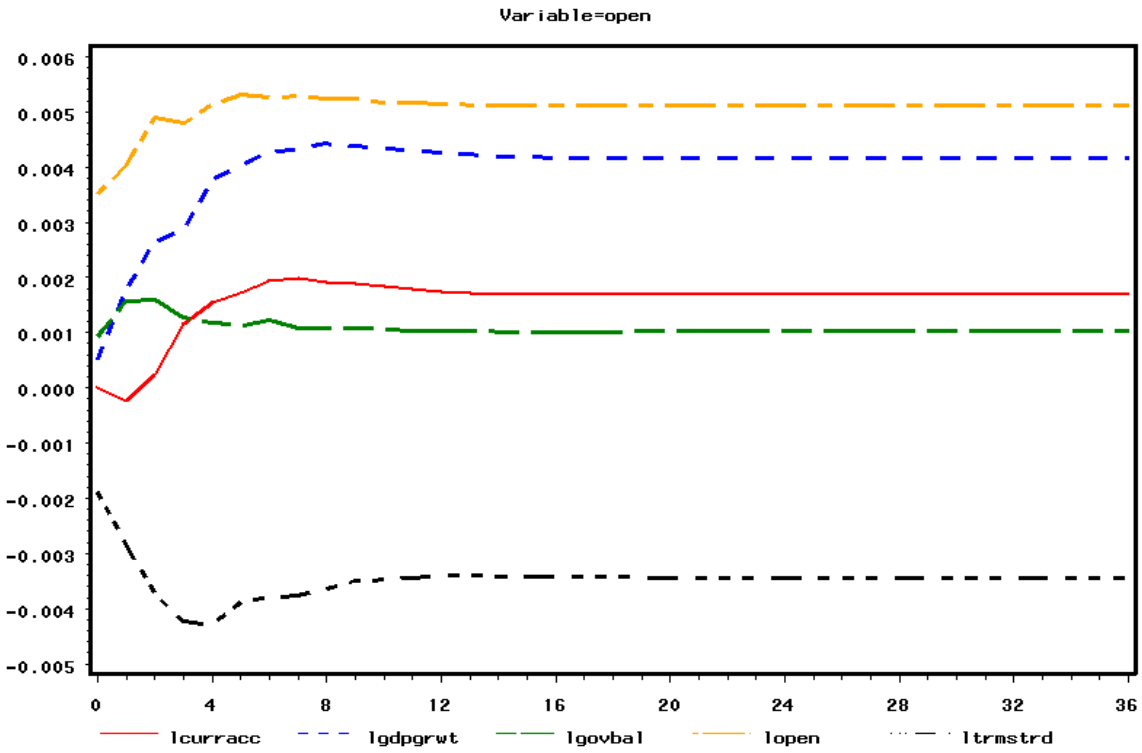

Figure 36: VECM - Openness Responses to One Standard Deviation Shocks

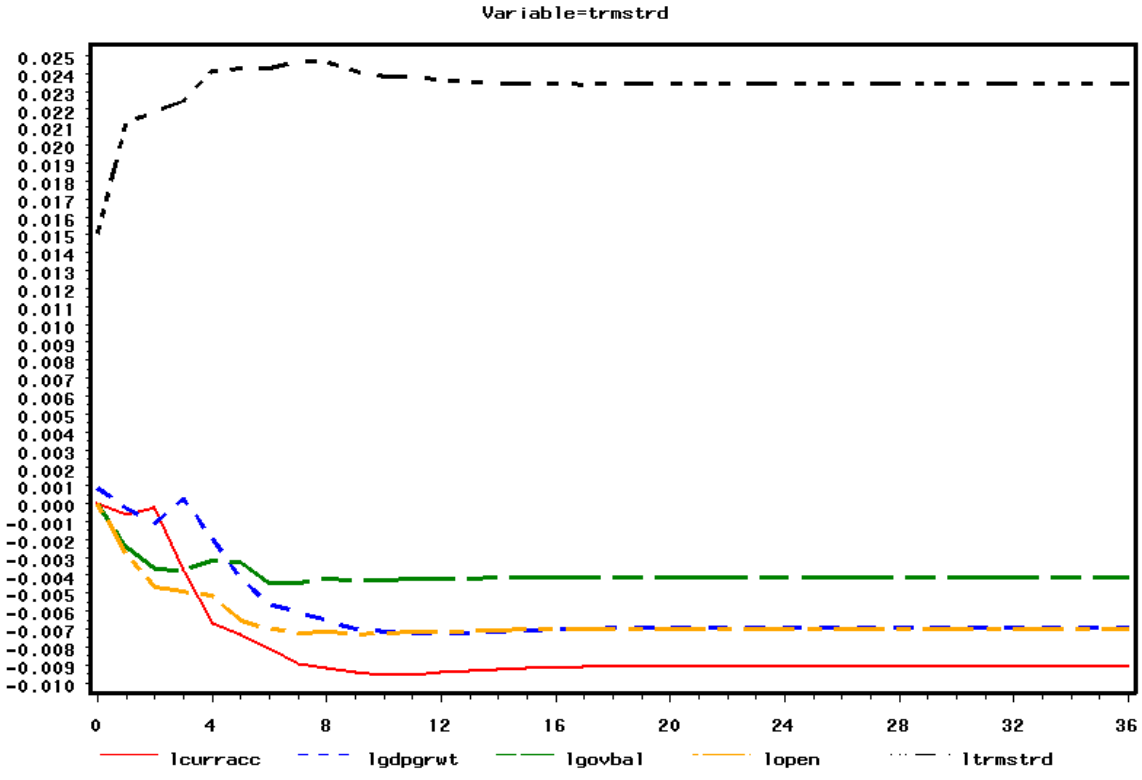

Figure 37: VECM - Terms of Trade Responses to One Standard Deviation Shocks

IX. CONCLUSION

This paper empirically examines the dynamic relationship between current account and a number of macroeconomic variables including average real GDP growth, terms of trade, government budget balance and the openness ratio. Quarterly data over the 1970 – 2005 period is used for the countries Japan, the U.K. and the U.S. Impulse response functions indicate that the mentioned macroeconomic variables explain the current account reasonably well and play an important role in current account adjustment process.

According to the results of impulse response analysis, a positive shock to real GDP growth creates a statistically significant negative adjustment to current account in all countries. This adjustment implies an increase either in investment or in imports as a result of a productivity shock. The relative importance of real GDP growth shocks in explaining the current account movements is highest in the U.K., since the U.K. has both the longest period of adjustment and the largest extent of responses to real GDP growth shocks.

The results of impulse response analysis indicate that the effect of terms of trade shock is considerably similar for all countries, confirming the Harberger-Laursen-Metzler (HLM) effect. In addition to this, a substantial fraction of forecast error variance of current account can be explained by terms of trade in the short run. This implies that an improvement in the terms of trade generates a decrease in the current account deficit in all countries.

Although a shock to government balance brings about a positive response in the current account both in Japan and in the U.S., this shock does not bring about any significant response to the current account in the U.K. Evidence from decomposition of forecast error variances also seems to promote the same argument in the long run. The lack of significant relationship between fiscal shocks and current account balance in the U.K. implies that the negative impact of budget deficit on current account is offset by private sector saving-investment decisions. On the other hand, the positive relationship between budget balance and current account in the U.S. can be interpreted as a support to twin deficit hypothesis. Therefore, fiscal policies, like reducing the government spending or raising tax revenues, may contribute to the correction of large U.S. current account deficit.

Although exogenous shocks to openness ratio brings about only immediate one-period responses to current account in all countries, forecast error variances of current account demonstrate that at longer time horizons openness to international trade can explain substantial fraction of the current account. However, the direction of relationship between the two variables is not stable across countries. It is positive in Japan, whereas it is negative in the U.K and in the U.S.

Both the results of impulse responses and the decomposition of error variances illustrate that current account in the U.S is more persistent than the current account in Japan and in the U.K. In the long run, this feature of the U.S. reduces the explanatory power of variables examined in this VAR system.

Finally, it should also be noted that the size of the current account deficit and the capital inflows that are financing it should be closely monitored and considerable effort should be devoted to trying to understand the driving forces of the current account.

LIST OF REFERENCES

Adalet, Müge and Barry Eichengreen (2005), "Current Account Reversals: Always a Problem?",

Bachman, Daniel D. (1992), "Why is the U.S. Current Account Deficit so Large? Evidence from Vector Autoregressions," Southern Economic Journal, vol. 59, pp 232.

Begg, David and Stephany Griffith-Jones, "Swinging since the 60s: Fluctuations in UK Saving and Lessons for Latin America".

Bernanke, Ben S. (2005), "The Global Saving Glut and the U.S. Current Account Deficit," Homer Jones Lecture, St. Louis, Missouri, April 14.
http://www.federalreserve.gov/boarddocs/speeches/2005/20050414/default.htm

Bussière, Matthieu, Marcel Fratzscher and Gernot J. Müller (2004), "Current Account Dynamics in OECD and EU acceding countries – An Intertemporal Approach," European Central Bank Working Paper Series, No. 311.

Bussière, Matthieu, Marcel Fratzscher and Gernot J. Müller (2005), "Productivity Shocks, Budget Deficits and the Current Account," European Central Bank Working Paper Series, No. 509.

Calderòn, Cèsar, Alberto Chong and Norman Loayza (1999) , "Determinants of Current Account Deficits in Developing Countries," Central Bank of Chile Working Papers No. 51.

Cashin Paul and C. John McDermott (2002), "Terms of Trade Shocks and the Current Account: Evidence from Five Industrial Countries" Open Economies Review 13: 219-235

Chinn, Menzie and Eswar S. Prasad (2000), "Medium-term Determinants of Current Accounts in Industrial and Developing Countries: An Empirical Exploration," NBER Working Paper No. 7581.

Chinn, Menzie D. (2005), "Getting Serious About the Twin Deficits", Council on Foreign Relations, CSR No. 10.

Collins, Sean, Francisco Nadal De Simone and David Hargreaves, "The Current Account Balance: An Analysis of the Issues"

Corden, W. M. (1977), Inflation, Exchange Rates and the World Economy, Ch. 3, Clarendon Press: Oxford.

Dibooğlu, Selahattin (1997), "Accounting for U.S. Current Account Deficits: An Empirical Investigation", Applied Economics, vol. 29, pp 787-793.

Dickey, D.A. (1988), "Comment", Journal of Business and Economic Statistics, vol. 6, pp 410-412.

Edwards, Sebastian (1995), "Why Are Saving Rates So Different Across Countries?: An International Comparative Analysis," NBER Working Paper No. 5097.

Edwards, Sebastian (2001), “Does the Current Account Matter?,” NBER Working Paper No. 8275.

Edwards, Sebastian (2005), “The End of Large Current Account Deficit, 1970 – 2002: Are There Lessons for the United States?,” NBER Working Paper No.11669.

Fischer, Stanley (1988), “Real Balances, the Exchange Rate, and Indexation: Real Variables in Disinflation” Quarterly Journal of Economics, vol. 103, issue 1.

Gruber, Joseph W. and Steven B. Kamin (2005), “Explaining the Global Pattern of Current Account Imbalances,” Board of Governors of the Federal Reserve System, International Finance Discussion Papers, No. 846, November.

Hung, Juann H. and Charles Bronowski (2002), “Modeling the U.S. Current Account as the Savings - Investment Balance”.

Hong Kong Monetary Authority (2003), “An Analysis of Balance of Payments Developments in 2002”, 23 April 2003.

Kent, Christopher and Paul Cashin (2003), “The Response of the Current Account to Terms of Trade Shocks: Persistence Matters”, IMF Working Paper WP/03/143.

Lütkepohl, Helmut (1993), Introduction to Multiple Time Series Analysis, Berlin: Springer-Verlag.

Masson Paul R., Tamim Bayoumi and Hossein Samiei (1998) , “International Evidence on the Determinants of Private Saving,” The World Bank Economic Review, vol. 12, pp. 483-501.

Milesi-Ferretti, Gian Maria and Assaf Razin (1996) , “Sustainability of Persistent Current Account Deficits,” NBER Working Paper No.5467.

Mitchell, James, “The Importance of Long Run Structure for Impulse Response Analysis in VAR Models.” National Institute of Economic and Social Research.

New Zealand’s Official Statistics Agency (2000), “New International Standards for Balance of Payments Statistics”, May 2000.
http://www.stats.govt.nz/NR/rdonlyres/A075F18E-6A35-4792-9D5D-A6F3268F0B66/0/NewIntlStds.pdf

Obstfeld, Maurice and Kenneth Rogoff (1994) , “The Intertemporal Approach to the Current Account,” NBER Working Paper No.4893.

Obstfeld, Maurice and Kenneth Rogoff (1996), Foundations of International Macroeconomics, The MIT Press.

Pestieau, Carolina (1974), A Balance of Payments Handbook, Canadian-American Committee.

Phillips, Peter C.B. (1998), ”Impulse Response and Forecast Error Variance Asymptotics in Nonstationary VARs” Journal of Econometrics, vol. 83, pp. 21-56.

Razin, Assaf (1993), “The Dynamic-Optimizing Approach to the Current Account: Theory and Evidence”, NBER Working Paper No.4334.

Sims, Christopher A, James H. Stock and Mark W. Watson (1990), “Inference in Linear Time Series Models with some Unit Roots”, Econometrica, vol. 58, pp. 113-144.

Zanghieri, Paolo (2004), “Current Accounts Dynamics in new EU members: Sustainability and Policy Issues”, CEPII Working Paper No. 2004 – 07.