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Trade, Foreign Direct Investment, Privatization, and Economic Growth

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TRADE, FOREIGN DIRECT INVESTMENT,

PRIVATIZATION AND ECONOMIC GROWTH

Empirical Studies

by

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Trade, Foreign Direct Investment, Privatization and Economic Growth

Thesis directed by Professor Robert F. Mc Nown

This thesis tries to enhance our understanding of the role of trade liberalization as it relates to economic growth and the factors affecting trade liberalization in various countries. In addition, this thesis deals with the problem of endogeneity with various econometric methods.

Chapter 2 presents a study of the impact of trade liberalization policy on economic growth with the simultaneous application of privatization policy in 25 transitional countries. The analysis applies two stage least squares (2SLS) to panel data from 1994 to 2006 for these 25 countries. The estimated results provide evidence of a significantly positive effect of both trade liberalization and privatization on economic growth, when controlling for political conflict and macroeconomic stability.

Chapter 3 emphasizes the political economy of trade protection by examining the role of lobbying as it relates to trade liberalization in the United States. I test the Grossman-Helpman model (1994) for a US annual panel data set including 193 four-digit SIC 87 US industries over the time period between 1997 and 2001 by applying a simultaneous three equation system. The effective rate of protection (ERP) is for the measure of trade protection. The estimated results offer support for the Grossman and Helpman model (1994). However, lobbying has a weak effect on trade protection.

Chapter 4 analyzes the impact of trade liberalization on economic growth for Malaysia and South Korea. A four variable vector autoregression (VAR) is used to study the relationships between trade, foreign direct investment (FDI) and economic growth over the time period from 1970 to 2004 (for Malaysia) and from 1976 to 2007 (for Korea). The differences in the estimated results are explained by the differences in the economic policies between the two countries. Although both countries implemented policies of export-orientated industrialization, the Malaysian government promoted foreign direct investment (FDI) as a tool of industrialization, while the Korea government built an "integrated national economy" using "chaebol" industrial structures and minimizing the role of FDI.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Trade liberalization is understood as the relaxing and removal of trade barriers, including tariffs and nontariff barriers, in order to create a free flow of goods and services from one country to other countries in the world. Trade liberalization takes on specific characteristics for different groups of countries. For instance, developed countries carried out trade liberalization earlier than developing countries, with the hope of increasing their economic growth. But while trade liberalization has been the slogan of developing countries for the past several decades, the political economy of trade protection now seems to have become more dominant in the developed countries. Therefore, studies of trade liberalization must be sensitive to specific characteristics of each type of country.

Transitional countries, including the Eastern European countries, the Commonwealth of Independent States and countries like Vietnam and China, have been carrying out economic reform in previously closed-to-market economies. In these transitional economies, trade liberalization policies and privatization policies have been simultaneously enacted—a distinguishing characteristic of these transitional economies. Therefore, studies on the relationship between trade liberalization and economic growth need to take into account the effects of simultaneous privatization and trade liberalization on economic growth.

Trade liberalization in the Asian Tiger countries can be seen in the shift from import-substitution policies to export-orientation policies. The impact of trade liberalization on economic growth is displayed in the relationship between trade (exports and imports) and economic growth. But, due to the fact that the Asian Tiger economies are connected with FDI, the relationship between trade and economic growth is not separate from the relationships between trade and FDI or between FDI and economic growth.

As mentioned above, the process of trade liberalization in developed countries occurred much earlier than in the developing, transitional economies. Since the 1970s, trade liberalization in developed countries, mostly in the United States, has conflicted with political-economic benefit. Lobbying, which proxies for political economic force, is considered an important factor affecting the trade liberalization process in the US.

1.2 REVIEW OF THE LITERATURE AND MOTIVATION OF THE STUDY

Does trade liberalization promote economic growth? It is amazing that after two decades of continuous argument over this problem, the answer is still ambiguous. Using different models and different assumptions, researchers have found different answers. Barlow (2006) was a rare paper that estimated the relationship between openness, privatization and growth in the 22 transitional countries, during the period from 1993 to 2001. Barlow found that trade liberalization had a positive effect on economic growth, while privatization had a negative effect. However, the coefficient of privatization was sensitive to the data sample and had both negative and positive signs, and more than half of the regressions were not statistically significant. The author also overcame the endogeneity of openness and privatization by applying IV-GMM, created by Arellano and Bond in 1991. The instruments for openness and privatization were the lags, the differences of openness and the differences of privatization, which may have provided insufficient information to explain openness and privatization. Not only Barlow (2006), but many other papers have tried to solve endogeneity problems of openness and privatization, such as Frankel and Romer (1999), Romalis (2007), Godoy and Stiglizt (2006), and others. Many of the papers in the literature have not tested whether openness or privatization needs to be instrumented, or whether their instruments are weak or not redundant and exogenous. Ignoring these tests may have led to biased results. Therefore, this study is an attempt to research and fill this gap in the literature.

The political economy of trade protection has received great attention from the 1970s to the present. During that time, economists have been trying to build an endogenous protection model to explain the political economy of trade protection. The Grossman and Helpman model of 1994 (hereafter the G-H model) marked a turning point in this literature, as it was the first model that allowed the political economy of trade protection to be presented through the lobbying variable. According to the authors, lobbying influenced the government's choice of trade policy. After the G-H model, there were a few studies, such as Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) that tested whether the G-H (1994) fit the actual data. A common characteristic of prior empirical studies has been that they have used tariffs or nontariff barriers (NTB) to proxy for trade protection. The definition of the effective rate of protection (hereafter ERP) states that if input tariffs are lower than output tariffs, the ERP is higher than the output tariffs. Statistical data provides evidence that developed countries, such as the U.S., Japan, and others, have imposed a higher tariff rate on consumption goods than on intermediate goods, which leads to a high ERP for the producers. The question is whether the theory of endogenous protection is correct in cases in which trade protection is measured by the ERP. To my knowledge, the answer to this question has not yet been revealed in the literature. In fact, prior empirical studies, which have applied the instrumental variable method, have not provided enough evidence to show the validity of their instruments. Therefore, their estimated results may be biased, if their instruments are weak or not exogenous. Furthermore, almost all papers have used the U.S. annual data from 1983 with three-digit SIC87 categories. Using that data set imposes some limitations: (1) the number of observations is small, which may cause ineffective estimation, and (2) it does not provide sufficient information about U.S. trade policy, since this policy has changed over the years. This gap in the literature has also motivated the present study.

The great economic achievement in the Asian countries from the 1970s to the present is the source of a tremendous body of theoretical literature. The literature partly provides theoretical explanations, based on the export-led growth hypothesis, the export-driven growth hypothesis, the import-compression growth hypothesis, and the intertemporal budget-constraint hypothesis. The empirical results from different authors for one Asian country sometimes are in conflict. Two-way causality between Korean exports and imports was discovered by Fung, Sawhney, Lo, and Xiang (1994) and Oskoee (1997), but both Mahadevan et al. (2008) and Kim et al. (2009) provided evidence of no causality between Korean exports and imports. Chang et al. (2000) found two-way causality between Taiwanese exports and imports, but Mahadevan et al. (2008) suggests no causality between them, and other conflicts in findings also exist. What causes these conflicting results? In studying prior studies of Asian countries, I have found that they typically use a bivariate VAR model or a trivariate VAR model to consider the dynamic impact among some of the four following variables: GDP, exports, imports and FDI. However, theoretical analysis reveals that three series, FDI, exports and imports, interact in their relationships with GDP. Therefore, there exists a possibility of cointegration between the four series. Also, a bivariate or trivariate VAR model constructed from two series or three series out of four series (GDP, exports, imports and FDI) will be misspecified. In addition, the prior studies ignored dynamic analysis, such as impulse responses and variance decompositions, and had limitations in their econometric procedures to apply the VAR model, such as ignoring VAR diagnostics. All of these factors may have caused biased results. It is for these reasons, also, that I have been motivated to conduct the present study.

1.3 PURPOSE OF THE STUDY

The purpose of this thesis is to enhance our understanding of the role of trade liberalization in relation to economic growth and the factors that affect it, for various groups of countries. Furthermore, this study tries to overcome endogeneity problems by applying different econometric methods.

Chapter 2 emphasizes the effect of trade liberalization and privatization on economic growth in transitional countries. Chapter 3 focuses on the impact of lobbying on U.S. trade protection. It tests the G-H political economy model (1994), using the ERP as a measure of protection. Chapter 4 studies the impact of trade and investment liberalization on the economic growth of Malaysia and Korea, using a cointegrated VAR involving FDI, trade and economic growth. Furthermore, this chapter interprets the VAR results in terms of the development strategies of the two Asian economies.

1.4 METHODOLOGY

This dissertation applies three econometric methods to overcome the endogeneity problem: (1) the two-stage least–squares (2SLS) method for single equations, (2) simultaneous three-equation systems and (3) the VAR model.

Chapter 2 applies the 2SLS method for a single equation of economic growth for 25 transitional countries from 1994 to 2006. The dependent variable is economic growth rate. The two right-hand side endogenous variables are the openness index and privatization. The control variables are political conflict, inflation, change in productivity, change in labor and change in investment. The instrumental variables to explain the two endogenous variables are: (1) The WTO dummy variable, (2) the landlocked dummy variable, (3) the openness index of largest trade partners, (4) the ratio between public output and private output, and (5) the ratio between government debt and GDP. The Wu-Hausman test has been implemented in order to check whether openness and privatization are endogenous or not. In addition, I conduct the test for weak instruments, the test for redundancy and the Sargan test to check the validity of instrumental variables. I also test fixed effects versus random effects by using the Hausman test (1978), the Breush-Pagan statistic test and the test for fixed effects. The robustness check of estimated results is carried out in two ways: (1) testing whether estimated results are robust with different structures of the sample set and (2) testing the specification of the instrumental variable TIME_LANDLOCK.

Chapter 3 applies the simultaneous three-equation systems to test the G-H model (1994) for the U.S. annual panel data set, including the 193 four-digit SIC 87 U.S. industries from 1997 to 2001. The ERP is the measure of trade protection. My econometric model builds on the simultaneous three-equation system of Gawande and Bandyopadhyay (2000). The first equation is the trade protection equation (ERP equation); the second equation is the import equation; the third equation is the lobbying equation (PAC equation). The Wu-Hausman test, the test for weak instruments, the test for redundancy and the Sargan test have been carried out in order to check the empirical validity of the model as specified. I also test the robustness of the estimated results when import demand elasticity is moved to the left hand side of the ERP equation.

Chapter 4 applies a four-variable VAR model involving four endogenous variables: the logarithm of real GDP, the logarithm of real exports, the logarithm of real imports and the logarithm of FDI. The dynamic relations among these four variables are investigated for Malaysia and Korea during the time period from 1970 to 2004 (Malaysia) and from 1976 to 2007 (Korea). The econometric method includes the following steps: (1) testing the unit root of four time series, (2) constructing a four-variate VAR model, (3) VAR diagnostics, (4) the Johansen cointegration test, (5) the Granger Causality/Block exogeneity test and (6) dynamic simulation (the impulse response function and variance decomposition).

1.5 SUMMARY OF MAIN FINDINGS

Chapter 2 provides support for a significantly positive effect of both trade liberalization and privatization on economic growth, while controlling for political conflict and macroeconomic stability. Based on comparison of beta coefficients, privatization policy effects on economic growth are greater than those for trade liberalization policy. In addition, political and macroeconomic stability considerably influence economic growth. For these countries, a political conflict offsets the contribution of one standard deviation in privatization and trade liberalization on economic growth. The robustness check confirms that all empirical results are robust.

Chapter 3 provides evidence to support the G-H model. (1) In the lobbying industries, trade protection increases (trade liberalization decreases) whenever the inverse import penetration increases and the import-demand elasticity decreases. (2) In the industries without lobbying, trade protection increases (trade liberalization decreases) with a lower inverse import penetration and a higher import-demand elasticity. However, lobbying has weak effects on trade protection, since the share of lobbying in the government's objective is very small (0.8 %). The robustness check confirms that all empirical results are robust.

Chapter 4 provides evidence that the four variables are cointegrated for both Malaysia and Korea. Exports are a long-run source of both Malaysian and Korean economic growth. For Malaysia, there is evidence to support the two-way causalities between each pair among the four variables, except for causality from GDP to exports. For Korea, there is one-way causality from exports, imports and GDP to FDI, from exports and imports to GDP, and from exports to imports. Exports are not affected by the other three variables. Trade liberalization has a positive effect on Malaysian economic growth, while the effect of trade liberalization on Korean economic growth is ambiguous. The difference in the estimated results is consistent with the difference in economic policies between the two countries. Both countries have implemented exports-orientation industrialization. However, the Malaysian government gives the leading role in industrialization to FDI, while the Korea government has built what is often called an integrated national economy, relying on industrial conglomerate *chaebols* and minimizing the role of FDI.

1.6 ARRANGEMENT OF THE STUDY

This thesis consists of four main chapters. The Second chapter analyzes the impact of trade liberalization and privatization on the economic growth of transitional countries. The third chapter studies the impact of lobbying on U.S. trade protection. The last chapter estimates relations between trade liberalization, FDI and economic growth in a VAR for Malaysia and Korea. The VAR results are interpreted in the light of alternative growth strategies pursued by these two economies.

CHAPTER 2

TRADE LIBERALIZATION, PRIVATIZATION AND ECONOMIC GROWTH

2.1 INTRODUCTION

After the end of the communist era, the Eastern European countries, the commonwealth of independent states, and countries like Vietnam and China went through economic reforms that included trade liberalization and privatization, with the hope of improving their economies to achieve higher growth rates. The simultaneous, rather than separately timed, enactment of trade liberalization policies and privatization policies has been a distinguishing characteristic of these transition economies. Therefore, studies that investigate only the relation between trade liberalization and economic growth, or only the relation between privatization and economic growth, may not be suitable to analyze transition economies. Thus, this paper focuses on the simultaneous effects of the two policies on economic growth.

What are the simultaneous effects of trade liberalization and privatization on economic growth? Addressing this question is of critical importance to policy makers in transition countries, who have an interest in finding a reasonable adjustment between the two policies, in order to improve economic growth.

Barlow (2006) was one of the rare papers that considered the simultaneous effects of both policies, in 22 transition countries from 1993 to 2001. The author found that trade liberalization had a positive effect on economic growth, while privatization had a negative effect. However, the coefficient of privatization was sensitive to the data sample and had both negative and positive signs,[1] and more than half of the regressions were not statistically significant. Barlow also overcame the endogeneity of openness and privatization by applying Instrumental Variable – Generalized Moment Method (IV-GMM)[2], the instruments for openness and privatization were the lags, the differences in openness and the differences in privatization. However, the paper did not show the test for weak instruments.

Not only Barlow (2006), but many other papers tried to solve endogeneity problems of openness and privatization. Finding the appropriate instruments was a challenge for economists. After a long period of examination of this problem, it appeared that there were only two types of instruments for openness that included the geographical variables recommended by Frankel and Romer (1999) and the decrease of U.S. MFN tariffs recommended by Romalis (2007). The instruments of Romalis were probably not suitable for transition countries, and the data were not sufficient, since the United States was not a large trading partner of many transition countries. Therefore, the impact of decreasing U.S. MFN tariffs may not have proxied for higher market access of transition countries in order to push up their trade volumes. In the course of reviewing the literature, I have found that many authors do not check whether openness or privatization in their models need to be instrumented, or whether their instruments are weak or not redundant and exogenous. Ignoring these tests may lead to biased results.

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[1] Barlow cut the original sample into smaller samples and then regressed again. The coefficient signs of privatization in those small samples were both negative and positive.

[2] IV-GMM is method combined instrumental variable method and generalizing method of moment. The instruments are lag and difference of variable its self. Arellano and Bond (1991) recommend this method. See chapter 8 in Balgati (2001).

Thus, there is a gap in the literature on endogeneity that needs to be studied, and that gap has become an important focus of this research. The contribution of this research project to literature is three-fold. First, I construct the appropriate instrumental variables for openness and privatization. Second, I apply econometric techniques to test the endogeneity and the validity of instruments. Third, I provide a forecast of the simultaneous effects of openness and privatization on economic growth, the foundation for making macroeconomic policies in the transition countries.

I use a data set including 25 transition countries during the period from 1994 to 2006. To overcome the endogeneity of openness and privatization, I apply the two-stage least–squares test (2SLS) to estimate the effects of openness and privatization on economic growth under both fixed and random effects. The set of instrumental variables includes the openness index of trading partners of transition countries, the date of a country's becoming a WTO member, the ratio of government debt over GDP, the ratio of public share over private share in GDP and the product of time and a land-locked dummy. I check the validity of instruments by applying the Wu-Hausman test, the weak instrument test, the test for redundancy and the test for overidentifying restrictions. The results from these tests show that openness and privatization need to be instrumented and that the instruments are valid. I also test fixed effects versus random effects by using the Hausman test (1978), the Breush-Pagan statistic test, and the test for fixed effects. The Hausman test (1978) provides evidence for the use of fixed effects. The primary estimation results suggest that both openness and privatization have a positive effect on economic growth when political conflict and macroeconomic stability are controlled for.

I check the robustness of the empirical results in two ways. (1) One way is to classify the original sample into six groups: Central European, Baltic, European CIS, South East Europe, Caucasia and Central Asian Countries. Taking out each group from the original sample, and then running regressions, I have found that the signs of coefficients of all independent variables are the same as the signs of the coefficients of those variables in the original sample, and they are mostly significant. (2) The other way is to check the robustness of my estimated results in the specification of the instrumental variable (the landlocked dummy interacted with time). I regress the sample in three steps. First, I include the time dummy variable. Second, I replace this variable by the landlocked dummy variable. Third, I add both the time dummy variable and the landlocked dummy variable to the instrument set. The statistical results show that coefficients of all variables in the structural equation are still statistically significant and have the same sign and small changes in value as the original estimated results.

The rest of this chapter is organized as follows. The second section is a literature review; the third section describes the methodology; and the fourth section reports the primary estimation results. The fifth section presents the conclusions.

2. 2 LITERATURE REVIEW

The literature review in this chapter addresses three topics. The first is the relationship between trade liberalization and growth; The second is the relationship between privatization and growth; The third is the relationship between trade liberalization, privatization and growth.

2.2.1 Trade Liberalization and Growth

2.2.1.1 Theoretical Model

This section will open with a fundamental question in economic development and international economics: Does trade liberalization push up economic growth? It is amazing that after two decades of continuous argument over this problem, the answer is still ambiguous. With different models and different assumptions, we get different answers. In the paper entitled "Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-National Evidence," Rodriguez and Rodrik (1999) summarized modern theories related to this question as follows:

- The negative relation between trade restrictions and growth was discovered in static models without market failures, in endogenous growth models with non-diminishing returns in input factors, or in learning by doing and endogenous technological progress.
- The positive relation occurs in static models of market failure.[3]
- No relation between trade restrictions and long-term output growth is found in models with exogenous technological progress and diminishing returns in input factors.

2.2.1.2 Empirical Model

Support for theoretical models has come from a substantial body of empirical evidence. Frankel and Romer (1999) employed a new instrumental variable for openness that helped

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[3] Assume that there are market failures; for example, positive externalities in production of competing import sectors. The production cost will reduce and then the output will increase.

economists solve the endogeneity problem of openness. Basing their work on the gravity model—that geographic characteristics have important effects on bilateral trade and are uncorrelated with income—Frankel and Romer used geographical variables as instruments for openness. These instrumental variables included: (1) the average weight of distance between two countries, which was measured by the distance between the capitals of the two countries; (2) a dummy variable that equaled one if the countries had a common border and zero otherwise; and (3) a dummy variable that equaled one if a country was landlocked and zero otherwise. Frankel and Romer used 2SLS to test the effect of openness on growth, under the control of population size and area, for 63 countries in 1985. Openness was measured by the ratio of trade volume (export plus import) to GDP in 1985. Their results suggested that trade had a statistically significant and positive effect on growth. According to Frankel and Romer (1999), trade increased income by increasing each determinant of income, such as the ratio of physical capital to labor, technological progress and human capital. They tested this school of thought by regressing each determinant of income on trade, population size and area.

Rodriguez and Rodrik (2000) examined previous research and concluded that there was no evidence of a positive relationship between trade liberalization and growth. Instead of constructing a specifically empirical model, they replicated the empirical models of Sachs and Warner (1995), Edwards (1998), Frankel and Romer (1999) and other researchers, to show problems in the empirical strategy and measurement of openness index. According to Rodriguez and Rodrik, the openness index constructed by Sachs and Warner was a dummy variable mainly derived from the black market premium and the state monopoly in export. But these two variables were not related to trade policy. Edwards (1998) used a more thorough approach, with nine openness indicators, to check the robustness of the positive relationship between trade and growth. By replicating Edwards (1998), Rodrick and Rodriguez showed that a high proportion of the openness coefficient was statistically insignificant and negative. In addition, they also suspected that the growth data of poor countries was highly unreliable. Therefore, Rodrick and Rodriguez argued that Edwards' conclusion of a positive relationship between openness and growth was an overstatement. Rodriguez and Rodrik also questioned the use of geographical variables, which were Frankel and Romer's instrumental variables. They contended that geographical variables had no impact on trade. To prove it, they replicated Frankel and Romer (1999) with other geographical variables, such as distance from the equator, percentage of land area located in the tropics and a dummy variable for region in the second stage. In addition, they thought that the ratio of trade volume to growth did not reflect trade policy. Through these analyses, Rodrick and Rodriguez concluded that there was little evidence to support a positive relationship between trade liberalization and growth.

Chang, Kaltani, and Loayza (2005) were also concerned about the endogeneity of openness. They found a positive effect of openness on growth for a sample set covering 82 countries from 1960 to 2000. They applied IV-GMM using lags and differences in openness as instrumental variables. Openness was equal to the residual from the regression of the logarithm of the ratio of trade volume to GDP on the logarithms of area and population and the dummy variables for oil export and landlocked countries. The dependent variable was the first difference of per capita GDP. The explanatory variables were trade openness and a set of control variables, which included the rate of secondary school enrollment (which proxied for human capital investment), the average ratio of private credit to GDP (which proxied for financial depth), an average rate of inflation (which proxied for macroeconomic stability) and the average number of main telephone lines per capita (which proxied for public infrastructure). In addition, Chang et al. used some variables that changed only across countries, such as political risk, the labor market, firm exit (or entry), the flexibility index and the index of economic freedom.

Romalis (2007) returned once again to the endogeneity problem of openness. Nearly seven years after Frankel and Romer (1999) recommended geographical variables as instrumental variables, Romalis introduced a new instrumental variable for openness. The main advantage of Romalis's instrumental variable was that it was constructed under panel data. Romalis considered tariff barriers of the United States as instrumental variables for openness. This arose from the school of thought that a lower tariff of a large trading partner meant higher market access and led to trade expansion. Like Frankel and Romer (1999), Romalis also used the openness index, which was the ratio of imports plus exports to GDP. However, they used different measures of per capita GDP, constructed from different sources. They used 2SLS to estimate the effect of openness on growth for 135 developing countries from 1960 to 2000. They also found a positive relationship between openness and growth. However, this instrument was not effective if the United States was not a large trading partner of the countries. For some groups of countries, U.S. tariff barriers could be the same, but the growth rates differed, meaning that the structure of this instrumental variable did not reflect the market access of the countries exactly. Besides, the absence of control variables in the regression model meant that the results of the paper could have been biased.[4]

[4] Do not include the control variable that leads to the econometric problem of the omitted variable. See Green (2008), page 133, chapter 7, section 7.2: Specification analysis and model building.

2.2.2 Privatization and Growth

2.2.2.1 Theoretical Model

My research project also includes the relationship between privatization and growth. Unfortunately, to my knowledge, there are no theoretical models dealing with this relation. Thus, it is difficult to present a model using the characteristics of privatization.

2.2.2.2 Empirical Model

The empirical evidence has shown mixed results. Plane (1997) found a significant positive relationship between privatization and economic growth for 35 developing countries between 1988 and 1992. The author used two models, the Tobit and Probit models, to test the determinants of privatization. The explanatory variables in the two models were the same and included per capita GNP, the ratio of foreign direct investment to GDP, the ratio of public debt to GDP, the ratio of saving rate to GDP, the real effective exchange rate, a variable reflecting market capitalization, a variable reflecting the structural adjustment program and a dummy variable for Latin American countries. All explanatory variables were sourced in 1988. In the Probit model, the dependent variable took the value of one if a country implemented privatization from 1988 to 1992, and zero otherwise. In the Tobit model, the dependent variable was defined as the cumulative proceeds from asset sales of state-owned enterprises, from 1988 to 1992, as a share of the 1990 GDP. The results from the two models showed that a country with a higher per capita GNP, foreign direct investment, level of market capitalization and public debt, as well as lower real effective exchange rate, saving rate and level of structural adjustment will have higher probability of privatization. Plane was the first to try solving the endogeneity of privatization. To investigate the impact of privatization on economic growth, as well as to overcome the endogenous bias of privatization, Plane used 2SLS. The first stage consisted of the Tobit or Probit equations. The second stage was an OLS regression of the GDP growth rate on international terms of trade, the external current account, economic policy variables and the predicted probability of privatization in either the Probit model or the Tobit model. The author found that privatization had a significantly positive effect on economic growth. However, he only used the Hausman test to test endogeneity of privatization. These results perhaps fell into the case in which the instrumental variables were weak instruments or not exogenous. An additional weakness of the study was that Plane did not define which variables were the control variables in his 2SLS model.

Cook and Uchida (2003) used data from 63 developing countries between 1988 and 1997 and the method of the extreme-bounds analysis (EBA). In order to conduct the EBA, they ran an OLS regression of the GDP on I, M and Z, as explained below, and obtained coefficients a_1, a_2 and a_3, respectively. I was the set of variables commonly included in the regression, such as the log of the initial GDP, the initial life expectancy at birth, the average rate of population growth, the ratio of government consumption to GDP, the ratio of gross domestic investment to GDP and the rate of secondary school enrollment. M was the set of policy variables, such as the privatization policy. Cook and Uchida (2003) also used the same privatization indicator as Plane (1997). Z was the set of control variables. They used 12 variables in set Z, including openness (which was measured by the ratio of trade to the GDP), average inflation rate, and average ratio of government budget surplus/deficit to GDP and dummy regional variables, among other variables. Cook and Uchida (2003) changed the combination of variables in set Z and obtained different values for coefficient a_2 and a corresponding standard deviation σ. The upper extreme bound was measured by a maximum value of a_2 plus σ. The lower extreme bound was measured by a minimum value of a_2 minus σ. The result was robust when the upper and lower extreme bounds had the same sign. By using EBA, Cook and Uchida (2003) confirmed that privatization had a negative effect on growth, the opposite result from Plane's paper, which used the same measurement of privatization for developing countries. This showed the sensitivity of the results to a larger sample, longer period of time and different econometrics methods. In particular, their use of OLS did not deal with the well-known endogeneity problem for privatization.

Like Plane (1997), Godoy and Stiglitz (2006) were concerned about the endogeneity problem. Godoy and Stiglitz (2006) chose 2SLS as the solution to eliminate the endogeneity of privatization. The level of privatization was measured by the weighted average of the indices of small-scale and large-scale privatization. The speed of privatization was measured by the difference between the privatization levels of 1990 and 2001. They used the initial condition as the instrumental variables for privatization.[5] These instrumental variables included the years under communist rule, the difference between the black market exchange rate and official exchange rate in 1990, the percentage of defense expenditure in GDP in the 1980s and the sum of three trade distortions: trade openness, the share of external trade in the GDP and the share of trade with socialist countries in the GDP in the late 1980s. They also used a three-stage least-

[5] See De Melo et al. (1997) and Popov (2000).

squares regression[6] (3SLS) to confirm the robustness of their results. They found that the level of privatization had a positive impact upon growth, but that the speed of privatization had a negative effect on growth, in a sample of 23 transitional economies over the period from 1990 to 2001. This result supported the school of thought that gradual privatization would obtain a higher growth rate. Since the number of observations was so small (25 observations), the estimation results may not have been reliable. On the other hand, the authors did not offer any tests for endogeneity or for validity of instruments. It is an intuitive judgment that the instrumental variables, such as the number of years under communist rule or trade openness in the 1980s, may not have been exogenous.

2.2.3 Privatization, Trade Liberalization, and Growth

2.2.3.1 Theoretical Model

It is unfortunate that there are no theoretical models in the current literature to present this relation. However, evidence from the relation between trade liberalization and privatization and welfare supports the possible existence of this relation, which I intend to research.

Chao and Yu (2006) designed their model for a small open economy in which two identical countries were undergoing economic reform with trade liberalization and privatization policies. This model was based on the international mixed oligopoly model, with partial privatization of domestic firms, used by Matsumura (1998). Privatization would transfer one part

[6] They check the robustness of their estimated results by using three-stage least-squares regression. Their estimated results from 2SLS and 3SLS are consistent.

of public ownership into private ownership. While the existence of state-owned firms was based on government subsidies, the existence of privatized firms depended on profit maximization. The privatized firms would reduce their output and increase the price of goods to maximize their profits. Therefore, privatization would lead to a decline in market supply and a decline in consumer surplus. Since consumer surplus was the main component of welfare, privatization would decrease welfare. On the other hand, lower tariffs, which imply trade liberalization, would lead to increases in the market supply, and therefore to increases in welfare.

2.2.3.2 Empirical Model

Barlow (2006) was the only paper that estimated the relationship between openness, privatization and growth in transition economies for the 22 transition transition countries during the period from 1993 to 2001. He discovered that trade liberalization played an important role in improving economic growth. This impact was very clear in the early period of the transition (1993-1996) and for the countries that were closest to the European Union. For the rest of the countries and in the later period of the transition (1997-2001), trade liberalization increased economic growth while privatization retarded growth. Using the IV-GMM, Barlow ran a regression of current GDP on the initial GDP, the log of inflation, the war dummy variable, the lag of the index of trade policy, the lag of the index of privatization, the lag of the index of internal market reforms, the lag of the interaction between the two policies, the first difference in the index of trade policy, the first difference in the index of privatization and the first difference in the index of internal market reform. The index of the trade policy was the European Bank for Reconstruction and Development's (EBRD's) transition indicator for foreign exchange and trade liberalization. The index of privatization was defined as the weighted average of the indices of small-scale and large-scale privatization. All indices were from the annual report of EBRD.

In summary, Barlow's paper raised the important problem that the simultaneous effect of both openness and privatization on economic growth needed to be considered. His paper used IV-GMM, in which the instruments were lags and differences of openness and privatization. Barlow concluded that privatization had a negative effect on growth. However, in only 4 of 10 regressions, the coefficient of privatization was significant, but with opposite signs. I think that these estimation results may have been biased, since the lag and the difference of privatization may not have been strong instruments, even though they were exogenous, as reported by the Sargan test. The limitations of Barlow's paper encouraged a search for other, stronger instruments for openness and privatization.

The above literature review shows that endogeneity of both openness and privatization needs to be considered. One of the greatest difficulties in overcoming the endogeneity of openness and privatization is to find the appropriate instruments. The instruments of Frankel and Romer (1999) were used only for cross-sectional data. The instruments of Romalis may not have been suitable for transition countries, since the United States was not a large trade partner of many transition countries. Therefore, the impact of decreasing U.S. tariffs may not have proxied for higher market access of transition countries in order to push up their trade volumes. This difficulty has encouraged me to identify new instruments for openness.

Exploring papers related to solving the endogeneity of openness and privatization, I have found many that did not check whether openness or privatization in their models needed to be instrumented, or whether their instruments were weak instruments or were not exogenous. All tests are very important, since they check the validity of the instruments that researchers use. These tests are an important step in determining the consistency of estimation results. For these reasons, I have become strongly motivated to research effective tests for endogeneity.

2.3 METHODOLOGY

The purpose of this research is to estimate the relations between privatization, openness and growth, by correcting the endogeneity of openness and privatization. In this research, I use 2SLS estimation of single-equation linear models. In the methodology section that follows, I describe the 2SLS estimation of single-equation linear models and the tests for the validity of instruments.

2.3.1 Single-equation estimation of the 1st equation of the structural model by 2SLS

Woodridge (2002) considered the first equation of the structural model (p. 83, eq.5.1):

$$\underset{(Tx1)}{y_1} = \underset{Tx(M^*-1)}{Y_1}\gamma_1 + \underset{TxK^*}{X_1}\beta_1 + \underset{(Tx1)}{\varepsilon_1}\ , \tag{1}$$

where y_1 is T x 1 vector of the dependent variable; Y_1 is T x (M^* -1) vector of the endogenous explanatory variables; X_1 is T x K^* vector of the exogenous variables included in the 1st equation; ε_1 is T x 1 vector of the error term; T is the number of observations; M^* is the number of endogenous explanatory variables; and K^* is the number of exogenous variables included in the 1^{st} equation. In my econometric model, y_1 denotes GROW. Y_1 includes PRI and OPEN. X_1 consists of WAR, INFLA, INVEST, EMPLOY and PRODU. T = 325, $M^* = 2$ (PRI and OPEN) and $K^*=5$ (WAR, INFLA, INVEST, EMPLOY and PRODU).

The reduced form of Y_1 is (Woodridge, 2002, p. 83, eq. 5.4)

$$\underset{Tx(M^*-1)}{Y_1} = \underset{TxK}{X}\hat{\Pi}_1 + \underset{Tx(M^*-1)}{\hat{V}_1}\ , \qquad (2)$$

where X is T x K vector of the determinant variables; $\hat{V}_1$ is T x (M^*-1) matrix of error term; K is the number of all determinant variables K=10. X includes X_1 and X_2. X_1 is T x K^* vector of the determinant variables included in the 1^{st} equation. X_2 is T x K^{**} vector of the determinant variables excluded from 1^{st} equation (hereafter called the excluded instruments). $K^{**}=K - K^*$ is the number of determinant variables excluded from equation 1 ($K^{**}=5$). X_2 is assumed to satisfy the IV exclusion restriction that there is no correlation between X_2 and the dependent variable in the structural equation. In my model, X_2 includes instrumental variables: (1) The WTO dummy variable, (2) The landlocked dummy variable, (3) The openness index of largest trade partners, (4) The ratio between public output and private output, (5) The ratio between government debt and GDP. The motivation to choose these instruments is explained in Section 2.4.1, p.35-37. These excluded instrumental variables are assumed to satisfy the IV exclusion restriction that they do not correlate with GROW: E (X_2, y_1) = 0. Section 2.4.1, p.38-39 provides arguments about the IV exclusion restriction. The definition of each variable will be given in the next part.

2.3.2 Testing for Endogeneity and Testing for Validity of Instruments

An estimation result may still be biased if the instruments of endogenous explanatory variables are not valid. To test the consistency of 2SLS, I have implemented the following tests: the Wu-Hausman test, the weak instrument test, the redundancy test, and the overidentifying restriction test (Sargan test).

2.3.2.1. Testing for Endogeneity (Wu-Hausman Test)

Consider the structural equation (1):

$$\underset{(Tx1)}{y_1} = \underset{Tx(M^*-1)}{Y_1}\gamma_1 + \underset{TxK^*}{X_1}\beta_1 + \underset{(Tx1)}{\varepsilon_1} \cdot$$

The reduced form of Y_1 is

$$Y_1 = X\hat{\Pi}_1 + \hat{V}_1 .$$

Since ε_1 is uncorrelated with X, so Y_1 is endogenous if and only if $E\left(\varepsilon_1 \hat{V}_1\right) \neq 0$. The linear projection of ε_1 on $\hat{V}_1$ in error form is

$$\varepsilon_1 = \lambda_1 \hat{V}_1 + e_1 , \qquad (3)$$

where $\lambda_1 = E\left(\hat{V}_1 \varepsilon_1\right) / E\left(\hat{V}_1{}^2\right)$, then Y_1 is exogenous if and only if $\lambda_1 = 0$.

Plugging equation (3) into equation (1), we have (Woodridge, 2002, p. 119, eq. 6.14)

$$\underset{(Tx1)}{y_1} = \underset{Tx(M^*-1)}{Y_1}\gamma_1 + \underset{TxK^*}{X_t}\beta_1 + \lambda_1 \hat{V}_1 + e_1 \cdot \qquad (4)$$

According to Woodridge (2002), the procedure of the Wu-Hausman test is as follows:

(1) Compute OLS residual ($\hat{V}_1$) from the first stage reduced form regression of Y_1 on X.

(2) Regress y_1 on Y_1, X_1 and $\hat{V}_1$. Then, test H_0: $\lambda_1 = 0$. If we reject H_0, there is evidence to believe that Y_1 is endogenous and the model must be estimated by an instrumental variable approach such as 2SLS.

2.3.2.2 Testing Overidentifying Restrictions (Sargan Test)

Consider the structural equation (1):

$$\underset{(Tx1)}{y_1} = \underset{Tx(M^*-1)}{Y_1}\gamma_1 + \underset{TxK^*}{X_1}\beta_1 + \underset{(Tx1)}{\varepsilon_1} = Z_1\delta_{2SLS} + \varepsilon_1 .$$

Woodridge (2002) demonstrates that the null hypothesis of the Sargan test is H_0: $E(X'\varepsilon_1) = 0$, where X is the complete set of predetermined variables. The procedure of the Sargan test is as follows:

(1) Compute 2SLS residuals from the structural equation $\hat{\varepsilon}_1 = y_1 - Z_1\hat{\delta}_{2SLS}$.

(2) Regress $\hat{\varepsilon}_1$ on X, the complete set of predetermined variables.

The test of overidentifying restriction is $S = T R^2 \sim \chi^2_{[K^*-(M^*-1)]}$, where T is the number of observations, R^2 is the usual R-squared and K^{**} - (M^* -1) is the number of overidentifying restrictions (that is, the difference between the number of excluded instruments and the number of right-hand side endogenous variables). This test is valid in the case of overidentification. If we fail to reject the null hypothesis, the overidentification restriction is valid. The instrumental variables are valid in the sense that they are uncorrelated with the error term in the structural equation with assuming that we have one valid instrument. “If we reject the null hypothesis, then our logic for choosing the IVs must be reexamined” (Woodridge, 2002, p. 123).

2.3.2.3 Testing Weak Instruments

If the correlations between endogenous explanatory variables and their excluded instruments are nonzero but small, those instruments are called weak instruments. There has been much attention to this in the econometric literature of the past 10 – 15 years. If the instruments are weak, 2SLS estimation may be biased and hypothesis tests have large-size distortion. Testing a weak instrument is carried out with a joint test of the statistical significance of the coefficients of all excluded instruments in the first-stage regression. The test statistic is simply the F-statistic of the first stage. Staiger and Stock (1997) give the rule of thumb for the case of one endogenous explanatory variable and one instrument. This rule states that the instrument is weak if the F-statistic for the first stage is less than ten. But, when the number of endogenous variables and the number of instruments increase, this rule is not appropriate. To develop the test for weak instruments in the case of n endogenous explanatory variables, Stock and Yogo (2004) have established a table of critical values with a 5% significance level. Therefore, the instrument is weak if the test statistic that is followed by Cragg and Donald (1993) is less than the critical value in the table.[7] The critical value is based on the type of IV estimator, the number of instruments, the number of endogenous explanatory variables and the level of bias or size distortion the researcher is willing to accept.

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[7] The test for weak instruments of Stock and Yogo (2004) is based on the test statistic of Cragg and Donald (1993).This test statistic coincides with the F-statistic for the first stage of 2SLS, in the case of only one right-hand side endogenous variable. The difference between Stock and Yogo and Cragg and Donald is that Stock and Yogo test the null hypothesis of weak instruments against the alternative of strong instruments. The null hypothesis of Stock and Yogo allows the parameters are identified. But, Cragg and Donald test the null hypothesis of weak instrument when the parameters are underidentified. Therefore, the critical values of Stock and Yogo and Cragg and Donald are different. Accoridng to Stock and Yogo, "a group of instruments is weak if the bias of the IV estimator, relative to the bias of ordinary least squares (OLS), could exceed a certain threshold *b*, for example 10%." And "if the conventional α-level Wald test based on IV statistics has an actual size that could exceed a certain threshold *r*, for example r = 10% when α = 5%." See Stock and Yogo (2004), page 3, 4.

2.3.2.4 Testing for Redundancy

A redundant instrument is an instrument that does not provide useful information about the endogenous variable. Adding a redundant instrument does not improve the asymptotic efficiency of estimation. Besides, using a large number of instruments can cause poor justification. Therefore, dropping redundant instruments is necessary.

Consider the structural equation (1).

$$\underset{(Tx1)}{y_1} = \underset{Tx(M^*-1)}{Y_1}\gamma_1 + \underset{TxK^*}{X_1}\beta_1 + \underset{(Tx1)}{\varepsilon_1},$$

where Y_1 is an endogenous regressor and X_1 is an exogenous regressor.

The reduced form of Y_1 (or the first stage equation) is

$$Y_1 = X\hat{\Pi}_1 + \hat{V}_1 .$$

Where X is a set of instruments which consist of excluded instruments X_2 and included instruments X_1, as follows:

$$Y_1 = \begin{pmatrix} X_1 & X_2 \end{pmatrix}\begin{bmatrix} \hat{\Pi}_{11} & \hat{\Pi}_{12} \end{bmatrix} + \hat{V}_1 . \qquad (5)$$

Assume that X_2 consists of two parts: X_{2A} and X_{2B}, where X_{2A} are possibly redundant instruments.

The redundant condition offered by Breusch et al. (1999) is

$$\begin{aligned} &P\lim \frac{1}{N} X'_{2A} M_{2B} Y_1 = 0 \\ &where \quad M_{2B} = I_N - P_{2B} \\ &\qquad\quad P_{2B} = X_{2B}\,(X'_{2B}\ \ X_{2B})^{-1}\, X'_{2B} \end{aligned} \qquad (6)$$

X_{2A} are said to be redundant instruments if, when we regress Y_1 on the full set of excluded instruments X_2, the coefficient on X_{2A} is zero; or if, when we regress Y_1 on the full set of both excluded and included instruments, the coefficient on X_{2A} is zero; or, if adding X_{2A} to the instrument set does not change the fitted value $(\hat{Y})$.

Breusch et al. (1999) describes the procedure to test for redundancy as follows:

1. Regress equation (5) by OLS;
2. Test the significance of $X_{2A,}$ using a large-sample Lagrange Multiplier test.[8]

The test statistic is distributed by chi-square, with a degree of freedom equal to the number of the endogenous regressors times the number of the tested instruments.

2.3.3 Random Effects and Fixed Effects

Omitted variables occur when we cannot include some necessary variables in the regression model, due to reasons such as unavailability of data or ignorance. Therefore, the error term will include these omitted variables. If the omitted variables and the independent variables are correlated, then those variables are endogenous. However, in panel data, we can see the other occurrence of omitted variables as time-constant variables, called *unobserved effects* (c_i). Unobserved effects often capture features of individuals (although in my model, they are features of countries) that do not change over time.

The model with unobserved effects can be written as (Balgati, 2001, p. 11, eq. 2.1 and 2.2)

$$y_{it} = X'_{it}\beta + u_{it} \qquad \mathrm{i} = 1...\mathrm{N}; \mathrm{t} = 1....\mathrm{T},$$
$$\mathrm{u}_{it} = c_i + \varepsilon_{it} \qquad (7)$$

[8] See Green, 2008, p. 166 and pp. 502-507.

where i denotes cross-section and t denotes time. β is K x 1 vector and X_{it} is N x K matrix . K is the number of explanatory variables. When c_i occurs in the model, there is serial correlation in $u_{i,t}$ such that $E(u_{i,t}, u_{i,s}) = \sigma_\alpha^2$ for $t \neq s$. Ignoring c_i causes at least an incorrect standard errors and ineffecient estimation.

There are two approaches to unobserved effects (c_i): (1) random effects estimation where c_i is treated as random effects, so that c_i is considered a random variable and is put into the error term; and (2) fixed effects estimation where c_i is treated as fixed effects, so that c_i is considered a parameter to be estimated.

2.3.3.1 Fixed Effects Model

To rewrite equation (7) for the fixed effects model, we have (Green, 2008, p. 194, eq. 9-12)

$$y_i = Ic_i + X_i\beta + \varepsilon_i \,. \tag{8}$$

Where I is T x 1 column of ones

To rewrite equation (8) under matrix form,

$$\begin{bmatrix} y_1 \\ y_2 \\ \dots \\ y_3 \end{bmatrix} = \begin{bmatrix} I & 0 & \dots & 0 \\ 0 & I & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & I \end{bmatrix} \begin{matrix} c_1 \\ c_2 \\ \dots \\ c_n \end{matrix} + \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_n \end{bmatrix} \beta + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \dots \\ \varepsilon_n \end{bmatrix} \tag{9}$$

$$y = \begin{bmatrix} d_1 & d_2 & \dots & d_n & X \end{bmatrix} \begin{bmatrix} c \\ \beta \end{bmatrix} + \varepsilon$$
$$y = Dc + X\beta + \varepsilon \tag{10}$$

Where d_i is a dummy variable and D is nT x n matrix and $D = [d_1, d_2, \dots, d_n]$.

2.3.3.1.1 Testing for Fixed Effects (F-test)

The null hypothesis is H_0: $c_1=c_2=\ldots=c_{N-1} = 0$.

Testing for fixed effects is carried out by checking the joint significance of dummy variables by the F-test. The procedure is that we run OLS and the fixed effects version of the model. The test statistic is (Balgati, 2001, p. 13, eq. 2.12)

$$F = \frac{\left(R^2_{RES} - R^2_{UNRES}\right)/(N-1)}{\left(1-R^2_W\right)/\left[N(T-1)-K\right]} \approx F_{N-1,N(T-1)-K} \quad , \tag{11}$$

where R^2_{RES} is the restricted residual sums of squares, and R^2_{UNRES} is the unrestricted residual sums of squares. R^2_{RES} is obtained from OLS on the pooled model, while R^2_{UNRES} is obtained from the least–squares dummy variable regression. Rejecting H_0 means there is evidence to support the existence of individual effects in the model.

2.3.3.2 Random Effects Model

To rewrite equation (7) for the random effects model, we have (Green, 2008, p. 201, eq. 9-25)

$$y_{it} = \alpha + \beta' X_{it} + c_i + \varepsilon_{it} \quad \text{where } u_{it} = c_i + \varepsilon_{it} . \tag{12}$$

This model makes the assumptions (Green, 2008, p. 201, eq. 9-26) that

$$
\begin{aligned}
&E(\varepsilon_{it}) = E(c_i) = 0 \\
&E(\varepsilon_{it}^2) = \sigma_\varepsilon^2 \\
&E(c_i^2) = \sigma_c^2 \\
&E(\varepsilon_{it} c_j) = 0 \quad \text{for all i, t, and j} \\
&E(\varepsilon_{it} \varepsilon_{js}) = 0 \text{ if } t \neq s \text{ or } i \neq j \\
&E(c_i c_j) = 0 \text{ if } i \neq j
\end{aligned}
\quad .
$$

2.3.3.2.1 Breusch-Pagan (1980) specification test (BP test)

Breusch and Pagan (1980) constructed the BP test from the Lagrange multiplier test for the random effects model.

The null hypothesis is H_0: $\sigma_c^2 = 0$ or $E(u_{it}, u_{is}) = 0$.

The BP test statistic is (Green, 2008, p. 205, eq. 9-39)

$$
LM = \frac{NT}{2(T-1)} \left[\frac{\sum_{i=1}^{N} \left(\sum_{t=1}^{T} \varepsilon_{it} \right)^2}{\sum_{i=1}^{N} \sum_{t=1}^{T} \varepsilon_{it}^2} - 1 \right]^2 \approx \chi_1^2 \quad . \tag{13}
$$

If H_0 is rejected, random effects exist in the model.

2.3.3.3 Fixed or Random effects?

Should fixed effects or random effects estimation be used? The Hausman specification test recommends a solution for choosing between fixed effects and random effects estimation.

2.3.3.3.1 Hausman Specification Test (1978)

The Hausman specification test is based on the difference between fixed effects and random effects. Fixed effects are consistent when c_i correlates with $X_{i,t}$ while random effects are not.

The null hypothesis of the Hausman specific test is H_0: $E(c_i, X_{it}) = 0$.

The Hausman statistic is (Green, 2008, p. 208, eq. 9-40)

$$\left[\hat{\beta}_{FE} - \hat{\beta}_{RE}\right]' \left[Var\left(\hat{\beta}_{FE}\right) - Var\left(\hat{\beta}_{RE}\right)\right]^{-1} \left[\hat{\beta}_{FE} - \hat{\beta}_{RE}\right] \approx \chi^2_K \,, \tag{14}$$

where $\hat{\beta}_{FE}$ is the coefficient vector of explanatory variables obtained from fixed effects regression, and $\hat{\beta}_{RE}$ is the coefficient vector of explanatory variables obtained from random effects regression. If the null hypothesis is rejected, only fixed effects estimation is suitable; otherwise, both random and fixed effects are suitable.

2.4 PRIMARY EMPIRICAL RESULTS

2.4.1 Data

I use a panel data set that covers 25 transition countries from 1994 to 2006. The transition countries include Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, FYR, Georgia, Hungary, Kazakhstan, Kyrgyz, Latvia, Lithuania, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

The dependent variable (GROW) is the growth rate of GDP. The main independent variables are the openness index (OPEN) and privatization (PRI). The level of privatization is measured by an average of indexes of small-scale and large-scale privatization. The calculation of indexes of large-scale privatization (LSP) is based on the privatization levels of the assets of large-scale public enterprises; for example, more than 75%, 50%, or 25% and less than 25%. The calculation of indexes of small-scale privatization (LSP) is also based on the privatization levels of the assets of small-scale public enterprises. These indexes are established and reported by EBRD. The openness index is measured by the ratio of trade volumes to GDP. The data on trade volumes and GDP are also taken from EBRD.

My econometric model includes control variables such as change in investment/GDP (INVEST), change in employment, change in labor productivity (PRODU), war (WAR) and the inflation rate (INFLA).[9] The INVEST variable is a proxy for the change in physical capital. The EMPLOY variable is a proxy for the change in labor. The PRODU variable is a proxy for technological progress. The WAR variable is a proxy for political conflict, while INFLA is a proxy for macroeconomic instability. WAR is a dummy variable, which receives the value of one if a country has political conflict in that year and otherwise is zero. The information related to political conflict in transition countries in my data set is taken from Central Intelligence Agency (CIA). The data of all other control variables are obtained from EBRD.

[9] The traditional theory of economic growth holds that economic growth is determined by production factors such as investment, labor and technological progress. Besides, the role of inflation rate and political conflict on the economic growth of transition countries is affirmed by many authors, such as Barlow (2006).

The instruments for openness and privatization are WTO, PARTNER, TIME_LANDLOCK, GOVDE and PUB_PRI. WTO variable is the year in which a country became a WTO member. WTO is a dummy variable, which receives the value of one if the country began to be or already was a WTO member in that year and zero otherwise. The data is taken from World Trade Organization (WTO). PARTNER is the average weight of an openness index of the composite of the five largest trading partners. These openness indexes are also measured by the ratios between trade volumes and GDP. The information about trading partners and the data on trade volumes of partners are taken from UN COMTRADE. The data about GDP of trade partners are taken from World Bank. TIME_LANDLOCK is the multiplication of two variables: YEAR and LANDLOCK. YEAR is a time variable, which receives value from 1994 to 2006. LANDLOCK is dummy variable, which receives the value of one if a country is landlocked, and zero otherwise. The data on LANDLOCK is taken from the CIA. GOVDE is government debt over GDP. The data on government debt is taken from EBRD. PUB_PRI is the ratio of public share of GDP over private share of GDP. The data on public firms' share over GDP and private firms' share over GDP are obtained from EBRD.

Rose (2004) and Subramanian and Wei (2003) studied the effect of WTO on trade. According to the authors, when countries became members of WTO, they had to follow bilateral mutual negotiations on cutting trade protection, and therefore, their openness increased. This conclusion led to the assumption that having become a WTO member was an important factor in change in the openness of the country. In this research, therefore, I have constructed a WTO variable and consider it a potential instrument of openness.

Romalis (2007) showed that a decrease in U.S. MFN tariffs—he assumes that the United States was the largest trade partner of developing countries—increased the possibility of market access for a developing country, and therefore increased the openness of that country. Therefore, the openness index of the largest trade partners of each transition country could provide necessary information to explain change in the openness index of that country. For this reason, therefore, I constructed the variable PARTNER and chose it as a potential instrument of openness.

Frankel and Romer (1999) used LANDLOCK as an instrument of openness. This arose from the idea that geographic characteristics of each country provided advantages or created limitations for that country in trade with the rest of the world. Therefore, I have borrowed from Frankel and Romer (1999) the use of LANDLOCK as a potential instrument of openness. However, LANDLOCK is a dummy variable and a time-constant variable, which receives the value of one if the country is landlocked and zero otherwise. To use it as an instrument for openness in the panel data sample, I multiply the LANDLOCK variable by the TIME variable to create a new variable, TIME_LANDLOCK. This means that I consider that LANDLOCK impacts openness through its joint impact with TIME on openness. This structure translates LANDLOCK into a time series. Section 5 confirms that this specification of the instrumental variable TIME_LANDLOCK is robust.

During the communist era, the public sector characteristically dominated the whole economy of a transition country. The operation of public firms did not aim toward profitability, but only toward social welfare.[10] The government had to use financial sources such as taxes, foreign debt, and exports to subsidize the operation of public firms. Lacking knowledge of management, technological progress, the dynamics of competition, and the relationship between demand and supply, public firms tended to operate ineffectively. The communist economy suffered from a high pressure of government debt owed to foreign countries. When the communist government did not have enough capacity to continue subsidizing public firms, then the government had to sell public firms to domestic or foreign investors. Therefore, higher levels of government debt created higher motivation for privatization in the transition countries. Plane (1997) used the ratio of government debt to GDP as the instrument of privatization. In this paper, I have followed Plane (1997) in choosing the ratio of government debt to GDP as an instrument of privatization.

Privatization transforms public firms into private firms. The purpose of privatization is not only to release the government from its heavy financial burden and to improve the effectiveness of public firms, but also to establish the foundation for market mechanisms through creating competitive sectors and private firms, and to push up economic growth. On the other hand, the governments of transition countries think that political institutions need to be ensured by economic forces such as the contribution of public firms in the economy. Therefore, the share of public firms' output to GDP, relative to the share of private firms' output to GDP, can be considered important information to explain the change in privatization level. It follows from this that using only the share of private firms' output to GDP does not provide necessary information to explain the change in privatization levels. Therefore, I have adopted the ratio of public firms'

[10] See Matsumara, T. (1998), p.473.

output to GDP to private firms' output to GDP as an instrument for privatization. This is the first use of this ratio in this way.

These instruments are assumed to satisfy the IV excluded restriction that they do not directly affect growth, but only have direct impact on openness and privatization. To my knowledge, there are not any theoretical or empirical models that display the direct effect of WTO, PARTNER, LANDLOCK, and PUB_PRI on economic growth. There is evidence to support the relationship between WTO, PARTNER, and LANDLOCK and trade or openness, and none that shows becoming a WTO member, having sea border, or the openness index of the largest trade partner has any direct linkage with the economic growth of a country.

There has been some concern about the direct impact of government debt on economic growth, but few studies have been done concerning this relationship. Recently, Reinhart and Rogoff (2010) have claimed that debt at low or moderate levels does not affect economic growth, but that if the ratio between debt and GDP is higher than 90%, then debt does have a negative effect on economic growth. Bivens and John (2010) have insisted that there is no theoretical model to display direct impact of government debts on economic growth. The theoretical model related to this issue would display the impact of government debt on economic growth through the channel of interest rate and investment. However, Bivens and John provide analysis and empirical evidence suggesting that there is no linkage between government debt and economic growth. They show that in the 1940s, the United States had a high ratio of debt to GDP, but economic growth rate was still double that in a period with a lower ratio of debt to GDP. By the

Granger causality test, Bivens and John (2010) have not found causality of debt ratio on economic growth.

The claim of Reinhart and Rogoff (2009) that debt has a negative effect on economic growth if the ratio between debt and GDP is higher than 90% has little relevance to this study. In my sample set, the average level of debt over GDP is 40.5%. There are only 16 observations—the total observations equal 325—that show a ratio between debt and GDP that is greater than 90%. Examining the case of the Kyrgyz Republic, for example, we find that there is no linkage between debt and economic growth. The economic growth rate at the high ratio, in fact, is higher than the economic growth rate at the low ratio. In 1995, the ratio between debts and GDP was 52.4 % and the economic growth rate was -5.40 %, while in 2000, the ratio between debts and GDP was 107.34 % and the economic growth rate was 5.44 %. There are also many cases in which the economic growth rates are very different, although the ratio of debts over GDP is the same.

The other concern is whether the ratio of public output over private output affects the economic growth rate. Up to now, there have not been any theoretical or empirical studies that have mentioned the direct effect of this ratio on economic growth. This ratio is only a characteristic of transitional economies. The ratio between public output and private output can be considered an indicator used by governments of transition countries to adjust the privatization level. I do not find any statistical evidence to support the relationship between economic growth and the ratio between public output and private output in my sample. Albania maintained the same ratio between public output and private output (0.333) during the time period from 1996 to

1999, but the economic growth rate changed within a large range (9.1 % in 1996; -10.2 % in 1997; 12.7 % in 1998; and 10.1 % in 1999). Many other countries provide similar evidence. For example, from 1994 to 1996, Belarus kept the same ratio between public output and private output (0.5667), but the economic growth rate changed from -11.7% in 1994 to 2.8 % in 1996. From 1997 to 2000, the ratio between public output and private output was 4, but the economic growth rate changed (11.4% in 1997; 8.4% in 1998; 3.4% in 1999; 5.8 % in 2000; and 4.7 % in 2001). From 2001 to 2004, the ratio between public output and private output was 3, but the economic growth rate varied (5.0% in 2002; 7.0 % in 2003; and 11.4 % in 2004).

Table 2.1 displays a summary of the main variables and also some of the characteristics of my sample. The observations total 325 and the data on variables such as OPEN, PRI, WAR, TIME_LANDLOCK, PUB_PRI, WTO, and PARTNER can be fully seen. From 1994 to 2006, the growth rate of GDP reached its highest rate at 34.5 %. The growth rate of GDP that is higher than 10 % is about 11% of whole sample. However, 16% of whole sample has negative growth rate of GDP. The lowest growth rate of GDP is 30.9%. The other feature of the sample is the inflation rate. 52% of the whole sample has a two-digit inflation rate; 39% of the whole sample has a three-digit inflation rate; 4% of the whole sample has a four-digit inflation rate. However, 1.8% of the whole sample has a negative inflation rate. The change in investment is also great. The growth rate of investment is 23.4% on average, 100.49% as the maximum rate and -311% as the minimum rate. The ratio of public share of GDP to private share of GDP decreases from 1994 to 2006. The average ratio is 1.027, the maximum ratio is 5.666, and the minimum ratio is 0.25. In general, the government debt to GDP reduces. The average level of the government debt to GDP is 40.5%; the maximum ratio of government debt to GDP is 319.79 % in Hungary in 1994.

Table 2.1: Statistical Summary of All Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
GROW	319	3.937749	6.736982	-30.9	34.5
OPEN	325	82.95631	29.42397	34.7	241.8
PRI	325	3.275462	0.7658746	1	4.165
WAR	325	0.1569231	0.3642891	0	1
INFLA	318	97.72408	458.4971	-1.374	6041.595
PRODU	306	6.450654	12.66028	-66.2	84.3
EMPLOY	316	-0.2433544	4.310237	-22	28.3
INVEST	290	2.761671	16.9127	-48.40764	103.333
TIME_LANDLOCK	325	1040	1000.744	0	2006
PUB_PRI	325	1.027479	1.092151	.25	5.666667
WTO	325	0.4338462	0.4963686	0	1
GOVDE	297	40.50165	32.21594	3.996	319.792
PARTNER	325	69.56384	15.43999	27.108	115.775

Before presenting the estimation results, I provide the results from an econometric test that show evidence supporting the choice of random effect versus fixed effect model as well as instruments.

2.4.2 Random Versus Fixed Effect

The test results are reported in Table 2.2.

First, I have used the F-test to test the individual effects. The result rejects the null hypothesis, since F (23, 231) = 5.81 and p = 0.000. Therefore, the unobserved effects and model must be estimated by either random or fixed effects.

Next, I have used the Breusch-Pagan test to test the null hypothesis H_0 that the variance of unobserved effects (c_i) is zero. The test rejects the null hypothesis, since chi-sq (1) = 67.08 and p = 0.000. This result provides evidence that my model can be estimated either by random or fixed effects.

The above results did not give concrete direction for my estimate. Therefore, I employed the test for random versus fixed effects discussed by Hausman (1978). The Hausman statistic for fixed effects versus random effects reports chi-sq (7) = 54.08 and p = 0.000. Based on this result, I will estimate my econometric model only by fixed effects.

Table 2.2: Random versus Fixed Effect

Hausman Specific Test	**F-Test that all u_i = 0**	**Breusch-Pagan Test**
Chi-sq (7) = 54.08 P-value = 0.000	F(23, 231) = 5.81 P-value = 0.0005	Chi-sq (1) = 67.08 P-value = 0.000

2.4.3 Testing the Validity of Instruments

The results from testing the validity of instruments are reported in Table 2.3 with fixed effects estimation. All tests are passed, to support the validity of all instruments. Table 2.3 reports the results of four tests: the endogeneity test, the test for weak instruments, the IV redundant test, and the Sargan test.

In the fixed effects model, the endogeneity test can be implemented by using the Wu-Hausman test. The Wu-Hausman statistic rejects the null hypothesis that there is no correlation between GROW and the residuals from the first stage regression, because F (2,229) = 14.89 and p = 0.000. Therefore, the Wu-Hausman test suggests that both PRI and OPEN are endogenous variables.

In addition, the joint test of weak instruments provides evidence that the chosen instruments are not weak. In the first stage regression of PRI, F (5,228) = 42.19 and p = 0.000, while in the first stage regression of OPEN, F (5,228) = 9.94 and p-value = 0.0000. The Cragg–Donald Wald F statistic is 8.201. It is higher than 5.91, the critical value for the weak instrument test of Stock and Yogo (2004), based on 20% maximal IV relative bias and a 5% significance level for the case of two endogenous explanatory variables and five excluded instruments. It is also higher than 6.89, the critical value for the weak instrument test of Stock and Yogo (2004), based on 30% maximal IV relative size and 5% significance level, for the case of two endogenous explanatory variables and five excluded instruments. Therefore, the instrument set is not weak in the case of 20% maximal IV relative bias and 30% maximal IV relative size.

Table 2.3: Tests for the Validity of the Instruments under Fixed Effects

Endogeneity test by Wu-Hausman test
Hypothesis H_0: No correlation between GROW and residuals from first stage regression.
If H_0 is rejected, there is correlation and PRI & OPEN need to be instrumented.
$F(2, 229) = 14.89$
P-value = 0.0000

Test of weak instrument
Hypothesis H_0 : All instruments are weak
If H_0 is rejected, then all instruments are not weak

First stage regression of PRI: Joint test of all instruments
$F(5, 228) = 42.19$
P-value = 0.0000

First stage regression of OPEN: Joint test of all instruments
$F(5, 228) = 9.94$
P-value = 0.0000

Cragg-Donald Wald F statistic:		8.201
Stock-Yogo weak ID test critical values:	5% maximal IV relative bias	13.97
	10% maximal IV relative bias	8.78
	20% maximal IV relative bias	5.91
	30% maximal IV relative bias	4.79
	5% maximal IV size	19.45
	10% maximal IV size	11.22
	20% maximal IV size	8.38
	30% maximal IV size	6.89

IV redundancy test: (LM test of redundancy of specified instruments)
Hypothesis H_0: instrument is redundant or instrument provides no useful information.
If H_0 is rejected, then instruments provide useful information and are not redundant.

Instrument	Chi-sq(2)	P-value
TIME_LANDLOCK	9.297	0.0096
PUB_PRI	12.217	0.0022
WTO	11.676	0.0029
GOVDEB	7.953	0.0188
PARTNER	15.911	0.0004

Sargan statistic: (overidentificatio test of all instruments):

Hypothesis H_0: all instruments are exogenous
Sargan test statistic: Chi-sq(3) = 5.844, P-value = 0.1174

On the other hand, the test for redundancy of each instrument confirms that each instrument provides useful information to explain PRI and OPEN, hence they cannot be omitted. Test statistics for TIME_LANDLOCK, PUB_PRI, WTO, GOVDE, and PARTNER are 9.297, 12.217, 11.676, 7.953 and 15.911, respectively. P-values are 0.0096, 0.0022, 0.0029, 0.0188, and 0.0004, respectively.

Finally, the Sargan test, or the overidentification test, suggests that the overidentification restriction is valid. The instrumental variables are valid in the sense that they are uncorrelated with error term in the structural equation. In the fixed effects model, chi-sq (3) = 5.844 and p-value = 0.1174.

2.4.4 2SLS Estimation Result

Table 2.4 reports the estimation result of 2SLS. The column in Table 2.4 corresponds to 2SLS estimation's results for fixed effects. In each cell, the first line reports the estimated regression coefficient value of the standardized beta coefficient and the level of statistical significance. Symbols ***, **, * denote 0.01, 0.05, 0.1 significance levels, respectively. The second line reports standard error. The coefficients of all regressors are statistically significant.

Empirical results from 2SLS estimation under fixed effect suggest that privatization and openness simultaneously promote economic growth in transition countries. Since both policies promote the same direction of economic growth, the joint impact of the two policies on economic growth is automatically predicted as positive.

Table 2.4: Summary of 2SLS Regression Results

Independent Variable	No standard Beta coefficient Dependent variable: GROW		Standard Beta coefficient Dependent variable: GROW	
	Random effects	**Fixed Effects**	**Random effects**	**Fixed Effects**
PRI	3.088*** (0.778)	6.918*** (1.347)	0.351*** (0.088)	0.786*** (0.153)
OPEN	0.100*** (0.028)	0.085** (0.039)	0.436*** (0.122)	0.371** (0.168)
WAR	-3.546*** (1.069)	-6.090*** (1.521)	-0.191*** (0.057)	-0.329*** (0.082)
INFLA	-0.011*** (0.002)	-0.009*** (0.002)	-0.786*** (0.127)	-0.644*** (0.134)
PRODU	0.194*** (0.023)	0.161*** (0.021)	0.364*** (0.0436)	0.301*** (0.039)
EMPLOY	0.208*** (0.074)	0.212*** (0.063)	0.133*** (0.047)	0.136*** (0.040)
INVEST	0.064*** (0.015)	0.048*** (0.013)	0.162*** (0.038)	0.121*** (0.035)

Note:
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

My result is different from Barlow's results (2006): that trade liberalization has a statistically significant positive effect on economic growth, and that privatization has a statistically nonsignificant, negative effect on economic growth. When comparing estimation methods, IV-GMM applied by Barlow (2006) used only internal instruments, including first lag and first difference of independent variables, but did not use external instruments. Internal instruments cannot provide sufficient information to explain endogenous variables (openness and privatization). In this case, misspecification in application of the estimation method may have been a reason for the wrong sign and statistical insignificance of the coefficient of the privatization variable found by Barlow.

In addition, Barlow's model (2006) did not control for production factors such as physical capital, labor, and technological progress. Barlow (2006) mentioned that Campos (2000) provided evidence to support the hypothesis that production factors do not influence economic growth in the transition stage. However, my findings relate to the impact of production factors on the economic growth of transition countries, and give evidence to support the traditional theory of endogenous growth and provide an opposite view to Campos (2000). Those three factors simultaneously contribute positively to economic growth. The standardized beta coefficients for physical capital, labor and technological progress are 0.121, 0.136, and 0.301, respectively. The standardized beta coefficient of technological progress is highest and is nearly triple that of physical capital and labor. This shows that technological progress is the most important factor in production. Transition countries should focus on upgrading advanced technology to improve their economic growth.

Comparing the standardized beta coefficients in fixed effects estimation, I have realized that the privatization policy had nearly twice the relative effect on economic growth as the openness policy, from 1994 to 2006. In fixed effects estimation, the standardized beta coefficient of privatization is 0.786, while the beta coefficient of openness is 0.371. If openness were to increase by one standard deviation, economic growth would increase only by 0.371 of a standard deviation; while if the privatization level were to increase by one standard deviation, economic growth would increase by 0.786 of a standard deviation. This shows that in order to accelerate economic growth, governments of transition countries might well emphasize privatization policy. It also implies that during the period from 1994 to 2006, building the foundation for market mechanisms through establishing competitive sectors played an important role in economic reform of transition economies. However, statistical data shows that openness increased considerably from 1994 through 2006, except for a few countries such as Albania, Armenia, and Uzbekistan, while the privatization level increased little. The growth rate of openness reached a maximum of 124.5%, while the growth rate of privatization reached a maximum of 40%. This may have been caused by the difficulties in implementing the privatization process, such as asset evaluation of public firms, choosing the privatization method, procedure in selling stocks and other problems.

In addition, the empirical results show the important role of stabilizing political conflict and mostly macroeconomic conditions. Political conflict and macroeconomic instability can decrease considerably the effects of privatization policy and trade liberalization in promoting economic growth. The standardized beta coefficient of INFLA is -0.644, which is very close to the value of the standardized beta coefficient of OPEN and PRI under an absolute comparison. To maintain the positive effects of trade liberalization and privatization policies on economic growth, governments of transition countries would need to implement macroeconomic stabilization policies and minimize political conflict. The statistical data from 1994 to 2006 provides promising signs of stabilization of the macroeconomics of transition countries. The inflation rate of transition countries decreased considerably, from an inflation rate of three or four digits in 1994, to an inflation rate of one or two digits in 2006. In general, political conflict is well controlled in many transition countries in my data sample, except for Kyrgyz, Georgia, Moldova, and Uzbekistan.

2.4.5 Robustness Check

I checked the robustness of the empirical results in two ways. The first was to observe the changes in the coefficients with different structures of the sample. The second was to check whether the instrumental variable of the landlocked dummy interacted with time, a reasonable specification.

First, I classified the original sample into six groups: Central European, Baltic, European CIS, South East Europe, Caucasia, and Central Asian Countries. I took out each group from the original sample and then ran the regressions. The statistical results show that signs of coefficients of all independent variables in the smaller sample are the same as the signs of coefficients of those variables in the original sample. More than 80% of the total coefficients are statistically significant. Some loss of significance is expected with the smaller samples. Table 2.5 reports the results of the robustness check for fixed effect estimation only.

Second, I examined the robustness of my estimated results with the instrumental variable TIME_LANDLOCK. I regressed the sample in three ways. First, I included the time dummy variables: dummy1994, dummy1995… dummy2006 in the instruments set. DummyT variable received the value of one for the year of T and zero otherwise (T = 1994, or 1995… or 2006). Second, I replaced the TIME_LANDLOCK variable by the LANDLOCK variable only. Third, I added both time dummy variables and the LANDLOCK variable in the instrumental set. The statistical results show that coefficients of all variables in the structural equation are still statistically significant and have the same sign. The values of coefficients are changed very little compared with the original estimated results. The P-value of openness is little higher than that of the original estimated result. All results reported in Table 2.6 confirm the robustness of my original estimated results.

Table 2.5: Robustness Report of Fixed Effects Estimation by Dropping Countries of One Region

Independent Variables	Dependent Variable: GROW					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
PRI	8.767*** (1.497)	7.086*** (1.445)	6.324*** (1.147)	10.456*** (2.074)	6.748*** (1.408)	3.936*** (1.309)
OPEN	0.047 (0.083)	0.088** (0.041)	0.052 (0.036)	0.042 (0.040)	0.085** (0.035)	0.063** (0.027)
WAR	-5.084 (2.077)	-6.071*** (1.598)	-6.682*** (1.884)	-4.369** (1.781)	-6.733*** (1.734)	-3.809** (1.286)
INFLA	-0.007*** (0.002)	-0.009*** (0.002)	-0.008*** (0.001)	-0.005** (0.002)	-0.009*** (0.001)	-0.013*** (0.002)
PRODU	0.156*** (0.025)	0.163*** (0.022)	0.162*** (0.020)	0.161*** (0.027)	0.177*** (0.022)	0.141*** (0.019)
EMPLOY	0.208*** (0.072)	0.229*** (0.069)	0.206*** (0.061)	0.364*** (0.079)	0.194*** (0.067)	0.117* (0.062)
INVEST	0.036*** (0.014)	0.048*** (0.014)	0.035*** (0.012)	0.039** (0.015)	0.058*** (0.013)	0.070*** (0.014)
CONT	-27.525*** (7.018)	-26.502*** (4.741)	-21.758*** (4.313)	-34.865*** (6.256)	-26.499*** (4.708)	-14.998*** (3.743)
Number of Observation	199	230	221	210	235	215

Note:
Central European countries: Czech, Slovak, Hungarian, Poland, Slovenia.
Baltic countries: Estonia, Latvia, Lithuania.
European CIS countries: Belarus, Moldova, Ukraine.
South East Europe countries: Albania, Bulgaria, Croatia, FYR Macedonia, Romania
Caucasia countries: Armenia, Azerbaijan, Georgia.
Central Asian Countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
(1) Take Central European Countries out of original sample
(2) Take Baltic Countries out of original sample
(3)Take European CIS countries out of original sample
(4) Take South East Europe countries out of original sample
(5) Take Caucasia countries out of original sample
(6) Take Central Asian Countries out of original sample
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

Table 2.6: Robustness Check of the Specification of the TIME_LANDLOCK Variable

Independent Variable	**Original Estimate Results**	**Robustness Check**		
		(1)	**(2)**	**(3)**
PRI	6.918*** (1.347)	6.122*** (1.207)	7.194*** (1.401)	6.122*** (1.207)
OPEN	0.085** (0.039)	0.054* (0.031)	0.073* (0.043)	0.054* (0.031)
WAR	-6.090*** (1.521)	-5.861*** (1.391)	-5.806*** (1.568)	-5.861*** (1.391)
INFLA	-0.009*** (0.002)	-0.009*** (0.001)	-0.009*** (0.002)	-0.009*** (0.001)
PRODU	0.161*** (0.021)	0.168*** (0.020)	0.161*** (0.021)	0.168*** (0.020)
EMPLOY	0.212*** (0.063)	0.235*** (0.060)	0.217*** (0.063)	0.235*** (0.060)
INVEST	0.048*** (0.013)	0.048*** (0.012)	0.048*** (0.013)	0.048*** (0.012)

Note:
(1): Adding time dummy variables
(2): Replace TIME_ LANDLOCK variable by LANDLOCK variable
(3): Adding both time dummy variables and LANDLOCK variable
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

2.5 CONCLUSION

This paper estimates the simultaneous effect of trade liberalization and privatization policies on economic growth. I used 2SLS with a full package of tests for endogeneity, weak instruments, redundancy and overidentifying restrictions. The tests establish the empirical validity of the model as specified. The main finding is that openness and privatization have statistically significant and simultaneously positive effects on economic growth. Based on comparison of beta coefficients, privatization policy effects on economic growth are greater than trade liberalization policy. In addition, political and macroeconomic stability influence economic growth considerably. For these countries, a political conflict offsets the contribution of one standard deviation in privatization and trade liberalization on economic growth. The robustness check confirms that all empirical results are robust.

CHAPTER 3

THE POLITICAL ECONOMY OF TRADE PROTECTION:

AN EMPIRICAL INVESTIGATION

3.1 INTRODUCTION

The political economy of trade protection has been given great attention from the 1970s to the present. During that time, economists have been trying to build an endogenous protection model to explain the political economy of trade protection. The Grossman and Helpman (1994) model (hereafter G-H model) marked a turning point in this effort. It was the first model that allowed the political economy of trade protection to be presented through a lobbying variable. According to the authors, lobbying had great influence over the U.S. Government's choices of trade policies.

To verify whether the G-H model was consistent with the practical data, Goldberg and Maggi (1999) used the maximum likelihood method for the U.S. annual data set from 1983, with three-digit SIC87 industries[11] Their estimated results provided evidence to support the G-H model. By using the simultaneous three-equation system for the same data set, Gawande and Bandyopadhyay (2000) also found evidence to support the G-H model. However, the argument about whether the G-H model matches the practical data still continues.

[11]Standard Industrial Classification in 1987 is denoted as SIC87

A common characteristic of empirical studies prior to this one has been that they have used tariffs or nontariff barriers (NTB) to proxy for trade protection. The definition of the effective rate of protection (hereafter ERP), in fact, implies that if input tariffs are lower than output tariffs, then the ERP is higher than the output tariffs. Statistical data from prior studies has provided evidence that developed countries, such as the United States, Japan, and others, have imposed higher tariff rates on consumption goods than on intermediate goods, which implies a high ERP for producers. The question is whether the theory of endogenous protection is correct when trade protection is measured by ERP. To my knowledge, the answer to this question has not yet been revealed in the literature. In fact, prior empirical studies using the instrumental variable method have not provided evidence to show the validity of their instrument. Therefore, their estimated results may be biased, if their instruments are weak and not exogenous. Furthermore, almost all prior papers have used U.S. annual data from 1983 with three-digit SIC87 categories. Using the 1983 data set leads to some limitations: (1) The number of observations is small, which may cause ineffective estimation, and (2) The data do not provide sufficient information about U. S. trade policy, since this policy has changed over the years.

This gap in the literature has motivated me to conduct the present study, which offers the following contributions to the literature of empirical testing of the G-H model: (1) I use the ERP to proxy for trade protection; (2) I use panel data constructed by the U.S. annual data for 193 four-digit SIC industries over the time period from 1997 to 2001; (3) I minimize bias in the estimated results from the simultaneous equation system by conducting several tests on the validity of instruments such as the WU-Hausman test for endogenity, the weak instrument test and the overidentification test.

My estimated results support the G-H model as follows: (1) In the lobbying industries, trade protection increases with a higher inverse import penetration and lower import-demand elasticity; (2) In the industries without lobbying, trade protection increases with a lower inverse import penetration and higher import-demand elasticity. The share of lobbying in the U.S. Government's objectives is very small (0.008), while the share of welfare in the Government's objectives is great (0.992). These estimated results suggest that U.S. trade policy was not affected seriously by lobbying between 1997 and 2001.

The rest of this chapter is organized into three parts. The second part is the literature review, the third part covers methodology and the last part is the conclusion.

3.2 LITURATURE REVIEW

This literature review consists of two parts. The first part is a review of the theory of endogenous protection. The second part is a review of the theory of effective protection.

3.2.1 The Theory of Endogenous Protection

The theory of endogenous protection was developed in the 1970s and has been continuously tested and changed since then. In this section, I present only a prominent theoretical study, Grossman and Helpman (1994), and some empirical tests of the G-H model.

Grossman and Helpman (1994) constructed the political economy model of protection, in which special interest groups made political contributions to influence the U.S. Government's choice of trade policies. According to the authors, lobbying made politicians "sell" their political influence. Therefore, trade protection could be structured as a function of "political favors." In this model, the Government set import and export taxes or subsidies to maximize social welfare and political contributions (Grossman and Helpman, 1994, p.838, eq.5).

$$G = \beta W + (1-\beta)\sum_{i \in L}^{n} PAC_i \qquad (1)$$
$$W = LI + \sum_{i=1}^{n} \pi_i + \sum_{i=1}^{n} TR_i + \sum_{i=1}^{n} CS_i ,$$

where G was the Government objectives function; W was social welfare; PAC was political contributions (lobbying); β was share of welfare in the Government objectives; LI was labor income; π was profit of firm; TR was trade tax revenue; and CS was consumer surplus.

The interaction between the U.S. Government and the lobbies was assumed to be expressed by the Nash equilibrium. Their model was presented under the formula (Grossman and Helpman, 1994, p.842)

$$\frac{t_i}{1+t_i} = \frac{I_i - \alpha_L}{\frac{\beta}{1-\beta} + \alpha_L} \frac{z_i}{e_i} , \qquad (2)$$

where t_i was ad valorem tariffs on $goods_{I,}$; $e_i = - M_I'(p_i)p_i \,/\, M_i\,(p_i)$ was the import-demand elasticity of $goods_I$; z_i was inverse import penetration $Y_i \,/\, M_{i,}$; Y_i was the value of domestic output; M_i was import value; β was the share of welfare in the Government objectives; α_L was the share of the population that owned the specific factor = $\sum_{i=1}^{L} \alpha_i$; and I_i was a dummy that took a value of one if industry j had lobbying, and a value of zero otherwise.

The G-H model (G-H model) estimated that trade protection and import penetration had a negative relationship in the industries, which were represented by the lobbies. Another result of this model was that import elasticity and trade protection had a negative relationship. When import elasticity was higher, the dead-weight loss from protection was higher, and thus the Government's dynamic of trade protection falls. If the Government did not care about political contributions or if all industries were represented by lobbying, then trade protection was insignificant or free trade was preferred.

3.2.2 Empirical Studies on Endogenous Protection

Trefler (1993) used the 1983 U.S. data set and employed the simultaneous two-equation system to investigate the relationship between import penetrations and trade protection. In using the simultaneous two-equation system, he intended to solve the potential problem that both import penetration and trade protection were not exogenous. His simultaneous two-equation system included the NTB equation and the import equation.[12]

Trefler (1993) suggested that a higher level of import penetration led to a higher level of trade protection in the NTB equation, while, in the import equation, a higher level of protection led to a reduction of import penetration. In addition, Trefler reported the impact of other factors

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[12] See Trefler, 1993, p. 140-144.

on trade protection. Trade protection was required to be higher when seller concentration, buyer concentration, the unemployment rate, the firm scale and capital stock were high. Occupations with high incomes, such as science and engineering, received the most protection.

However, Trefler's (1993) estimated results had some limitations. In the NTB equation, the coefficient of import penetration was not statistically significant. Only the coefficients of variables such as exports, buyer concentration scale, capital stock, change in import penetration, seller concentration and unemployment rate were statistically significant. The coefficients of the remaining exogenous variables were not statistically significant. In the import equation, only the coefficients of physical capital and occupations were statistically significant.

Trefler (1993) checked the consistency of his predicted results by sensitivity analysis, which included (1) observing the change of the NTB coefficients in the import equation with different sets of instruments; (2) employing the Wu-Hausman test to measure the endogeneity of each regressor in the NTB equation or in the import equation; (3) investigating the sensitivity of the import-equation NTB coefficient to the omission of observations; (4) checking the sensitivity of estimated results to different measurements of trade protection, such as average tariffs and the tariffs' coverage ratio.[13] Trefler found that his estimated results were robust under sensitivity analysis.

Goldberg and Maggi (1999) looked for empirical evidence supporting the G-H model. They translated equation (1) into an econometric model and then moved import-demand elasticity to the left-hand side of equation (1):

[13] See Trefler (1993), p. 155.

$$\frac{t_i}{1+t_i}e_i = \frac{I_i - \alpha_L}{\frac{\beta}{1-\beta} + \alpha_L} z_i + \varepsilon_i \tag{3}$$

$$= \gamma z_i + \delta I_i z_i + \varepsilon_i$$

,

where γ= [- α_L / (β/ 1-β) + α_L], and δ = [1 / (β/ 1-β) + α_L].

The authors tested equation (1), using the maximum likelihood method. Both inverse import penetration and the lobbying variables were treated as endogenous variables, which were explained by the set of determinant variables recommended by Trefler (1993).

Goldberg and Maggi (1999) used a data set from 1983 with three-digit SIC87 categories. They took the data on import-demand elasticity from Shields et al. (1986). The data on the inverse import penetration ratio were taken from the trade and immigration data file of the National Bureau of Economic Research (NBER). The data of the remaining variables were taken from Gawande and Bandyopadhyay (2000) and Trefler (1993). To construct a dummy variable for political contributions, they used a threshold level of $100,000,000. If the political contribution value was higher than that threshold, the dummy variable received a value of one, and a value of zero if the political contribution value was lower.

Goldberg and Maggi (1999) found empirical evidence supporting the claim of the theoretical G-H model that trade protection patterns in the lobbied industries (called the organized sector) differed from those in the industries without lobbying (called the unorganized sector). In the unorganized sector, a higher level of trade protection resulted from a higher level of import penetration in the G-H model. Goldberg and Maggi (1999) did not find opposite evidence in the unorganized sector. The estimated parameters, β and $\alpha_{L,}$ were high. This indicated that the United States was oriented toward trade liberalization. Goldberg and Maggi (1999) found a small weight of political contributions in the Government objectives function (β=0.02). However, they still argued that there was not enough evidence to reject the G-H model hypothesis about the impact of lobbying on trade policy.

To determine the consistency of their estimated results, Goldberg and Maggi (1999) employed a sensitivity analysis that consisted of (1) testing whether the occurrence of import-demand elasticity on the left-hand side was a reasonable specification; (2) estimating the model with different lobbying dummy variables, based on different threshold levels; (3) investigating the change in the coefficients when the political dummy variable was treated as an endogenous variable; (4) observing the change in the estimated results with different definitions of dependent variables. They replaced the dependent variable t / (1+t) by only t or by [t / (1+t)] *e * z and then estimated the model; (5) analyzing the sensitivity of the estimated results with different types of NTB coverage ratios.[14] Their findings were robust with regard to all types of sensitivity analysis.

Gawande and Bandyopadhyay (2000) emphasized an empirical test of the G-H model. Gawande and Bandyopadhyay (2000) differed from Goldberg and Maggi (1999) and other papers in that they employed intermediate input.[15]

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[14] See Trefler(1993), p. 155. There are three types of NTB coverage ratios: the price-oriented NTBs (e.g., variable levies or dumping duties), the quantity-oriented NTBs (e.g., quotas or voluntary export restraints), and the threat-oriented NTBs (e.g., countervailing investigations).

[15] See Proposition 2, page 842 in Grossman and Helpman (1994).

Their econometric model was

$$\frac{t}{1+t} = a_{1o} + a_{11}\frac{z}{e} + a_{12}\left(I*\frac{z}{e}\right) + a_{13}INTERMTAR + a_{14}INTERMNTB \quad , \qquad (4)$$
$$+ X_N\Gamma + \varepsilon_1$$

$$\ln\frac{PAC}{VA} = a_{20} + a_{21}\ln\frac{t}{1+t} + a_{22}\ln e + a_{23}\ln\frac{1}{z}$$
$$+ a_{24}\ln DOWNSTREAMSHR + a_{25}\ln DOWNSTREAMHERF \,, \quad \text{and} \qquad (5)$$
$$+ a_{26}\ln HERF + X_P\Pi + \varepsilon_2$$

$$\frac{1}{z} = \mathrm{a}_{30} + a_{31}\frac{t}{1+t} + X_M\Delta + \varepsilon_3 \;. \qquad (6)$$

where t was the U.S. nontariff barrier coverage of imports from partner j; z was inverse import penetration; e was import-demand elasticity; I was a dummy variable that received a value of one if the industry had lobbying; PAC was political contributions; VA was value added; INTERMTAR was average tariffs on intermediate goods; INTERMNTB was average NTB coverage of intermediate goods; DOWNSTREAMSHR was the percentage of an industry's shipments used as intermediate goods; DOWNSTREAMHERF was "intermediate-goods-output buyer concentration"; HERF was the Herfidahl index of firm concentration; X_N, X_P, X_M are the sets of control variables .

Gawande and Bandyopadhyay (2000) used the data from 1983 and the same data source as Goldberg and Maggi (1999) and Trefler (1993). They used 2SLS estimation for the simultaneous three-equation system, with the same set of instrumental variables as recommended by Trefler (1993). Their estimated results strongly supported the main implications of the G-H model. The estimated coefficients of Z/e and (I*z/e) were negative and positive, respectively, and statistically significant. This showed that import penetration had a positive effect on the lobbied industries and a negative effect on the industries without lobbying. The estimated coefficients on INTERMTAR and INTERMNTB were both statistically significant and positive. This implied that the rate of protection on intermediate goods had a positive effect on the rate of protection on final goods. The estimated coefficients of DOWNSTREMSHR and DOWNSTREAMHERF were both statistically significant and positive, confirming that lobbying competition in downstream industries caused higher lobbying spending.

To determine the consistency of their estimated results, Gawande and Bandyopadhyay (2000) carried out sensitivity analysis. First, they investigated the change in the estimated results when the econometric model was linear. Second, they estimated the model with separate variables: z, I*z/e, 1/e and I*1/e. Finally, they determined whether the estimated results changed with different measurements of dependent variable NTB (bilateral NTB and trade data between the United States and five developed countries: UK, Japan, Italy, Germany and France). This sensitivity analysis showed that their estimated results were robust with the different specifications of the model.

3.2.3 Effective Rate of Protection (ERP)

Studies of ERP have been prevalent since the 1960s. In this literature review, I do not focus on separate papers related to the theory of ERP, due to the fact that my paper does not intend to explore the development of this theory. Instead, I use ERP as one of the main variables to replace tariffs or the coverage ratio of NTB. Therefore, I cover general knowledge on ERP, what it is and how to measure it.

We usually know the nominal rate of protection (NRP), which is measured by tariffs on final goods or intermediate goods. In general, the tariffs on consumption goods are high, while the tariffs on intermediate goods are low (and sometimes, zero). The ERP deals with the tariff structure that includes tariffs on both final goods and intermediate goods. It is defined as the percentage by which a country's trade barriers increase the value added per unit of output (Corden, 1966, p.222).

Cordern (1966) recommended the ERP's calculations. First, he considered the one-input model. In free trade (no trade barriers) the value added per unit of output m (V_m) is measured by

$$V_m = P_m - C_m = P_m (1-a_{nm}), \qquad (7)$$

where P_m is the price per unit of output m; C_m is the cost per unit of output m and; a_{nm} is the share of input n in cost per of output m.

If tariffs are imposed on output and input, the value added V'_m is

$$V'_m = P_m [(1+t_m) - a_{nm} (1 + t_n)], \qquad (8)$$

Where t_n is the tariff rate on input n; and t_m is the tariff rate on output m.

The ERP_m is measured by (Corden, 1966, p.222, eq.4)

$$ERP_m = (V'_m - V_m) / V_m = (t_m - a_{nm} t_n) / (1 - a_{nm}) = t_m + \frac{(t_m - t_n)a_{nm}}{1 - a_{nm}} \qquad (9)$$

From equation 9, we have:

1. If $t_n = t_m$, then $ERP_m = t_n = t_m$. If the input and output tariffs are the same, the ERP is the same as the output tariffs.

2. If $t_n > t_m$, then $ERP_m < t_m < t_n$. If the input tariffs are higher than the output tariffs, the ERP is lower than the output tariffs.

3. If $t_n < t_m$, then $ERP_m > t_m > t_n$. If the input tariffs are lower than the output tariffs, the ERP is higher than the output tariffs.

Next, he considered multiple input models with n inputs. ERP is calculated by the following formula (Balassa, 1965, p. 577, eq. 1 and Corden, 1966, p.223, eq.4.2)

$$ERP_m = \frac{t_m - \sum_{n=1}^{N} a_{nm} t_n}{1 - \sum_{n=1}^{n} a_{nm}} \qquad (10)$$

.

The literature review shows that most papers use NRP (tariffs or nontariffs). The question is whether the theory of endogenous protection is right when trade protection is measured by ERP. Therefore, my research emphasizes empirically testing the theory of endogenous protection by using ERP as the representative variable for trade protection. When testing the G-H model, most authors use the U.S. coverage ratio of nontariff barriers instead of the U.S. tariff rate, because the U.S. tariff rate is so low that it would have considerable influence on the estimated results. The definition of ERP shows that if input tariffs are lower than output tariffs, ERP is higher than output tariffs. The statistical data provide evidence that developed countries, such as the United States, Japan and others, impose higher tariff rates on consumption goods than on intermediate goods, and this leads to a high ERP for the producers. Therefore, employing ERP in empirical tests of the theory of endogenous protection might bring interesting results.

Considering the econometric side, most papers, starting from Trefler (1993), have constructed econometric models in which tariffs (in practice the authors use nontariff barriers) and also import penetration are treated as endogenous variables. They have found strong evidence to support the G-H model. But to my knowledge, no papers have provided sufficient evidence for the validity of their instruments, and their estimated results will be biased if their instruments are weak or not exogenous.

Furthermore, almost all papers have used data from 1983 with three-digit SIC87 categories. Because the variables are not classified in the same industry code, the number of observations in the final data set, after matching all classifications of different variables, will be narrowed and will yield a small sample. I am not aware of any papers in this field with data sets constructed as panel data. In addition, U.S. trade policy has changed considerably since 1983. Therefore, using data only from 1983 does not cover sufficient information about U.S. trade policy, the relationship between U.S. trade protection and U.S. import penetration, as well as the impacts of other determinants on U.S. trade protection.

For these reasons, my paper uses the data set from 1997 to 2001, with 4 digit-SIC87 code, to test the G-H model, by applying the simultaneous three-equation system with trade protection measured by the ERP.

3.3 METHODLOGY

My econometric model borrows the method of the simultaneous three-equation system of Gawande and Bandyopadhyay (2000). I use the simultaneous three-equation system to test the G-H model for the data set, which is classified in four-digit SIC87 categories and covers the time period of 1997-2001. The first equation is the trade protection equation (ERP equation); the second is the import equation; the third is the lobbying equation (PAC equation).

The NTB equation investigates the impact of import penetration on trade protection. The construction of this equation is based on the specifications of the G-H model. Therefore, it includes three main independent variables: import penetration, import-demand elasticity and political contributions. The two main variables in the NTB equation must be (z /e) and [PAC * (z/e)]. The choice of a dependent variable to proxy for trade protection is one feature that distinguishes my model from other published models. Instead of using NTB, as previous studies have, I use ERP to proxy for trade protection. Therefore, the dependent variable in my first equation is ERP. The two right-hand side endogenous variables are (1) import penetration, scaled by import-demand elasticity (z/e), and (2) the product of lobbying spending and import penetration, scaled by import-demand elasticity [PAC * (z/e)].

The other feature that distinguishes my model from previous ones is the construction of the political variable. While Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) used dummy political variables, I use lobbying spending, due to difficulty in choosing the threshold level. Following Gawande and Bandyopadhyay (2000) and Trefler (1993), my determinant set for trade protection includes the seller concentration ratio (SCR4), the geographical concentration index (GCR), the industry scale (SCALE), the percentage of employees covered by unions (UNION) and the size of employment (EMPSIZE). In my data set, the industry scale variable (SCALE) is measured by the number of plants scaled by the number of companies, while Trefler (1993) and Gawande and Bandyopadhyay (2000) use the variable SCALE defined as the added value, scaled by the number of companies. Following Bohara and Kaempfer (1991), I have placed macroeconomic variables, such as the growth rate of GDP or trade balance, in the set of control variables. Finally, I use the size of capital stock as a control variable in the NTB equation, instead of using capital stock, as recommended by Trefler (1993), because we need to control the size of companies when investigating the impact of import penetration on trade protection in the lobbied industries. Two main specifications of company size are employment size and the size of capital stock. Therefore, I utilize both employment size and the size of capital stock in the first equation, instead of following Gawande and Bandyopadhyay (2000) and Trefler (1993).

My second equation is the import equation that investigates the impact of trade protection on import penetration. A higher level of trade protection is expected to a lower level of import penetration. The dependent variable in the import equation is U.S. import penetration, which is classified by four-digit SIC87 categories. A right-side endogenous variable is the ERP scaled by import-demand elasticity. This differs from the approach of Gawande and Bandyopadhyay (2000). They investigated only the impact of trade protection on import penetration, ignoring import-demand elasticity, while I observe the joint effect of trade protection and import-demand elasticity on import penetration. This makes the second equation match up with the first equation in constructing the right-hand side endogenous variable. The set of determinant variables in the import equation is based on Trefler (1993), who used the factor shares: labor share (LABSHARE), capital share (CAPSHARE) and inventory share (INVENSHARE). I do not include the share of land and the share of subsoil in this equation, due to limitations of the data source. In addition, Trefler (1993) showed the insignificant effect of those factors on import penetration. Trade balance may have an impact on import penetration, based on the logic that a higher level of trade protection leads to a lower level of import penetration when the trade balance is low. Therefore, I regard trade balance as a control factor when observing the effect of trade protection on import penetration.

The third equation is the lobbying equation, which presents the response of political spending to the dead-weight loss from trade protection. In the G-H model, a level of trade protection results from maximizing the objectives function, which is a weighted sum of political contributions and social welfare. The marginal impact of political contributions on trade protection will be reduced when trade protection reaches a high level accompanying a low level of import penetration. Therefore, lobbying spending will decrease when the level of trade protection is high. Of course, two main right-side variables are ERP and import penetration. Since the first two equations investigate the two-way impact between trade protection and import penetration, both trade protection and import penetration must appear simultaneously in the third equation, thus ensuring the logic of the whole equation system. That is why the coefficients of the two variables in the third equation must have opposite signs. My third equation is different from that of Gawande and Bandyopadhyay (2000) in that I do not use the logarithm form. This is because lobbying spending data has negative numbers (when lobbying spending is refunded) and import-demand elasticity has a negative number.[16] I borrow from Gawande and Bandyopadhyay (2000) to use lobbying spending scaled by the added value (PAC/VA) as the dependent variable. The difference lies in the way the two right-side endogenous variables are constructed. While Gawande and Bandyopadhyay (2000) used only nontariff barriers and the import penetration, I scale these variables by import-demand elasticity. This method allows me to investigate the response of political contributions to the joint effects of trade protection and import-demand elasticity, as well as to the response of political contributions to the joint effects of import penetration and import-demand elasticity. In addition, this structure allows the third equation to match up with the first two equations. From the first equation, if PAC is moved to the left side, then the right side must be the product of ERP and import-demand elasticity (ERP * e). Similarly, If PAC appears on the left side, the right side must be the product of import-demand elasticity and import penetration [e * (1/ z)]. I borrow from Gawande and Bandyopadhyay (2002) the use of the Herfindahl index as a control variable in this equation. I also employ level of unionization as a control variable in this equation, because a high level of unionization leads to higher lobbying spending.

[16] Goldberg and Maggi (1999) considered the positive value of import-demand elasticity as the “wrong sign”(p. 1149). They used sensitivity analysis, which replaced the positive value of import-demand elasticity with a veru small negative value. This conflicts with the study of Gawande (2000) that uses the logarithm of import-demand elasticity.

My econometric model is

$$ERP = a_{1o} + a_{11}\frac{z}{e} + a_{12}\left(PAC * \frac{z}{e}\right) + a_{13}X_E + \varepsilon_1 , \tag{11}$$

$$\frac{1}{z} = \mathrm{a}_{30} + a_{31}(ERP * e) + a_{32}X_M + \varepsilon_3 \text{ , and} \tag{12}$$

$$\frac{PAC}{VA} = a_{20} + a_{21}(ERP * e) + a_{22}\frac{e}{z} + a_{23}X_P + \varepsilon_2 \; . \tag{13}$$

The definitions and notations of all the variables in my econometric model are described in the next part.

3.4. PRIMARY EMPIRICAL RESULTS

3.4.1. The Data

I use a panel data set covering the time period 1997-2001 and aggregating up to four-digit SIC87 categories. The panel data set cannot be further prolonged, since many variables in the sample set are only available from 1997.

Three left-hand side endogenous variables are ERP, import penetration (1/z) and political contributions scaled by the added value (PAC/VA). Two right-hand side endogenous variables of equation (11) are inverse-import penetration, scaled by import-demand elasticity (z/e), and the product of political contributions and inverse import penetration, scaled by import-demand elasticity [PAC* (z/e)]. The right-hand side endogenous variable of equation (12) is the product of ERP and import-demand elasticity (ERP * e). Two right-hand side endogenous variables of equation (13) are (1) the product of ERP and import-demand elasticity (ERP * e) and (2) the product of import-demand elasticity and import penetration [e*(1/z)]. The set of determinants

(X_E) in equation (11) includes the geographical concentration ratio (GCR), the seller concentration ratio (SCR4), the industry scale (SCALE), employment size (EMPSIZE), the size of capital stock (CAPSIZE), the union coverage percentage (UNION) and the growth rate of GDP (GROW). The set of determinants (X_M) in equation (12) contains labor share (LABSHARE), inventory share (INVENSHARE), capital share (CAPSHARE) and trade balance (TRABALANCE). The set of determinants in equation (13) consists of the Herfindahl index (HHindex) and the union coverage percentage (UNION).

ERP is estimated by equation (10). The data on tariffs are sourced from United States tariff data set of Romanlis, classified by the ten-digit harmonized tariff schedule of the United States (HTS) for the time period 1989 – 2001 (Feenstra, Romalis, and Scott 2002). The data on the input-output coefficients for the time period 1997 – 2001 are taken from the BEA. These input-output coefficient data are classified by the input-output code (I-O). This code can be transformed into the HTS code, SIC87 code or North American Industrial Classification System Code (NAICS) by the SIC87–IO, HTS–IO and NAICS97-IO concordance provided by the BEA.

Import penetration is equal to import value scaled by total shipment value. The data on U.S. import values are taken from the U.S. import and export data of Robert Freenstra at the Center for International Data at University of California. The data descriptions are discussed in NBER Working paper # 9387 (Freenstra, Romanlis, & Scott 2002). This data set provides the U.S. import data for the time period 1972 – 2006 at four-digit SIC87 categories. The data on total shipment value covering the time period 1992 – 2006 were taken from NBER-CES Manufacturing Industry Database of Becker and Gray. This database also provides the data on physical capital, labor, employment size, added value, total shipment value, inventory and material cost. The data cover the time period 1992 – 2006 and are classified by two, three, or four-digit SIC87 categories as well as six-digit NAICS 97 categories and are classified into two, three and four-digit SIC87 categories and six-digit NAICS97 categories.

The data on import elasticity are provided by William R. Hauk (Haulk 2006). The data are only for the year of 1997 and are classified into ten-digit HTS categories as well as six-digit NAICS 97 categories.

The data on political contributions (PAC) are sourced from the Center for Responsive Politics. They cover the period of 1989 – 2008 and are classified in their own code. Chris Magee has translated this code into SIC87 categories. This concordance is discussed in Beaulieu and Magee (2004).

The seller concentration ratio of the four biggest firms and the Herfindahl index of firm concentration are taken from U.S. Census Bureau. The data are only for the year 1997. For this reason, I use the product between Herfindahl index and years.

The geographic concentration index is calculated by equation (Trefler, 1993, p. 157)

$$GCR_i = \sum_{j=1}^{50}\left[\frac{VA_{ij}}{\sum_{j=1}^{50} VA_{ij}} - \frac{POP_j}{\sum_{j=1}^{50} POP_j}\right] \tag{14}$$

where VA_{ij} is the added value of industry i at state j, and POP_j is the population of state j. The data on population are taken from the Current Population Survey (CPS). The data on the level of unionization are sourced from the Union Membership and Coverage database of CPS. They are classified by the Census Industry Code (CIC). The concordance between the CIC code and the three-digit SIC87 categories is taken from the CPS. Hirsch & Macpherson (2003) describe this data set.

The macroeconomic variables such as GROW and TRABALANCE are taken from the World Development Indicators (WDI) of World Bank. The data are classified not by the industrial code, but by years. TRABALANCE is measured by the export value minus the import value.

Table 3.1 displays the definitions and notations of all variables. The variables (z, z/e, PAC*(z/e), SCR4 and HHINDEX are scaled by 10^3, 10^3, 10^3, 10^6 and 10^6, respectively. PAC_VA is multiplied by 10^6.

Table 3.2 summarizes the basic statistics of all variables, including mean, median, maximum, minimum, standard deviation and the number of observations. The statistics are based on a sample set with 965 observations covering 193 four-digit SIC87 industries over the time period 1997 – 2001.

Table 3.1: The Definition of All Variables

Variable	Definition	Measurement
ERP	Effective rate of protection (The formula of calculation is based on equation (13)	
1/z	Import penetration = shipment value / import value	
z	Inverse import penetration = 1/ import penetration	Scaled by 10^3
PAC/VA	Political contributions / added value	Multiply with 10^6
e	Import-demand elasticity	
z/e	Inverse import penetration / import-demand elasticity	Scaled by 10^3
PAC * (z/e)	Political contributions * (inverse import penetration / import-demand elasticity)	Scaled by 10^3
(1/z) * e	Import penetration * import-demand elasticity	
ERP * e	Effective rate of protection * import-demand elasticity	
SCR4	Seller concentration ratio	Scaled by 10^6
GCR	Geographical concentration ratio (calculated by equation 17)	
SCALE	Industry scale = shipment value / number of companies	
EMPSIZE	Number of employee / number of companies	
CAPSIZE	Capital stock / number of companies	
UNION	Percentage covered by union	
GROW	The grow rate of GDP	
CAPSHARE	Capital share = capital stock / shipment value	
INVENSHARE	Inventory share = inventory / shipment value	
LABSHARE	Labor share = payroll / shipment share	
TRABALANCE	Export value – import value	
HHINDEX	Herfindahl index of firm concentration	Scaled by 10^6

Table 3.2: The Statistical Summary of All Variables

	Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Obs
1	z/e	-0.02991	-0.00434	-8.36E-06	-5.67224	0.216864	955
2	PAC * (z/e)	-0.00575	-3.54E-05	1.10E-05	-1.04454	0.058550	624
3	PAC_VA	27.60927	2.764012	1326.638	-0.49603	105.5255	624
4	ERP	0.048383	0.025471	1.504735	-1.65933	0.121529	927
5	ERP * e	-0.10575	-0.03236	2.235844	-11.3799	0.438886	927
6	(1/z) * e	-1.14554	-0.23068	-0.00018	-119.665	6.500305	955
7	GCR	0.497879	0.511238	0.780388	0.204364	0.084187	965
8	GROW	2.378200	3.012000	3.297000	-0.255	1.345948	965
9	SCR4	0.052406	0.052202	0.092246	0.017973	0.017415	965
10	SCALE	24.53746	9.185185	363.3540	0.008948	43.43178	955
11	UNION	15.73710	13.70000	47.70000	0.700000	8.987071	965
12	INVENSHARE	0.134498	0.124975	0.492420	0.016803	0.063629	955
13	CAPSHARE	0.036047	0.030763	0.213650	0.003459	0.023009	955
14	LABSHARE	0.099681	0.099199	0.416736	0.010289	0.049408	955
15	EMPSIZE	0.106426	0.048340	1.670000	6.32E-05	0.195608	955
16	CAPSIZE	15.80291	3.692296	277.1469	0.002399	33.77545	955
17	TRABALANCE	-0.9042	-0.10535	28.30898	-103.241	7.001850	965
18	HHINDEX	0.646359	0.683858	1.326663	0.070095	0.331724	965

The average ERP is 4.8%. The maximum ERP is 150.4% and the minimum ERP is -165.9%. The four-digit SIC87 industries that have ERPs higher than zero and lower than 10% account for approximately 67% of the total industries. Around 12.7 % of four-digit SIC87 industries have ERPs that are higher than 10%, but lower than 50%. Around 4.8% of four-digit SIC87 industries have ERPs that are higher than 50% and lower than 100%. Approximately 4% of four-digit SIC87 industries have ERPs that are higher than 100%. However, only about 4% of four-digit SIC87 industries have ERPs that are less than zero. Figure 3.1 displays the distribution of the ERPs of U.S. four-digit SIC87 industries over the time period 1997 – 2001. In summary, we can say that the ERP of the United States is small.

Figure 3.2 displays the distribution of the average MFN tariffs for about 1200 8-digit HTS industries with approximately 6000 observations. The maximum average MFN tariffs are 461.9% and the minimum average is 0%. Industries that have average MFN tariffs higher than zero and lower than 10% account for approximately 71.7% of the total industries. About 11.6 % of 8-digit HTS industries have average MFN tariffs that are higher than 10%, but lower than 50%. Around 1.3% of 8-digit HTS industries have average MFN tariffs that are higher than 50% and lower than 100%. Approximately 2% of 8-digit HTS industries have average MFN tariffs that are higher than 100%. In summary, we can say that the average MFN tariffs of the United States are low.

Figure 3.3 exhibits the distribution of PAC and also reports PAC statistics. The average PAC expenditures per each four-digit SIC87 industry is $70,559, while the maximum expenditure reaches $2,665,600. Figure 3 displays the distribution of PAC expenditures. About 47% of four-digit SIC87 industries pay PAC expenditures less than or equal to $5,000. About 14 % of four-digit SIC87 industries pay PAC expenditures less than or equal to $10,000, but more than $5,000. The average percentage of four-digit SIC87 industries that are covered by unionization is about 15%. The maximum is about 47%, while the minimum is around 0.7%.

The data on PAC are smaller than the data on firm lobbying, which are taken from Center for Responsive Politics. These data are from 1998 up to now and are organized into 9 categories of industries. It is very difficult to find the specific lobbying expenditures for each four-digit SIC87 industry within those 9 categories. On the other hand, my data set is from 1997-2000. Therefore, I am unable to apply this data to my dissertation at the present. Using the political expenditures by PAC may underestimate the weight of lobbying in the government objective function. This is a limitation of this study and requires further studies.

Figure 3.1: The Distribution of ERP

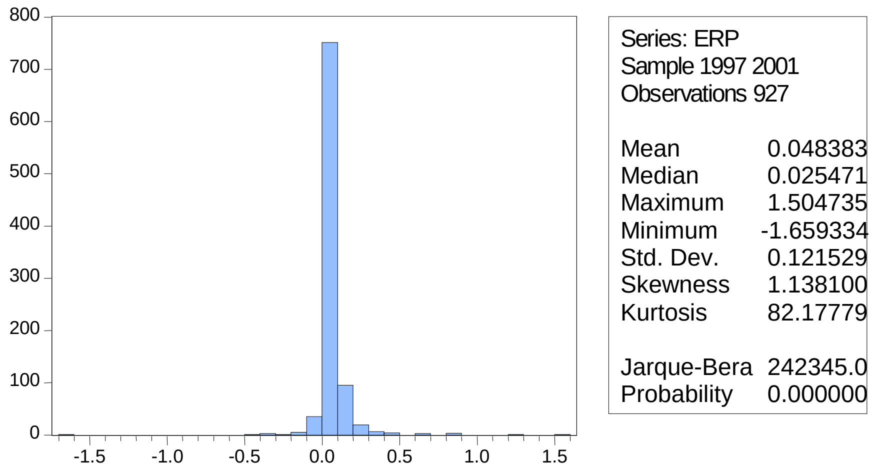


Figure 3.2: The Distribution of Average MFN tariffs

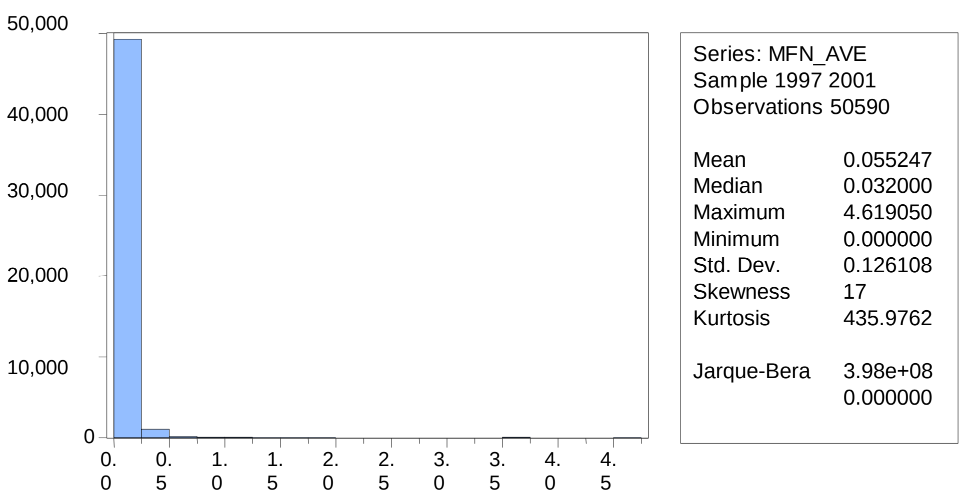
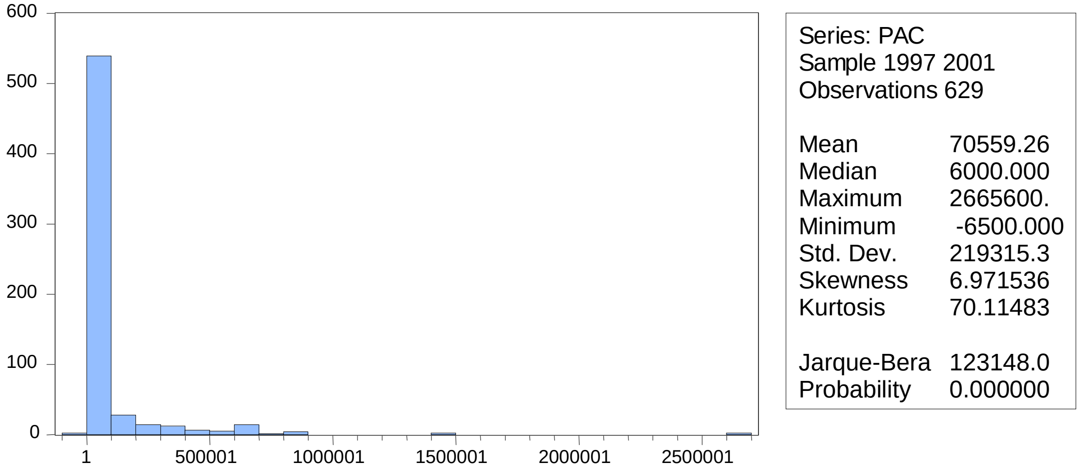


Figure 3.3: The Distribution of PAC



3.4.2. Primary Estimated Results

Table 3.3 and Table 3.4 display 2SLS and 3SLS estimations, respectively, from the simultaneous three-equation system. The estimated results from the two methods are similar. The coefficients of the right-hand side endogenous variables from the two methods have the same signs and are significances. The first column in these two tables lists the names of independent variables with respect to each equation of the simultaneous three-equation systems. Each table is divided in two parts. The first part, which includes the first three columns, reports the non-standardized beta coefficient. The second part, which contains the second three columns, reports the standardized beta coefficient. In each part, the first column reports the estimated results for the ERP equation, the second column reports the estimated results for the import equation and the third column reports the estimated results for the lobbying equation. Each cell reports the coefficient of the independent variable in the first row; the standard error is in parenthesis in the second line. The 0.1, 0.05 and 0.001 significance levels are denoted by the symbols *, ** and

***, respectively. Because 3SLS estimation is more effective than 2SLS estimation, I only discuss the estimated results from 3SLS estimation in this section.

Table 3.3: 2SLS Estimation of Three Simultaneous Equation Systems

Independent equation	No standardized Beta Coefficient Dependent variable			Standardized Beta Coefficient Dependent variable		
	ERP equation (ERP)	**Import equation (1/z)**	**Lobbying Equation (PAC/VA)**	**ERP equation (ERP)**	**Import equation (1/z)**	**Lobbying Equation (PAC/VA)**
z/e	-1.6098** (0.7310)			-2.8655** (1.3012)		
Pac * (z/e)	8.6609** (4.0380)			4.1726** (1.9454)		
(1/z) * e			17.976** (7.865)			1.1073** (0.4845)
ERP * e		-4.796*** (1.187)	-227.362** (97.58)		-2.0711*** (0.5126)	-0.9456** (0.4058)
SCR4	-1.0017 (0.7380)			-0.1435 (0.1058)		
GCR	-0.0723 (0.1420)			-0.0501 (0.0984)		
SCALE	-0.0007 (0.0005)			-0.2641 (0.1787)		
EMPSIZE	0.297 (0.2110)			0.4789 (0.3396)		
CAPSIZE	-0.0005 (0.0005)			-0.1295 (0.1390)		
UNION	-0.0022 (0.0020)		0.714 (0.825)	-0.1645 (0.1479)		0.0440 (0.0508)
GROW	-0.0055 (0.0080)			-0.0607 (0.0886)		
CAPSHARE		2.006 (3.713)			0.0454 (0.0841)	
INVENTSHARE		3.228** (1.271)			0.0202** (0.0080)	
LABSHARE		2.589** (1.081)			0.1259** (0.0526)	
TRABALANCE		-0.037*** (0.010)			-0.2549*** (0.0689)	
HHINDEX			-11.895 (24.201)			-0.0374 (0.0761)

Note:
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

Table 3.4: 3SLS Estimation of Three Simultaneous Equation Systems

Independent equation	No Standardized Beta Coefficient			Standardized Beta Coefficient		
	ERP equation (ERP)	**Import equation (1/z)**	**Lobby equation (PAC/VA)**	**ERP equation (ERP)**	**Import equation (1/z)**	**Lobby equation (PAC/VA)**
z/e	-1.555** (0.717)			-2.7679** (1.2763)		
PAC * (z/e)	8.216** (3.955)			3.9583** (1.9054)		
(1/z) * e			20.275** (7.619)			1.2489** (0.4693)
ERP * e		-4.993*** (1.149)	-262.586** (95.338)		-2.156*** (0.4962)	-1.0921** (0.3965)
SCR4	-0.892 (0.715)			-0.1278 (0.1025)		
GCR	-0.110 (0.138)			-0.0762 (0.0956)		
SCALE	-0.0006 (0.0005)			-0.2144 (0.1787)		
EMPSIZE	0.256 (0.207)			-0.4120 (0.3332)		
CAPSIZE	-0.0003 (0.0004)			-0.0862 (0.1112)		
UNION	-0.0022 (0.002)		0.701 (0.746)	-0.1627 (0.1479)		0.0432 (0.0460)
GROW	-0.0067 (0.0076)			-0.0742 (0.0842)		
CAPSHARE		2.003 (3.311)			0.0454 (0.0750)	
INVENTSHARE		3.313** (1.159)			0.0207** (0.0073)	
LABSHARE		3.064** (1.009)			0.1490** (0.0491)	
TRABALANCE		-0.030*** (0.010)			-0.2067*** (0.0689)	
HHINDEX			-18.748 (22.161)			-0.0589 (0.0697)

Note:
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

The estimated results from equation (11) provide evidence to support the G-H model. The coefficient of inverse import penetration scaled by import-demand elasticity (z/e) is negative and statistically significant, while the coefficient of the product between political contributions and inverse import penetration scaled by import-demand elasticity (PAC * (z/e)) is positive and statistically significant. The coefficients of (z/e) and [PAC * (z/e)] are -1.555 and 8.216, respectively, while the standardized beta coefficients of (z/e) and [PAC * (z/e)] are -2.7679 and 3.9583, respectively, and significant at the 0.05 level. If inverse import penetration were to increase by one standard deviation, lobbying causes trade protection increase by 3.9583 standard deviations. Without lobbying, if inverse import penetration were to increase one standard deviation, trade protection would decline by 2.7679 standard deviations. This implies that inverse import penetration has a positive effect on trade protection in the lobbied industries and has a negative effect on trade protection in the industries without lobbying. Therefore, my estimated results support the findings of Trefler (1993), Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000). However, Trefler did not find a statistically significant coefficient on import penetration. The gap between my estimated results and the estimated results of Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999) partly results from the fact that I do not construct the PAC variable as a dummy variable. If the PAC variable were constructed as a dummy variable, the different levels of the threshold would create different dummy variables. Therefore, the estimated results might be affected by the choice of the threshold level. Because previous studies used only data from 1983, the chosen threshold level displays the political context of only that year. There is no guarantee that this political feature repeats in following years. In practice, politics change from decade to decade and from year to year. Therefore, a reasonable threshold level cannot be drawn from my PAC data, which are constructed as panel data covering the time period 1997 – 2001.

In addition, because the absolute value of the standardized beta coefficient of [PAC * (z/e)] is higher than that of (z/e), lobbying causes inverse import penetration to have a stronger influence on trade protection. This is because the offset of the impact of inverse import penetration on trade protection, between lobbied industries and industries without lobbying, will be positive. Furthermore, my estimated results also support the quantitative implications of the G-H model. First, the sum of the coefficients of (z/e) and [PAC* (z/e)] is positive. Because z is scaled by 10^3, (z/e) is scaled by 10^3 and [PAC * (z/e)] is scaled by 10^3, the estimated values of γ and δ in original units are -1.555 10^{-3} and 8.216 10^{-3}. The sum of coefficients on (z/e) and [PAC*(z/e)] = (-1.555 10^{-3} + 8.216 10^{-3}) = 6.661 10^{-3} > 0. From equation (3), we can calculate the relative weight that the Government places on welfare relative to lobbying expenditure (β):

$$\beta = \frac{\gamma + 1}{1 + \gamma + \delta} \qquad (15)$$

,

where δ is the coefficient of [PAC * (z/e)] and γ is the coefficient of (z/e). Appendix A provides the details on how to get equation (15). Pluging in the original values of δ and γ and we have β = (-1.555 10^{-3} +1)/ (1 -1.555 10^{-3} + 8.216 10^{-3}) =0.991838362. The Government objectives function is

$$G = 0.992\ W + 0.008 \sum_{i \in L}^{n} PAC_i$$

.

I apply the Delta method to calculate the standard error of β. These calculations are presented in Appendix B. The standard error of β is 3.902583 10^{-3}. I am concerned about whether the United States is pure welfare or not. Therefore we need to test the null hypothesis is H^0: β = 1 versus the alternative H^1: β < 1

The test statistic is $t = \frac{\beta - 1}{\sigma} = \frac{0.991844274 - 1}{0.003902583} = -2.0971337227$ (16)

This result rejects the null hypothesis that β is equal to 1, suggesting that trade protection in the United States is affected by lobbying. However, the share of lobbying in the Government objectives is very small (0.008), and thus lobbying has weak effects on trade protection. My result is close to the findings of Goldberg and Maggi (1999) that the weight of welfare in the Government’s objectives is 0.98, while the weight of lobbying in the Government‘s objectives is only 0.02. However, Goldberg and Maggi (1999) refuse to draw the conclusion that the United States is pure welfare. My estimated result is different from Gawande and Bandyopadhyay (2000) that the Government places weight on total net welfare (gross welfare less political contributions) to be equal to the weight on total lobbying spending.

I am not aware of any theoretical models before the G-M model that presented the political impact on trade protection through the PAC variable, as in the G-H model. Therefore, prior studies have used control variables (called organized variables by Trefler (1993)), such as SCR4, GCR, UNION, EMPSIZE and others, to proxy the political impact, as seen in the model structures of Trefler (1993) and others. After the G-H model was introduced, the impact of political contributions on trade protection was not necessarily interpreted through those organized variables. However, I still discuss the impact of these control variables.

In equation (11), the coefficient sign of the seller concentration ratio is -0.892, which is not positive as expected. According to Trefler (1993), when seller concentration is small, the free-rider problem will be an obstacle to lobbying and trade protection will be small. The coefficient of the seller concentration ratio is negative and not statistically significant, supporting the findings of Gawande and Bandyopadhyay (2000). The coefficients of SCALE, CAPSIZE and GROW are -0.0006, -0.0003 and -0.0067. They are negative as expected, but not statistically significant. The demand for trade protection decreases when the firms have a large scale and a high level of capital stock or high growth rate of GDP. This is because a high level of scale and capital stock and a high growth rate of GDP create large obstacles to the entry of rivals into the market. When employment size is high, the demand to be protected from the risk of unemployment will increase. The coefficient of employment size is 0.256, which supports this idea. The coefficient of the level of unionization is negative (-0.002) and not statistically significant, supporting the findings of Gawande and Bandyopadhyay (2000). It can be explained by the fact of that when the percentage covered by unionization increases under the condition of a low initial level of import penetration, the demand for trade protection does not increase.

The standardized beta coefficients of SCR4, GCR, SCALE, EMPSIZE, CAPSIZE UNION and GROW are -0.1278, -0.0762, -0.2144, -0.4120, -0.0862, -0.1627, and -0.0742, respectively. The impact level of those variables on trade protection follows the ordering: EMPSIZE > SCALE > UNION > SCR4 > CAPSIZE > GCR > GROW. This shows that employment size, scale of the firms and the level of unionization play important roles in trade policy, when we consider the impact of inverse imports penetration on trade policy. The coefficients of the control variables in the ERP equation are not statistically significant, a result seen in some previous studies. One of the reasons is the omitted variables or the correlations between the control variables. Table 3.5 reports the correlation between the control variables. For example, the high correlation between SCALE and EMPSIZE, SCALE and CAPSIZE and CAPSIZE and EMPSIZE are 0.851, 0.688 and 0.722, respectively.

My estimated results from equation (12) strongly affirm the logic that trade protection leads to a decline in import penetration. The standardized beta coefficient of (ERP*e) is -2.156, with a 0.001 significance level. If trade protection increases by one standard deviation, import penetration decreases by 2.156 standard deviations. Compared with equation (11), the absolute value of the standardized beta coefficient of (ERP * e) is less than that of (z/e) and of [PAC* (z/e)]. This implies that import penetration has more impact on trade protection than trade protection has on import penetration.

The coefficients of the share of factors in equation (12) are positive and statistically significant, except for the coefficient of capital share. The standardized beta coefficients of CAPSHARE, INVENSHARE and LABSHARE are 0.0454, 0.0207, and 0.149, respectively. The coefficient of LABSHARE is positive and significant at 0.05 levels, which supports the findings of Gawande and Bandyopadhyay (2000). This shows that labor is a source of comparative disadvantage for the United States in general. Due to lack of data, I did not investigate the impact of occupation as Trefler (1993) and Gawande and Bandyopadhyay (2002) did. This is a limitation of my research that requires further study.

Table 3.5: The Correlation between the Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	1											
(2)	0.1031	1										
(3)	0.2503	0.1014	1									
(4)	0.0226	0.1151	-0.1733	1								
(5)	0.1439	0.0779	0.8511	0.0423	1							
(6)	0.2133	0.1006	0.6888	-0.0535	0.7224	1						
(7)	0.2766	0.1808	0.0581	0.0209	0.0918	0.3358	1					
(8)	-0.4061	-0.1466	-0.2995	0.1067	-0.1136	-0.2221	0.0313	1				
(9)	-0.0896	-0.0385	-0.0297	0.2013	-0.021	-0.0847	-0.0823	0.3133	1			
(10)	-0.0011	-0.0396	0.003	0.0205	0.0144	-0.0204	0.0577	-0.0164	-0.0593	1		
(11)	0.9373	0.0421	0.2522	-0.1119	0.1307	0.2047	0.2278	-0.4614	-0.1751	-0.0017	1	
(12)	0.4519	0.1499	0.4039	-0.0706	0.376	0.4217	0.0819	-0.3085	-0.0549	0.0787	0.4937	1

Note:
(1): HHINDEX
(2): GCR
(3): SCALE
(4): TRABALANCE
(5): EMPSIZE
(6): CAPSIZE
(7): CAPSHARE
(8): LABSHARE
(9): INVENSHARE
(10): GROW
(11): SCR4
(12): UNION

It is interesting that Trefler (1993) and Gawande and Bandyopadhyay (2000) can show the concrete source of the U.S. comparative disadvantage: engineers, scientists and unskilled workers. The coefficient on CAPSHARE has a positive sign, which conflicts with the findings of Trefler (1993). However, it is not statistically significant, so we cannot conclude that capital stock is a source of the U.S. comparative disadvantage. Since Trefler shows the insignificant impact of land and subsoil on import penetration, I did not employ these factors in my econometric model. One difference from previous studies is my finding about the impact of trade balance on import penetration: The coefficient of trade balance is -0.2067 and statistically significant at the 0.001 level. This shows the automatically self-adjusting mechanism of the economy. A higher trade balance creates motivation to accelerate import-substituting production that leads to a decline in imports. Since the standardized beta coefficient of TRABALANCE has a higher absolute value than those of LABSHARE, CAPSHARE and INVENSHARE, the trade balance surplus will serve as a tool to replace the trade barriers. Therefore, export promotion needs to be emphasized in order to keep the trade balance at a surplus.

Finally, I consider equation (13). The standardized beta coefficients of [e*(1/z)] and (ERP * e) are 1.248 and -1.0921, respectively, and are statistically significant at the 0.05 level. This can be interpreted to mean that one standard deviation increase in (ERP * e) leads to an increase of 1.2489 standard deviations in the PAC_VA. This estimated result provides a successful test of the implications drawn from the first two equations, since the coefficients of [e*(1/z)] and (ERP * e) have opposite signs—an increase in trade protection is accompanied by a decrease in import penetration—but the absolute value of the two coefficients is close. This result also shows the interaction mechanism of import penetration and trade protection on the adjustment of political contributions. A decrease in trade protection leads to an increase in import penetration. But an increase in import penetration turns out to cause the demand for trade protection to increase. This forces the owners of specific factories to pay more money for lobbying, in the hope of stepping up trade protection in order to reduce the risk of unemployment and unprofitable business. Two control variables are UNION and HHindex. Their coefficients are 0.701 and -18.748 and are not statistically significant. The coefficient on UNION is expected. A higher level of unionization provides a greater amount of lobbying expenditure. The coefficient of the seller concentration ratio (HHindex) is negative and unexpected. The logic of this relationship must be as follows: when the seller concentration is small, lobbying is restricted by the free rider problem, so spending for lobbying is also small.

Table 3.6 reports the empirical tests of the validity of the instruments. The results show that my chosen instruments are valid. I do not repeat the theoretical description of each test since they were presented in the first chapter.

The Wu-Hausman test[17] for endogeneity checks whether variables such as (z/e), [PAC* z/e], (ERP* e) and (e/z) are endogenous and need to be instrumented. The null hypothesis indicates that there is no correlation between the dependent variable in the structural equation and the residuals collected from the first-stage regression of the tested variable on all instruments. In the ERP equation, the joint test of (z/e) and [PAC* (z/e)] reports the F-statistic =

[17] Detailed descriptions of the endogeneity test, the weak instrument test and the Sargan test are given in Chapters 5 and 6 of Wooldridge (2002).

6.758 and p-value = 0.0013. This result provides evidence to reject the null hypothesis. It means that in the first equation, (z/e) and [PAC*(z/e)] need to be instrumented. In the import equation, the test of variable (ERP * e) gives an F-statistic = 82.336 and p-value = 0.000. This result allows us to reject the null hypothesis. We can say that (ERP*e) is the endogenous variable. In the lobbying equation, the joint test of (ERP *e) and (e/z) provides an F-statistic = 5.270 and p-value = 0.0054. Therefore, the null hypothesis is rejected and (ERP*e) and (e/z) need to be instrumented.

The next test is the weak instrument test.[18] An instrument is considered weak when the partial correlation with the right-hand side endogenous variable is small. For the endogenous variable (z/e), Table 3.6 (Appendix 1) reports the F-statistic = 6.3590 and p-value = 0.000. So, we have some reason to believe that all instruments for (z/e) are not weak. For the endogenous variable [PAC *z/e], the F-statistic = 4.155 and p-value = 0.001.

These results suggest that all instruments for [PAC * z/e] are not weak. For the endogenous variable (e/z), F-statistics = 4.569 and p-value = 0.000. This result provides evidence supporting the hypothesis that the instruments are not weak. For the endogenous variable (ERP * e), the F-statistic = 2.278 and p-value = 0.0204. This result provides evidence to support the hypothesis that the instruments are not weak. The test for weak instruments of the simultaneous equation system in the panel data set has not been studied as sufficiently as in the single equation. We did not know the threshold level of the F-statistic that leads to limitation.

[18] Detailed descriptions of the endogeneity test, the weak instrument test and the Sargan test are given in Chapters 5 and 6 of Wooldridge (2002).

Table 3.6: Tests for Validity of Instruments

Test of Weak Instrument
Hypothesis H^0 : Some instruments are weak
Reject H^0, then all instruments are not weak

Tested variable	Statistics
First stage regression of z/e: Joint test of all instruments	F (6, 942) = 6.3590 p-value = 0.000
First stage regression of PAC* z/e: Joint test of all instruments	F (5, 611) = 4.155 p-value = 0.001
First stage regression of (1/z) * e: Joint test of all instruments	F (10, 942) = 4.569 p-value = 0.000
First stage regression of ERP * e: Joint test of all instruments	F(8,904) = 2.278 p-value = 0.0204

Endogeneity Test by WU Hausman Test
Hypothesis H^0: No correlation between dependent variable in the structural equation and the residuals that is collected from first stage regression of the tested variable on all instruments
Reject H^0, there is correlation and the tested variable need to be instrumented

Equation	The tested variable	Statistic
1	z/e , PAC* (z/e)	F (2, 578) = 6.758 & p-value = 0.0013
2	ERP * e	F(1, 910) = 82.336 & p-value = 0.000
3	ERP * e, (1/z) * e	F (2, 583) = 5.270 & p-value = 0.0054

Sargan Test: (overidentificatio test of all instruments):
Hypothesis H^0: overidentification restriction is valid. The instruments are valid.
Reject H^0: there some instruments are not exogenous.

Equation	Statistics
1	Sargan test statistic: 4.379 , P-value = 0.2234
2	Sargan test statistic: 6.697 , P-value = 0.461
3	Sargan test statistic: 9.704 , P-value = 0.2864

The final test is the Sargan test.[19] The null hypothesis of this test is that the overidentification is valid or all instruments are valid. The Sargan test statistic = 4.379 and p-value = 0.2234 for equation (1) are reported in Table 3.6. This result gives some reason to believe that all instruments excluded from the first equation are valid. While the Sargan test statistic = 6.697 and p-value = 0.461 for the import equation, it is 9.704, and p-value = 0.2864,

for the lobbying equation. This result reveals that all instruments excluded from both the import equation and the lobbying equation are valid.

3.4.3 Robustness Check

In this part of the model, I check the robustness of my estimated results (Table 3.7). I observe the change in the coefficients of variables when import-demand elasticity is moved to the left-hand side of the ERP equation. The coefficients of the right-hand side endogenous variables, (z/e), [PAC*(z/e)], (ERP*e) and (e/z), do not change signs for the 2SLS and 3SLS estimations. In the 2SLS estimation, four of five right-hand side endogenous variables have coefficients, which are statistically significant, except for the coefficient of [PAC*(z/e)]. In the 3SLS estimation, three of the five right-hand side endogenous variables have statistically significant coefficients, except for the coefficients of (z/e) and [PAC*(z/e)].

[19] Detailed descriptions of the endogeneity test, the weak instrument test and the Sargan test are given in Chapters 5 and 6 of Wooldridge (2002).

Table 3.7: Robustness Check

Independent equation	2SLS			3SLS		
	ERP equation (ERP)	**Import equation (1/z)**	**Lobbying Equation (PAC/VA)**	**ERP equation (ERP)**	**Import equation (1/z)**	**Lobbying Equation (PAC/VA)**
z/e	-1.4908* (0.8430)			-1.2228 (0.7679)		
Pac * (z/e)	8.0512 (5.7420)			5.1759 (5.0785)		
(1/z) * e			17.976** (7.865)			18.7523** (7.3432)
ERP * e		-4.796*** (1.187)	-227.362** (97.58)		-5.2604*** (1.1119)	-297.3492** (93.0365)
SCR4	0.3190 (1.6748)			-0.1049 (1.4272)		
GCR	0.2945 (0.3330)			0.4462 (0.2889)		
SCALE	0.0009 (0.0012)			-0.0001 (0.0011)		
EMPSIZE	0.0001 (0.0011)			-0.0008 (0.0008)		
CAPSIZE	-0.0013 (0.0183)			0.0088 (0.0145)		
UNION	0.1905 (0.4379)		0.714 (0.825)	0.1771 (0.3777)		0.8072 (0.7429)
GROW	0.0042 (0.0046)			0.0036 (0.0039)		
CAPSHARE		2.006 (3.713)			1.7539 (3.1535)	
INVENTSHARE		3.228** (1.271)			3.6958** (1.1200)	
LABSHARE		2.589** (1.081)			2.7298** (0.9664)	
TRABALANCE		-0.037*** (0.010)			-0.0305*** (0.0095)	
HHINDEX			-11.895 (24.201)			-15.2000 (22.000)

Note:
** = 0.1 significant level; ** = 0.05 significant level; and *** = 0.01 significant level*

3.5 CONCLUSION

This paper applies the simultaneous three-equation system and uses U.S. annual data for 193 four-digit SIC87 industries over the time period of 1997 to 2001, to estimate the G-H model. To determine the consistency of the method, I have used several tests, which include the weak instrument test, the Wu-Hausman test for endogeneity and the test for overidentification restriction. I have found evidence to support the G-H model: (1) in the lobbying industries, trade protection increases whenever inverse import penetration increases and import-demand elasticity decreases; (2) In the industries without lobbying, trade protection increases whenever the inverse import penetration decreases and the import-demand elasticity increases. The share of lobbying in the Government's objectives was very small (0.008), while the share of welfare in the Government's objectives was great (0.992). These estimated results suggest that U.S. trade policy was not affected seriously by lobbying in this time period.

CHAPTER 4

EXPORTS, IMPORTS, FDI AND ECONOMIC GROWTH

4.1 INTRODUCTION

Even after more than 20 years of carrying out import-substitution industrialization, many Asian countries have not improved their economies. At the end of the 1960s, most Asian countries shifted from import-substitution industrialization to export-oriented industrialization. In addition, Asian countries pursued programs attracting foreign direct investment (FDI), relaxed trade barriers and simultaneously carried out social programs, obtaining spectacular economic achievement. Such a high level of economic growth in Asian countries calls for research that can provide theoretical explanations, lessons for the future and an economic forecast. This paper focuses on the following main questions: Are there causal relationships between economic growth, exports, imports and FDI? What is the effect of trade liberalization on economic growth? What is the implication for economic policy?

There are still many papers trying to understand these issues, in spite of the fact that the problem is not new. The literature partly provides theoretical explanations through the exports-led growth hypothesis, the growth-led exports hypothesis, the import-compression growth hypothesis and the intertemporal budget constraint hypothesis. The empirical results from different authors for the same Asian country are sometimes in conflict. For example, two-way causality between Korean exports and imports is discovered by Fung, Sawhney, Lo and Xiang (1994) and by Bahmani-Oskooee and Rhee (1997). But, Mahadevan et al. (2008) and also Kim et al. (2009) provide evidence of no causality between Korean exports and imports. Chang, Fang, Liu and Henry (2000) find a two-way causality between exports and imports in Taiwan, but Mahadevan et al. (2008) suggest no causality between them. There are further examples of inconsistency. What causes these conflicting results?

Observing prior studies of Asian countries, I find that they typically use the two-variable VAR model or the three-variable VAR model to consider the dynamic impacts of some of four variables (GDP, exports, imports and FDI) on other variables. However, theoretical analysis reveals that all three series, FDI, exports and imports, interact as follows with GDP: (1) They generate capital flow in or out of the domestic country; (2) They promote technological diffusion through relations with foreign partners, in learning by doing, and in other ways; and (3) They are influenced by competition in international markets, which requires improvement in management and technology. In addition, there is theoretical evidence suggesting a possible relationship between exports, imports and FDI. Furthermore, observing four time series (GDP, exports, imports and FDI) in two Asian countries (Malaysia and Korea) during the period from 1970 to the present, one can see that they have the same stochastic time trend. Therefore, there may possibly be cointegration between the four series. Also, a two-variable or three-variable VAR model constructed from two or three series out of the four series (GDP, exports, imports and FDI) will be misspecified. In addition, prior studies have ignored dynamic analysis, such as impulse responses and variance decompositions, and have had gaps in their econometric procedure of applying the VAR model, such as ignoring VAR diagnostics. All of these factors may have caused biased results.

The paucity of literature encourages me to engage in further study, but with a different approach, to correct current shortcomings. Therefore, my paper makes the following contributions to the literature: (1) It provides the econometric application in the correct way, to avoid misspecification and to minimize the resulting bias. It also tests and estimates the causal relationship by applying the four-variable VAR model based on the four time series (GDP, exports, imports and FDI); (2) It supplements the literature on relationships between trade liberalization, economic growth and empirical evidence about the source of economic development for the Asian countries, Malaysia and Korea; (3) It analyzes and maps economic policy onto estimated results, and then gives lessons and policy implications.

In this study, I test the long-run and short-run relationships between GDP, exports, imports and FDI for Malaysia from 1970 to 2004 and for Korea from 1976 to 2007, using a four-variable VAR. I apply econometric procedures, including the unit root test of four series, lag structure, the VAR diagnostic, the Johansen cointegration test, the Granger causality/block exogeneity Wald test (GCBEW test), analysis of impulse response and analysis of variance decomposition.

The estimated results suggest that the four variables are cointegrated for both Malaysia and Korea. Exports are a long-run source of economic growth for both Malaysia and Korea. For Malaysia, there is evidence to support two-way causalities between each pair among the four variables, except for causality of GDP on exports. For Korea, there is one-way causality from exports, imports, and GDP to FDI, from exports and imports to GDP and from exports on imports. Exports are not affected by the other three variables. Trade liberalization has increased

Malaysian economic growth through the positive effects of both exports and imports, while trade liberalization has also increased Korean economic growth, but only through the positive effects of one channel: exports. The difference in the estimated results is explained by the difference between the two countries' economic policies. Although both countries have implemented policies of export-oriented industrialization, the Malaysian government has promoted FDI as a tool of industrialization, while the Korean government has built an "integrated national economy" using industrial conglomerate structures and does not emphasize the role of FDI.

The rest of the paper is organized as follows. The second section is a literature review. The third section describes the methodology. The fourth section describes the data set and reports the primary estimation results. The fifth section offers a conclusion.

4.2 LITURATURE REVIEW

This review includes two parts. The first part is a summary of the theoretical explanation of possible causality between exports, imports, FDI and economic growth. The second part is the review of empirical studies about causal relationship between exports, imports, FDI and economic growth, using the VAR model.

4.2.1 Theoretical Review

From the end of World War II until the 1970s, the import-substitution policy was dominant in most developing countries. This policy was built on the belief that "the best way to create a strong manufacturing sector was by protecting domestic manufactures from international competition" (Krugman & Obstfeld, 2002, p.256). However, many countries applying this policy did not gain the desired rate of economic growth. According to Krugman and Obstfeld, this policy generated a high effective rate of protection, limited the economic scale and led to higher income inequality and unemployment. Thus, developing countries shifted to an export-promoting policy and consequently gained a high rate of economic growth. Many economists believe that the achievement of Asian countries in this period is explained by the exports-led growth hypothesis. They have been trying to build a theoretical model as well as to carry out empirical studies to support this hypothesis.

The exports-led growth hypothesis rests on the following assumptions: (1) Exports lead to a higher level of specialization in production, which improves productivity and thus increases economic growth. (2) Thanks to export growth, resources are allocated more efficiently, through shifting factors, to the more productive export sectors. (3) Exports increase the capacity of utilization and economies of scale, which improves productivity. (4) Exports promote diffusion of knowledge through interaction with foreign buyers and through learning by doing. Economic growth is thus increased by higher innovation. (5) Exporting firms are forced to learn technological advancements and better management techniques in order to compete in international markets, further improving productivity. (6) Exports provide a foreign exchange that is used to import capital goods and intermediate goods, thus improving the input quality of production, which promotes productivity. Exports promote economic growth, and, consequently, the productivity growth leads to lower unit cost, facilitating further exports. Thus, economic growth also promotes exports, an argument that is called the growth-led exports hypothesis

(Asafu-Adjaye & Chakraborty, 1999, p. 164; Baharumshah & Rashid, 1999, p.391; Kim et al., 2009, p.1821; Ramos, 2001, p. 613-614).

While carrying out exports-promoting policies, some Asian countries relaxed trade barriers and opened domestic market to attract FDI. Therefore, FDI can be a factor, beyond exports, to explain the strong economic growth of Asian countries in the 1970s. FDI contributes to economic growth in the following ways (Lim, 2001, p.3): (1) FDI contributes to GDP through its impact on two of the three main production factors: investment capital and innovation. Increase in innovation is due to technology diffusion from multinational corporations to local firms. (2) Local firms are forced to use their current sources more efficiently and look for more advanced technologies, in order to confront the severe competition arising from the entry of multinationals, and their productivity should increase accordingly. (3) Multinationals provide assistance for local suppliers in training, management, organization, finding customers, production and skills, thereby increasing the productivity of local suppliers.

The import-substitution policies in Asian countries assumed a negative impact of imports on economic growth. After this policy was rejected in most Asian countries, the positive effect of imports on economic growth was gradually recognized. The imports-compression growth hypothesis suggests that a shortage in imports will restrict economic growth. The imports-compression growth hypothesis (Asafu-Adjaye & Chakraborty, 1999, p.164; Esfahani, 1991, p.95-99; Kim et al. (2009), p.1821) is based on the following arguments. (1) Importing consumption goods forces the domestic import-substitution firms to innovate and restructure themselves, which improves their productivity. (2) Imports can increase productivity through improving input quality, varieties of inputs and the reallocation of capital and labor to importers. (3) Imports of capital goods and intermediate goods can increase economic growth through technological diffusion. In contrast, a higher income level pushes up demand for high-quality luxury consumption goods, and modern design that may not be domestically produced. On the other hand, a higher quality output calls for a higher quality input, which increases the demand for importing capital and intermediate goods.

The relationship between exports and imports can be carried out through two channels. Exports provide foreign exchange that can be used for importing consumption goods, intermediate goods or capital goods. Also, importing high-technological equipment intermediate goods for production will accelerate production for exports.

An Increase in FDI may require a high level of importing essential intermediate goods and capital goods for production. But, a higher level of importing consumption goods may have a negative effect on the import-substitution industry with foreign capital, and thus FDI may decrease. Therefore, there may be causality between FDI and imports (Alguacil, 2003, p.20; Liu, et al., 2001, p.191-193).

As multinational firms consider the options of exporting goods or establishing factories in foreign markets, the choice between exports and FDI depends on the level of convenience, risk and profit and long run developing strategy of firms, competitors, etc (Liu et al., 2001, p.191-193). The profit is determined by the gap between goods-exporting fees (including money to pay for tariffs and transportation costs) and the cost of establishing a new factory in a particular foreign market. Exports are usually easier and less risky, but they face trade barriers such as tariffs and nontariff barriers (import quotas, import licensing, and others). Almost all Asian countries limit imports in order to protect both main and infant industries, while at the same time usually encouraging FDI. However, for multinational firms, the choice of FDI also depends on how much advantage can be derived from foreign countries through factors such as cheap labor costs, availability of natural resources and the priorities of foreign governments with regard to FDI. For example, some Asian countries implement exports-promoting policies, which offer many special benefits, such as low income tax and free import duties for firms manufacturing export goods. So, to better receive those benefits, FDI flows into Asian countries in order to produce the export goods. Therefore, export promotion attracts FDI, and then FDI increases exports. So, we may have two-way causality between exports and FDI.

4.2.2 Empirical Review

I present only the relationships discovered recently in economic research about Asian countries, such as the exports-imports relationships, the exports-imports-growth relationships, the FDI-exports–growth relationships and the FDI-imports-growth relationships. This part is also limited to empirical studies applying the three-variable VAR model, since the two-variable VAR tests are likely to be biased.

4.2.2.1 Exports and Imports

The relationship between exports and imports was examined later than the relationship between exports and growth. The pioneer in exploring the effect of imports on exports and vice versa was Husted (1992). After Husted's study, a series of papers found evidence to support a long-run relationship between exports and imports. Bahmani-Oskooee and Rhee (1997), applying the two-variable VAR for Korean quarterly data over the time period 1963-1991, found that Korea's exports and imports were cointegrated and converged in a long-run equilibrium. However, the two-variable VAR is likely to be biased. On the other hand, the relationships between exports and imports are not independent from the relationships between exports and imports with the GDP and FDI. Therefore, misspecification in VAR structure may lead to bias in their estimated results.

4.2.2.2 Exports, Imports, and Economic growth

Fung et al. (1994) investigated the relationship between exports, imports and growth for both advanced countries and NIC countries over the period 1957-1991, by applying the three-variable VAR model. They used quarterly data on imports, exports and GDP, sourced from International Finance Statistics (IFS) published by the International Monetary Fund (IMF). The four Asian countries were Japan (representing advanced countries) Malaysia, Singapore and Korea (NICs). Their test results revealed that three series were cointegrated in the cases of Japan and Korea, but not cointegrated in the case of Singapore. They found two-way causality between exports and imports for Korea and Malaysia, between exports and GDP for Malaysia and

Singapore and between imports and GDP for Korea and Singapore. They also found unidirectional causality of GDP on exports in Korea, of GDP on imports and of exports on imports in Japan and of imports on GDP in Malaysia. The role of FDI in the economies of Malaysia and Singapore was very important. FDI accounts for most export manufacturing industries of Malaysia (Jomo, 2003, pp. 28 and 41). Foreign transnational corporations (TNCs) accounted for 84% of the manufacturing exports in 1972 and for 92.9% of the manufacturing exports in 1980. Thanks to improved development of the financial sector, good communication and better transportation facilities, Singapore has become a “center for international procurement” (Kim, 1998, p. 83). This suggests that FDI should be in the VAR system in order to avoid misspecification of the problem. On the other hand, biased results may be due to the failure of the VAR system to satisfy conditions.

Chang et al. (2000) used the three-variable VAR model to observe the relationships between exports, imports and income in Taiwan from 1971 to 1995. The results showed that the three series were cointegrated. Chang et al. also found evidence to confirm bidirectional causality between exports and imports, and between imports and growth. They did not find evidence to support for exports-led growth hypothesis in Taiwan from 1971 to 1995. This result seems not be consistent with the export-oriented industrialization of Taiwan. Taiwan has been called “the home of internationalizing subcontractors.” Small and medium entrepreneurs have dominated the export sector, producing export goods following design and quality requirements of foreign buyers. The manufactured exports of Taiwan account for the high proportion of total exports and increase from 72.3% in 1970 to 86.7% in 1981 (Kim 1998, p.69, Table 8).

Mahadevan et al. (2008) emphasized the hypotheses of imports-led growth and exports-led growth for Japan and the Asian Tigers. The point distinguishing this from previous papers is that they used the VECM-GARCH Model, which accounts for uncertainty. The quarterly data on GDP, exports and imports was sourced from Datastream International, Inc. For Japan, the data covered the time period 1957:1 – 2005:2. For Korea, the data covered the time period 1970:1 – 2005:2. For Taiwan, the data covered 1961:1 – 2005:2, and for Hong Kong, the data covered 1973:1 – 2005:2. Without taking uncertainty into account, Johansen cointegration test suggested long-run cointegration between the three series. Granger causality estimation provided evidence to support the exports-led growth hypothesis, in the long run, only for Japan, Korea and Taiwan. For Hong Kong, the direction of causality was of GDP on exports. The imports-led growth hypothesis was confirmed in the long run for Japan, Taiwan and Hong Kong. With uncertainty included as a variable, only Taiwan and Hong Kong satisfied the export-led growth hypothesis in the long run. There was no evidence to support this hypothesis in Japan or Korea. Imports were the source of GDP growth in the three countries other than Korea. This is different from the results of Fung et al. (1994) and Chang et al. (2000). Mahadevan et al. (2008) do not find the linkage between exports and imports for Korea and Taiwan, nor for the other remaining countries. As mentioned above, Kim (1998) described Taiwan’s economy as largely made up of international subcontractors, importing capital goods and raw materials in order to produce export goods following the design and quality requirements of foreign buyers. Therefore, imports could be assumed to be linked, for the most part, in Taiwan.

Kim et al. (2009) investigated the relationships between exports, imports and growth in Korea from 1980 to 2003, by applying the three-variable VECM and three-variable VAR and

Granger causality. They found unidirectional causality of imports on Total Factor Productivity (TFP). Imports had a positive impact on economic growth while exports did not. Kim et al. (2009) insisted upon the advantage of using TFP, because it accounted for the substitution between capital and labor. (TFP is measured as the residual from the regression of GDP on capital stock and labor input.) Similar to Mahadevan et al. (2008), Kim et al. (2009) did not find two-way relationship between exports and imports or unidirectional causality of GDP on exports. In addition, they found evidence of unidirectional causality of imports on GDP. Section 4.4.3.2 provides an analysis of Korean economic policy related to possible causality between GDP, imports, exports and FDI. The difference between my results and those of Kim et al. (2009) is partly due to misspecification in the structure of the VAR system.

4.2.2.3 FDI, Exports, Imports, and Economic Growth

Liu et al. (2001) investigated the relationships between trade (imports, exports) and FDI for China, over the period of 1984 – 1998. They used the Granger causality test based on a three-variable VAR for the panel data covering 19 regions of China. Their findings were as follows: (1) there is a unidirectional causality relationship of imports on FDI. (2) There is a unidirectional causality relationship of FDI on exports and (3) there is a unidirectional causality relationship of exports on imports. These results suggest that the greater openness of China will lead to higher imports, then higher FDI and exports.

Hsiao and Hsiao (2006), in an interesting paper, investigate the relationships between FDI, exports and GDP, between eight rapidly developing East and Southeast Asian economies (China, Korea, Taiwan, Hong Kong, Singapore, Malaysia, Philippines and Thailand) from 1986 to 2004. They applied a three-variable VAR model with a dummy variable which accounted for the Asian financial crisis. In using the Johansen test, they found that the three series were cointegrated in the case of Hong Kong, Singapore, Malaysia, Philippines and Thailand. The Granger causality test showed different results for different countries, suggesting that there may not have been a general rule for the whole sample. Thus, they constructed panel data covering those eight countries from 1986 to 2004. Using the panel data Granger causality test, they found evidence to support bidirectional causality between exports and GDP, as well as unidirectional causality of FDI on GDP and of FDI on exports.

On the basis of theoretical analysis, we realize that three series (FDI, exports and imports) have common characteristics in their relationships with GDP. First, they generate capital flow in or out of the domestic country. Second, they promote technological diffusion through relations with foreign partners and through learning by doing and other means. Third, they are influenced by competition in the international market, which requires improvement in management and technology. In addition, theoretical studies also provide an explanation of the possible relationships between trade (exports and imports) and FDI. On the other hand, the figures of the four series (GDP, exports, imports and FDI) exhibit stochastic time trends and do not wander too far from one another. Therefore, there may be the possibility of cointegration between the four series. Thus, the two-variable or three-variable VAR model constructed from two series or three series out of four series (GDP, exports, imports, and FDI) may be misspecified. To avoid the misspecification problem, VAR needs to be structured with four series. To my knowledge, there have not yet been papers on the relationships between those four series revealed by a four-variable VAR model.

On the econometric side, it is necessary to use an appropriate econometric procedure when using the VAR model to obtain unbiased empirical results. This has been ignored in many prior studies. For this reason, my study focuses on applying appropriate econometric procedures, which include a unit root test of four series, lag structure, VAR stability, VAR diagnostic, the Jonhansen cointergration test, and the GCBEW test. Analysis of impulse response, as well as of variance decomposition, provides an explanation for how and how much one variable, for example GDP, responds to a shock to other variables, such as exports, imports and FDI.

On the other hand, testing the export-led growth hypothesis, the export-driven growth hypothesis, the import-compression growth hypothesis, and the intertemporal budget constraint hypothesis is very important, since the results will provide orientation in making economic policy. Many prior papers have given answers based mostly on the Granger causality test. However, the Granger test cannot tell us the magnitude of the impact.

Finally, the economic achievement of Asian countries in the last three decades requires research and explanation. On the other hand, Asian countries are the typical examples for which the causality relationship between GDP, exports, imports and FDI can be exhibited and developed. More than that, the literature review shows that there are conflicts in the findings of different authors for the same country. The explanation for these conflicting results has not been fully discovered. According to my assessment, it will be due to misspecification in the VAR structure and insufficient econometric procedures—such as shortage in VAR diagnostics, ignoring dynamic analysis, differences in the ordering of variables in the VAR model and identification problems. The gap in the literature suggests there should be more studies on this. This paper will therefore reexamine the hypothesis and find better explanations by applying the econometric procedure in the correct way.

To test for all of the above, I will test the long-run and short-run relationships between the variables GDP, exports, imports and FDI, for ten Asian countries from 1970 to 2007, using a four-variable VAR model. I will apply Johansen (1991) with VEC restriction to test the long-run relationships between variables as well as to test the hypothesis. I will apply sufficient econometric procedure, including a unit root test of four series, lag structure, VAR stability, VAR diagnostics, the Johansen cointegration test, the GCBEW test, analysis of impulse response and analysis of variance decomposition.

4.3 METHODOLOGY

In this section, I will review my strategy, which includes the following steps:

- Test unit root of four time series;
- Construct four-variable VAR model;
- VAR diagnostics;
- Johansen cointegration test;
- Causality test;
- Dynamic simulation (impulse response function and variance decomposition);

4.3.1 Unit Root Test

I implement the unit root test of four series—(realGDP_l, realexports_l, realimports_l and realFDI_l)—by using the Dickey-Fuller (GLS) test. Consider the equation (Enders, 2003, p. 182, equation 4.25).

$$\Delta y_t = a_0 + a_1 y_{t-1} + \sum_{i=2}^{p} a_i \Delta y_{t-i+1} + \varepsilon_t \, . \qquad (1)$$

Null hypothesis: $a_1 = 0$. Rejecting the null hypothesis means the series is stationary. This series is nonstationary if we cannot reject the null hypothesis. Dickey-Fuller with GLS detrending (DFGLS) involves detrending y_t with GLS technique, and then substituting the detrended y_t into the Augmented Dickey-Fuller test (see Enders 2003, p.190).

If those studied series are I(1), they will be used to construct a four-variable VAR. If some of the series, or all four, have a higher order than I(1), I will transfer them into other forms such as logarithms, share of GDP or form of difference, and then retest the unit root. This step will cease when the transformed series are nonstationary with an order of one.

4.3.2. VAR Model

I consider the four-variable standard VAR model of order p as (unstructured form) (Shin and Pesaran, 1998, p. 18, eq.1)

$$y_t = \sum_{i=1}^{p} A_i y_{t-i} + Bx_i + e_t \, , \qquad (2)$$

where y_t is n x 1 random vector. In my model, four-variable VAR, n = 4 and y_t = (realGDP_l realexports_l realimports_l realFDI_l)'; However, there will be 4! = 24 ordering of vector y_t ; The A_i is n x n fixed coefficient matrices; p is order of lags; B is n x d coefficient matrix of exogenous variables; x_j is d x 1 vector of exogenous variables; For Malaysia, exogenous variables are dummy variables for years 1974, 1998 and 2001, while exogenous variables are dummy variables for year 1998 and year 2001; Thus, d = 3 for Malaysia and d =2 for Korea; e_t is a n x 1 random vector of error terms and is a white noise process.

According to Shin and Pesaran (1998), the model satisfies the following conditions:

Assumption 1: $E(e_t) = 0$; $E(e_t e_t') = \sum_e$ (nonsingular) ; $E(e_t e_s') = 0$ if s ‡ t.

Assumption 2: No roots are inside the unit circle.

Assumption 3: There are not full collinearity among y_{t-1}, y_{t-2}… y_{t-p}, x_t,.

4.3.3 VAR Diagnostics

This step is to check whether the assumptions of our VAR model are met. It includes the following:

- Lag order selection;
- VAR residual serial correlation LM test;
- VAR residual normality.

4.3.3.1 Lag Order Selection

According to Enders (2003), the model will be misspecified when lag length is too small. The more lags, the more parameters we need to estimate and the less bias in our results. The model will be overparameterized if the number of lags is too large. Selecting the lag order is simply to understand that we find p such that A_i =0 for all i > p in the VAR model. There are two approaches: lag order selection based on the LR test; and lag order selection based on Information criteria such as AIC (Akaike's Information Criterion), FPE (final prediction error), SC (Schwarz criterion), HQ (the Hannan & Quinn (1979) criterion)

(Lutkepohl 2005, p. 142, eq. 4.2.3).

$$\text{LR (p)} = (T - c)[\ln\left|\sum{}_{un}\right| - \ln\left|\sum{}_{re}\right|] \quad (3)$$

(Lutkepohl, 2005, p. 147, eq. 4.3.2).

$$\text{AIC (p)} = \ln\left|\sum{}_{un}\right| + \frac{1}{T}2(n^2 p) \quad (4)$$

(Lutkepohl, 2005, p. 147, eq. 4.3.1).

$$\text{FPE(p)} = \left[\frac{T + np + 1}{T - np - 1}\right]\left|\sum{}_{un}\right| \quad (5)$$

(Lutkepohl, 2005, p. 150, eq. 4.3.9).

$$\text{SC (p)} = \left[\frac{\ln(T)}{T}\right]np^2 + \ln\left|\sum{}_{un}\right| \quad (6)$$

(Lutkepohl, 2005, p. 150, eq. 4.3.8).

$$\text{HQ (p)} = \left[\frac{2\ln[\ln(T)]}{T}\right]np^2 + \ln\left|\sum{}_{un}\right| \;, \quad (7)$$

where $\sum_{re}$ and $\sum_{un}$ are variance/covariance matrices of the unrestricted and restricted system, respectively; T is the number of observations; c is the maximum number of regressors included in the longest equation of unrestricted system; n is the number of endogenous variables; p is the order of VAR system; q is the total number of restrictions in the system.

LR statistics are distributed chi-squared with the degrees of freedom (q) equal the number of restrictions in the system. We reject the null hypothesis of restriction if the p-value is small. For information criteria, we need to choose the number of lags that minimize the criteria. However, it is not unusual that different criteria give a different number of maximum lag lengths. The problem is which criteria we should choose. To overcome this problem, I will run VAR with different lag orders, chosen by different criteria and the LR test, and then implement the VAR residual serial correlation LM test and the normality test. I will choose lag order based on those tests.

4.3.3.2 The VAR Residual Serial Correlation LM Test

We can assume that the residual of the VAR model is in the form (Lutkepohl, 2005, p. 171, equation 4.4.25)

$$e_t = C_1 e_{t-1} + ... + C_{t-p} e_{t-p} + r_t \,. \qquad (8)$$

This test is to test the autocorrelation in the residuals e_t of the VAR model. The hypothesis is that there is no serial autocorrelation up to lag p.

H_0: $C_1 = C_2 = \ldots = C_{t-p} = 0$.

H_1: $C_j \neq 0$ for at least one $j < m$.

The test is performed by the La Grange Multiplier method.

4.3.3.3 The VAR Residual Normality Test

According to Lutkepohl (2005), the VAR residual normality test checks the skewness and kurtosis properties (third and fourth central moments) of residual e_t. The basic idea is that if $y \approx N(0,1)$, then third moment E (y^3) =0 and fourth moment E (y^4) =3. Consider a K-dimensional Gaussian white noise process with $e_t \approx N(\mu_e, \Sigma_e)$, and we have P P' = $\sum_e$, and then u_t: = (u_{1t},…, u_{Kt})':= $P^{-1}(e_t - \mu_e) \approx N(0, I_K)$.

The test statistics are (Lutkepohl, 2005, p. 176, eq. 4.5.4)

$$\lambda_s := Tb_1^{'}b_1 / 6 \approx \chi^2(K), \tag{9}$$

$$\lambda_k := T(b_2 - 3_K)^{'}(b_2 - 3_K) / 24 \approx \chi^2(K) \text{ and} \tag{10}$$

$$\lambda_{sk} := \lambda_s + \lambda_k \approx \chi^2(2K), \tag{11}$$

where

b_1 := (b_{11}, …, b_{k1})' with $b_{k1} = 1/T \sum u_{kt}^3$ k = 1, …, K,

b_2 := (b_{12}, …, b_{k2})' with $b_{k2} = 1/T \sum_t u_{kt}^4$ k = 1, …, K.

4.3.4 The Johansen Cointegration Test

This test allows us to test the long-run cointegration of four time series. Consider the model (Enders, 2003, p. 354, eq.6.54)

$$\Delta y_t = \alpha_0 + \alpha\, y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \varepsilon_t, \tag{12}$$

where $\alpha = -\left(I - \sum_{i=1}^{p} A_i \right)$ and $\alpha_i = -\sum_{j=i+1}^{p} A_j$.

To determine the number of cointegration vectors (r), we can use the maximum eigenvalue test and the trace test. Both tests are based on the likelihood ratio test.

4.3.4.1 The Trace Test

The null hypothesis H_0 : all λ_i =0 with i= 1,2,..4 (r = 0).

The alternative hypothesis H_A : some λ_i ‡ 0 (r>i).

Test statistics (Enders, 2003, p.352, eq.6. 55): $\lambda_{trace} = -T \sum_{i}^{n} \ln(1 - \hat{\lambda}_i)$, (13)

where $\hat{\lambda}_i$ is the estimated value of eigenvalues (the characteristic roots), which results from the estimation of α matrix. T is the number of observations and n is the number of characteristic roots.

4.3.4.2 The Maximum Eigenvalue Test

The null hypothesis H_0: all λ_i =0 with i = 1,2,..4 (r = 0) .

The alternative hypothesis H_A: some λ_i ‡ 0 (r=i).

Test statistics (Enders, 2003, p.353, eq. 6. 56): $\lambda_{\max} = -T \ln(1 - \hat{\lambda}_i)$. (14)

The definitions of $\hat{\lambda}_i$ and T are the same as mentioned in equation 13.

When λ_{trace} and λ_{max} conflict, we should choose the number of the cointegration vector based on λ_{max} , because "the λ_{max} test has the sharper alternative hypothesis. It is usually preferred for trying to pin down the number of cointegrating vectors." (Enders, 2003, p. 354).

If all series are not stationary with a lag order of 1 and are not cointegrated, we should implement VAR in the first difference. If all series are not stationary with a lag order of 1 and cointegrated, we should implement VAR in levels (Enders, 2003, p. 358).

4.3.5 The Causality Test

I will apply the Granger causality/ Block exogeneity Wald test (Enders, 2003, p. 284). In this test, all endogenous variables can be treated as exogenous. This test detects whether the lags of one variable can Granger-cause any other variables in the VAR system. The null hypothesis is that all lags of one variable can be excluded from each equation in the VAR system. For example, this test helps to answer whether or not all lags of FDI can be excluded from the equation of GDP or not. Rejection of the null hypothesis means that if all lags of FDI cannot be excluded from the GDP equation, then GDP is an endogenous variable and there is causality of FDI on GDP. The test statistic is (Enders, 2003, p. 282, eq.5.44)

$$(T-3p-1)(\log\left|\sum_{re}\right|-\log\left|\sum_{un}\right|) \sim \chi^2(2p), \qquad (15)$$

where T is the number of observations; $\sum_{un}$ is variance/covariance matrices of the unrestricted VAR system; $\sum_{re}$ is variance/covariance matrices of the restricted system when the lag of a variable is excluded from the VAR system; and p is the number of lags of the variable that is excluded from the VAR system.

4.3.6 Dynamic Simulation

4.3.6.1 The Impulse Response Function

Rewrite equation (2) in the infinite moving average representation (Shin and Pesaran, 1998, p. 18, eq.2), as follows:

$$y_t = \sum_{i=0}^{\infty} Q_i e_{t-i} + \sum_{i=0}^{\infty} S x_{t-i} \qquad t = 1, 2, \ldots, T, \qquad (16)$$

where

$$Q_i = A_1 Q_{i-1} + A_2 Q_{i-2} + \ldots + A_p Q_{i-p} \qquad i = 1, 2, \ldots, \qquad (17)$$

$Q_o = I_n$ and $Q_i = 0$ for $i < 0$ and $S_i = Q_i B$.

"An impulse response function measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamic system" (Shin and Pesaran, 1998, p. 18). The impulse response function is defined as

$$IR(m, h, Z_{t-1}) = E(y_{t+m} | e_t = h, Z_{t-1}) - E(y_{t+m} | = Z_{t-1}) , \qquad (18)$$

where m denotes the time, h = ($h_1, \ldots, h_m$)' is n x 1 vector denotes the size of shock, Z_{t-1} denotes accumulative information about the economy from the past up to time t-1 (Shin and Pesaran, 1998, eq. 4).

The choice of h plays an important role in the relations of the properties of the impulse-response function. Sim (1980) establishes the orthogonalized impulse response (OIR) by identifying the shock h through using the Cholesky decomposition of $\sum_e$ = P P'. P is n x n lower triangular matrix. Thus the orthogonalized impulse response is

$$IR_{ij}^{0}(m) = Q_m P \varepsilon_j \qquad m = 0, 1, 2, \ldots, \tag{19}$$

where ε_t is n x 1 selected vector in which j^{th} element is unity and other elements are zeros.

The IOR is criticized because it is imposed by the restriction. The restriction is that the series have no contemporaneous effect on the other series. According to Lutkepohl, when this assumption is violated, OIR will change with reordering of endogenous variables. There are two approaches to deal with the ordering of the endogenous variables. The choice depends on the consistency between the estimated results from impulse response function and the estimated results of the GCBEW test.

The first approach is to use the generalized impulse response (GIR) (Shin and Pesaran, 1998, p.19, eq.10)

$$IR_{ij}^{G}(m) = \left(g_{ij}\right)^{1/2} Q_m \textstyle\sum_e \varepsilon_j), \tag{20}$$

where $h_j = (g_{ij})^{1/2}$. GIR is invariant to changes in the ordering of the endogenous variables.

The second approach is to use OIR with the ordering of the variables will be as follows (Enders, 2003, p. 276):

- The first place in the list of ordering will be reserved for the variable that is not caused by any other variables;
- The ordering of the remaining variables will follow in order of increasing correlation among them;
- The last place in the list of ordering will be reserved for the target variable.

4.3.6.2 Variance Decomposition

According to Enders (2003), variance decomposition tells how much a given variable changes under the impact of its own shock and the shock of other variables. Therefore, the variance decomposition defines the relative importance of each random innovation in affecting the variables in the VAR. If $\varepsilon_{realexports\_l}$, $\varepsilon_{realimports\_l}$ and $\varepsilon_{realFDI\_l}$ explain none of the forecast error variance of realGDP_l at all forecast horizons, then realGDP_l is said to be exogenous. If $\varepsilon_{realexports\_l}$ or/and $\varepsilon_{realimports\_l}$ or/and $\varepsilon_{realFDI\_l}$ can explain some of the forecast error variance of realGDP_l at all forecast horizons, then realGDP_l is said to be endogenous. Variance decomposition can be derived from the orthogonalized impulse-response function ($IR_{ij}^{0}(m)$) as well as from the generalized impulse-response function ($IR_{ij}^{g}(m)$) (Shin and Pesaran 1998, p. 20).

$$VD_{ij}^{0}(m) = \frac{\sum_{i=0}^{m}(\varepsilon_i^{'} Q_i P \varepsilon_j)^2}{\sum_{i=0}^{m}(\varepsilon_i^{'} Q_i \sum Q_i^{'} \varepsilon_j)^2} \; . \qquad \text{i,j} = 1, \ldots, n \qquad (21)$$

$$VD_{ij}^{g}(m) = \frac{g_{ij}^{-1}\sum_{i=0}^{p}(\varepsilon_i^{'} Q_i P \varepsilon_j)^2}{\sum_{i=0}^{p}(\varepsilon_i^{'} Q_i \sum Q_i^{'} \varepsilon_j)^2} \; . \qquad \text{i,j} = 1, \ldots, n \qquad (22)$$

Where $\sum_{j=1}^{n} VD_{ij}^{0}(m) = 1$ but $\sum_{j=1}^{n} VD_{ij}^{g}(m) \neq 1$

The variance decompositions are also sensitive to the ordering of the variables. We can change the ordering of the variables until we get the variance decompositions that are closest to the estimated results from GCBEW test (Enders, 2003, p. 280; Sims, 1980).

4.4 EMPIRICAL ANALYSIS AND FINDINGS

4.4.1 Data and Unit Root Test

The countries that I have chosen to study are Malaysia and Korea. The time of estimation is 1970 – 2004 for Malaysia and 1976 – 2007 for Korea. The four time series are realGDP_l, realexports_l, realimports_l and realFDI_l. RealGDP_l is the logarithm of real GDP; realexports_l is the logarithm of real exports; realimports_l is the logarithm of real imports and realFDI_l is the logarithm of real FDI. The data is sourced from World Bank. The choice of the variables requires some comment. First, to avoid the effect of inflation, I divide four time series—GDP, exports, imports and FDI—by a GDP deflator, to obtain realGDP, real exports, real imports and real FDI, respectively. However, the four series realGDP, real exports, real imports and real FDI are nonstationary with an order higher than one, for which we can't construct VAR. Therefore, to satisfy the condition of the VAR model that all variables must be I(1), I must transfer these series into the natural logarithm.

Table 4.1 and Table 4.2 provide the evidence that the four time series (realGDP_l, realexports_l, realimports_l and realFDI_l) are nonstationary with an order of 1 for Malaysia. Table 4.3 and Table 4.4 provide evidence that these four time series (realGDP_l, realexports_l, realimports_l and realFDI_l) are nonstationary with an order of 1 for Korea. The first column of each table exhibits the name of the series. The next columns report the t-statistic values, the numbers of lag, the numbers of maximum lag, and the number of observations, in that order, left to right.

Table 4.1: Unit Root Test in Levels for Malaysia

Series	**t-Stat**	**Lag length**	**Max lag**	**Obs**
RealGDP_l	-2.283188	1	8	33
Realexp_l	-2.953621	5	8	29
Realimp_l	-2.469140	1	8	33
RealFDI_l	-3.439528	3	8	31

Note:
Unit root test by Dickey-Fuller (GLS) test
1 percent critical value = - 3.770

Table 4.2: Unit Root Test in First Difference for Malaysia

Series	**t-Stats**	**Lag Length**	**Max lag**	**Obs**
RealGDP_l	-4.455159	0	8	33
Realexp_l	-4.388893	0	8	33
Realimp_l	-4.119046	0	8	33
RealFDI_l	-3.153449	3	8	30

Note:
Unit root test by Dickey-Fuller (GLS) test
5 percent critical values = -1.951

Table 4.3: Unit Root Test in Levels for Korea

Series	t-Stat	Lag length	Max lag	Obs
RealGDP	-2.010870	0	7	31
Realexp	-3.135229	1	7	30
Realimp	-2.816564	1	7	30
RealFDI	-2.662293	1	7	30

Note:
Unit root test by Dickey-Fuller (GLS) test
1 percent critical value = - 3.770

Table 4.4: Unit Root Test in First Difference for Korea

Series	t-Stats	Lag length	Max lag	Obs
RealGDP	-4.635355	0	7	30
Realexp	-3.836050	0	7	30
Realimp	-4.587495	1	7	29
RealFDI	-4.304318	1	7	29

Note:
Unit root test by Dickey-Fuller (GLS) test
5 percent critical values = -1.951

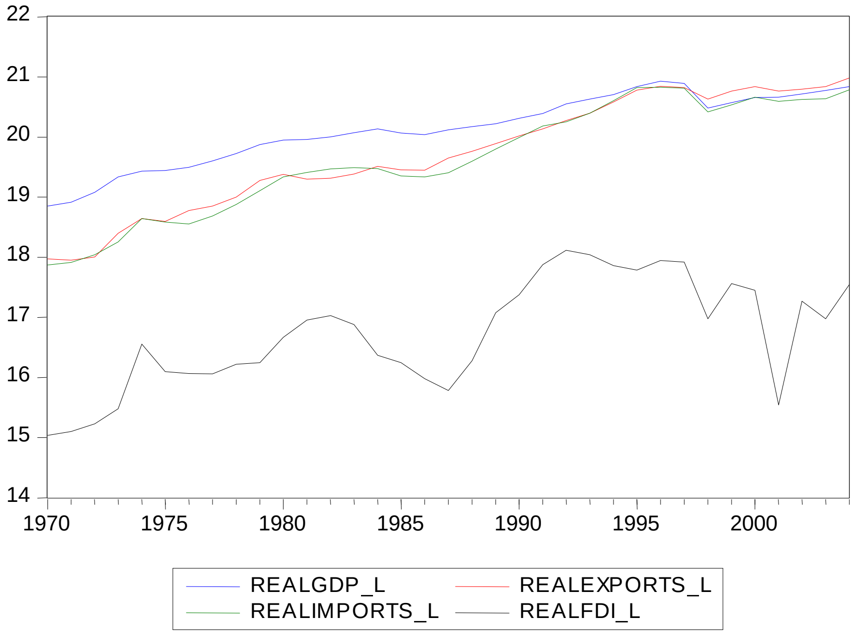
The test result (reported in Table 4.1 and Table 4.3) with constant and time trend shows that we cannot reject the null hypothesis (of nonstationary) at a 0.01 significant level. The t-statistic values for each series in the case of Malaysia are -2.283, -2.953, -2.469 and -3.439, respectively. Their absolute values are less than the absolute value of 1 percent critical value of -3.770. The t-statistic values for each series in the case of Korea are -2.010, -3.135, -2.861 and -2.662, respectively. Their absolute values are less than the absolute value of 1 percent critical value of - 3.770. Thus, they have a unit root and I continue to test the unit root of their first difference. The test results using a constant and no time trend are reported in Table 4.2 (for Malaysia) and Table 4.4 (for Korea). The t-statistics for each series of Malaysia are -4.455, -4.388, -4.119 and -3.153 and the t-statistics for each series of Korea are -4.635, -3.836, -4.587

and -4.304. Since their absolute values are higher than the absolute value of 5 percent critical values of -1.951, we can reject the null hypothesis of non-stationary at a 0.05 level. Thus, we can conclude that the four series are non-stationary with the root of order 1 for both Malaysia and Korea.

Figures 4.1 and 4.2 describe the four series, realGDP_l, realexports_l, realimports_l and realFDI_l for Malaysia and Korea, respectively. Examining data and Figure 4.1, we realize that the Asian financial crisis in 1998, the OPEC oil crisis in 1974, and the US recession in 2001 had a strong impact on the economy of Malaysia. The OPEC oil crisis in 1974 led the growth rate in GDP, exports and imports down from 8.3%, 15.9% and 36.8% in 1974 to 0.801%, -2.99% and -17.095% in 1975, respectively. The share of FDI in GDP also fell from 5.6% in 1974 to 3.54% in 1975. To cause the economy to recover, the Malaysian government continued to strongly promote export-oriented industrialization, by establishing free trade zones and allowing duty-free imports of raw material and capital goods. In 1994, the Malaysian economy boomed again with a growth rate of GDP, exports and imports of about 9%, 21.9% and 25.6%, respectively. In 1997-1998, the Asian financial crisis hurt the Malaysian economy. In 1998, exports growth declined about 5% compared with 1997. The growth rates of imports and GDP were down to -18.75% and -7% in 1998, respectively. The Malaysian government then implemented a series of programs with the aim of stabilizing the currency, restoring and stabilizing the market, and other policies. Thanks to these government efforts, the Malaysian economy recovered fully. However, the economic downturn repeated itself again in 2001, when the global economy was in danger of recession and the September 11, 2001 terrorist attacks occurred in the United States. The GDP growth rate reached only 0.517% in 2001. The growth rates of exports and imports fell to -6.8%

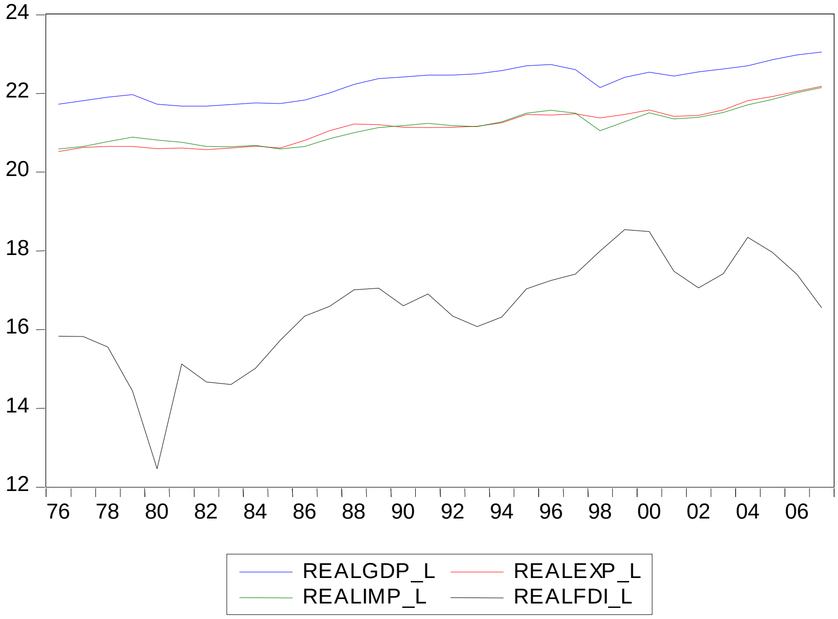
and -8.23% in 2001, respectively. The share of FDI in GDP was only 0.597%, compared with 4% in the year 2000. To control for these special events, I use dummy variables: dummy74, dummy98, and dummy01. Each dummy variable will receive the value of 1 if the year is 1974, 1998, or 2001 and zero otherwise.

Figure 4.1: Describe Four Time Series of Malaysia



Looking at Figure 4.2 and examining the data set for Korea, we find that the 1998 Asian financial crisis and 2001 U.S. recession also affected the Korean economy. Because the Korean data set only covers 1976 to 2007, we do not take into consideration the OPEC oil crisis. To control for the special events, I use the dummy variables dummy98 and dummy01. Each dummy variable will receive the value of 1 if the year is 1998 or 2001 and zero otherwise.

Figure 4.2: Describe Four Time Series of Korea



4.4.2 Primary Results

4.4.2.1 Malaysia

I construct the VAR system with four endogenous variables (realGDP_L, realexports_L, realimports_L and realFDI_L) and three exogenous variables (dummy74, dummy98, and dummy01). The result from the test for lag length criteria, based on the four-variable VAR system with the maximum lag number of 4, is reported in Table 4.5. The lag orders chosen by the LR test, the FPE, the AIC criterion, and the SC criterion are all 4.

Table 4.5: Test for Lag Length Criteria for Malaysia

Lag	LogL	LR	FPE	AIC	SC	HQ
0	39.42305	NA	2.61e-06	-1.511165	-0.771042	-1.269903
1	155.7180	172.5667	4.21e-09	-7.981805	-6.501560	-7.499282
2	174.1028	22.53621	4.08e-09	-8.135663	-5.915296	-7.411879
3	208.8670	33.64279	1.59e-09	-9.346257	-6.385768	-8.381211
4	250.0789	29.24717*	5.34e-10*	-10.97283*	-7.272220*	-9.766525*

Note:
(*) indicates the lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC:Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hannan-Quinn Information Criterion

I run VAR with the lag order of 4. The results of VAR are reported in Table 4.6. The results from the VAR residual normality test and the VAR residual serial correlation LM test are reported in Table 4.7 and Table 4.8, respectively. With the data from Table 4.7, we cannot reject the hypothesis of normality properties, since P-values are 0.5922, 0.4665 and 0.6055 for skewness, kurtosis and the Jarque-Bera test. This provides some support for the hypothesis that residuals from our VAR model have a normal distribution. Table 4.8 shows that we also cannot reject the null hypothesis of no autocorrelation up to lag 5, since P-values are 0.6273, 0.7736, 0.1147, 0.5396 and 0.9795 for the lag order of 1, 2, 3, 4, and 5, respectively. These two tests give support to the assumptions of our model about white noise residuals.

Table 4.6: VAR Model with Lag of Four and Dummy Variables (1974, 1998, and 2001)

	REALGDP_L	REALEXP_L	REALIMP_L	REALFDI_L
REALGDP_L(-1)	0.647111	0.179518	0.395451	-1.050808
	(0.30209)	(0.50780)	(0.28040)	(0.84949)
	[2.14214]	[0.35352]	[1.41029]	[-1.23699]
REALGDP_L(-2)	0.245256	0.286731	0.595571	0.508008
	(0.25045)	(0.42101)	(0.23248)	(0.70429)
	[0.97924]	[0.68105]	[2.56183]	[0.72130]
REALGDP_L(-3)	-0.395830	-0.277350	0.211687	-1.727269
	(0.48598)	(0.81693)	(0.45110)	(1.36661)
	[-0.81450]	[-0.33950]	[0.46927]	[-1.26391]
REALGDP_L(-4)	0.160928	-0.154698	-0.185253	2.676573
	(0.35974)	(0.60472)	(0.33392)	(1.01161)
	[0.44735]	[-0.25582]	[-0.55479]	[2.64586]
REALEXP_L(-1)	0.146521	1.145285	0.403589	0.512872
	(0.16611)	(0.27924)	(0.15419)	(0.46713)
	[0.88205]	[4.10147]	[2.61743]	[1.09793]
REALEXP_L(-2)	-0.273971	-0.401343	0.123865	2.039328
	(0.25000)	(0.42025)	(0.23206)	(0.70302)
	[-1.09587]	[-0.95501]	[0.53376]	[2.90080]
REALEXP_L(-3)	0.608077	1.049759	0.591281	-0.257556
	(0.23786)	(0.39984)	(0.22079)	(0.66887)
	[2.55647]	[2.62546]	[2.67806]	[-0.38506]
REALEXP_L(-4)	-0.015761	-0.269045	0.410873	1.043130
	(0.22506)	(0.37832)	(0.20890)	(0.63287)
	[-0.07003]	[-0.71116]	[1.96681]	[1.64825]
REALIMP_L(-1)	0.109557	-0.294999	0.299976	0.160276
	(0.22569)	(0.37939)	(0.20949)	(0.63466)
	[0.48543]	[-0.77757]	[1.43191]	[0.25254]
REALIMP_L(-2)	-0.151617	-0.174671	-0.866361	-0.650335
	(0.23976)	(0.40303)	(0.22255)	(0.67422)
	[-0.63237]	[-0.43339]	[-3.89285]	[-0.96457]
REALIMP_L(-3)	-0.482309	-0.956386	-0.698072	-1.028931
	(0.22754)	(0.38250)	(0.21121)	(0.63987)
	[-2.11963]	[-2.50036]	[-3.30507]	[-1.60804]
REALIMP_L(-4)	0.164141	0.776936	-0.052905	-1.802223
	(0.18478)	(0.31062)	(0.17152)	(0.51962)
	[0.88829]	[2.50125]	[-0.30845]	[-3.46833]
REALFDI_L(-1)	0.035568	0.082424	0.099003	0.431450
	(0.02715)	(0.04563)	(0.02520)	(0.07633)
	[1.31026]	[1.80630]	[3.92914]	[5.65208]
REALFDI_L(-2)	0.044059	0.087575	0.127590	0.369349
	(0.02398)	(0.04031)	(0.02226)	(0.06743)
	[1.83744]	[2.17266]	[5.73239]	[5.47755]
REALFDI_L(-3)	0.030798	0.034916	0.057044	0.078184
	(0.02969)	(0.04991)	(0.02756)	(0.08349)
	[1.03726]	[0.69956]	[2.06978]	[0.93640]
REALFDI_L(-4)	0.011160	-0.058811	-0.031996	-0.074026
	(0.04495)	(0.07557)	(0.04173)	(0.12641)
	[0.24825]	[-0.77826]	[-0.76678]	[-0.58559]
C	2.876051	-0.569493	-9.208637	-5.327591
	(2.75414)	(4.62969)	(2.55647)	(7.74483)

	[1.04426]	[-0.12301]	[-3.60209]	[-0.68789]
DUMMY01	-0.296448	-0.422590	-0.240961	-3.314420
	(0.17039)	(0.28642)	(0.15816)	(0.47914)
	[-1.73985]	[-1.47542]	[-1.52354]	[-6.91744]
DUMMY98	-0.416886	-0.265084	-0.489520	-0.757724
	(0.06155)	(0.10347)	(0.05713)	(0.17309)
	[-6.77302]	[-2.56202]	[-8.56803]	[-4.37775]
DUMMY74	0.006568	0.112351	0.419895	1.506881
	(0.07432)	(0.12493)	(0.06899)	(0.20899)
	[0.08838]	[0.89930]	[6.08662]	[7.21014]
R-squared	0.996450	0.996558	0.998916	0.990015
Adj. R-squared	0.990318	0.990614	0.997044	0.972769
Sum sq. resids	0.021793	0.061580	0.018777	0.172329
S.E. equation	0.044510	0.074821	0.041315	0.125165
F-statistic	162.5063	167.6398	533.6550	57.40522
Log likelihood	68.54561	52.44471	70.85441	36.49411
Akaike AIC	-3.131975	-2.093207	-3.280930	-1.064136
Schwarz SC	-2.206822	-1.168054	-2.355777	-0.138983
Mean dependent	20.26644	19.92651	19.84779	16.92738
S.D. dependent	0.452357	0.772283	0.759966	0.758497

Determinant resid covariance (dof adj.)	7.29E-11
Determinant resid covariance	1.16E-12
Log likelihood	250.0789
Akaike information criterion	-10.97283
Schwarz criterion	-7.272220

Table 4.7 VAR Residual Normality Test for Malaysia

Component	Skewness	Chi-sq	Df	Prob.
1	0.167632	0.145187	1	0.7032
2	0.396988	0.814265	1	0.3669
3	-0.225524	0.262782	1	0.6082
4	0.552263	1.575804	1	0.2094
Joint		2.798038	4	0.5922

Component	Kurtosis	Chi-sq	Df	Prob.
1	2.313992	0.607867	1	0.4356
2	2.534493	0.279900	1	0.5968
3	3.662707	0.567276	1	0.4513
4	4.281239	2.120366	1	0.1454
Joint		3.575408	4	0.4665

Component	Jarque-Bera	df	Prob.
1	0.753053	2	0.6862
2	1.094165	2	0.5786
3	0.830058	2	0.6603
4	3.696170	2	0.1575
Joint	6.373446	8	0.6055

Table 4.8: VAR Residual Serial Correlation LM Test for Malaysia

Lags	LM-Stat	Prob
1	13.61586	0.6273
2	11.56153	0.7736
3	22.96220	0.1147
4	14.79601	0.5396
5	6.646689	0.9795

Probs from chi-square with 16 df.

To test the long-run cointegration relationship between the four time series, I carry out the Johansen cointegration test (1993). The test results, reported in Table 4.9, indicate that four series are cointegrated and there are three cointegrating vectors. Table 4.9 is divided into two parts. The first part reports the results from the trace test, while the second part reports the results of the maximum eigenvalue. In each part, columns 1, 2, 3, 4, and 5 report the number of cointegrating vectors we want to test, the eigenvalue, the value of λ_{TRACE} equal to each number of cointerating vectors, the critical value at the 0.05 significance level and the P-value, respectively.

Table 4.9: Johansen Cointegration Test with Optimal Lag Length of Three for Malaysia

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.930588	161.3113	47.85613	0.0000
At most 1 *	0.854538	78.61259	29.79707	0.0000
At most 2 *	0.422458	18.84953	15.49471	0.0150
At most 3	0.057365	1.831346	3.841466	0.1760

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.930588	82.69872	27.58434	0.0000
At most 1 *	0.854538	59.76305	21.13162	0.0000
At most 2 *	0.422458	17.01819	14.26460	0.0179
At most 3	0.057365	1.831346	3.841466	0.1760

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

To consider the hypothesis that the variables are not cointgrated (r=0) against the alternative of one or more cointegrating vectors (r>0), we have to look at the value of λ_{TRACE}. Column 3 of the first part of Table 4.9 indicates the value of λ_{TRACE} equal to each number of the cointegrating vector: λ_{TRACE} (0) = 161.31, λ_{TRACE} (1) = 78.61, λ_{TRACE} (2) = 18.84 and λ_{TRACE} (3) = 1.831 Since the value of λ_{TRACE} (2) exceeds the critical value (15.495) at the 0.05 significance level, we can reject the null hypothesis of two cointegrating vectors (r=2) and accept the alternative hypothesis of more than two cointegrating vectors (r>2) at the 0.05 level. Because the value of λ_{TRACE} (3) is less than the critical value (3.841) at the 0.05 level, we cannot reject the null hypothesis of $r \leq 3$ and reject the alternative hypothesis of four or more cointegrating vectors at the 0.05 level. If we consider the hypothesis that the variables are not cointgrated (r=3) against the alternative of three cointegrating vectors (r=4), we need to look at the λ_{MAX}. Column 3 of the second part of Table 4.9 indicates the values of λ_{MAX} (0), λ_{MAX}(1), λ_{MAX}(2) and λ_{MAX}(3) are 82.69, 59.76, 17.01 and 1.83, respectively. The test of the null hypothesis r=3 against the specific alternative r=4 cannot be rejected at the 0.05 level, because the value of λ_{MAX}(1) is less than the 5 percent critical value of 3.84. This suggests that the number of cointegration vectors is three.

The Johansen test gives the estimate that there are three contegrating vectors within the four series. Since the number of cointegration within the four series is affirmed, I continue to the next step of testing the causality relationships between them. Table 4.10 reports the results from the GCBEW test. Table 4.10 includes four parts. The first part reports the result of testing whether we can exclude each variable out of the equation of realGDP_L. Similarly, the next part reports the results of testing for the equation of realexports_L, realimports_L and realFDI_L.

Each part of Table 4.10 includes four columns. The first column lists the variables which will be excluded from the equation. The next columns are the value of chi-sq, degrees of freedom and P-value. The last row in each part of Table 4.10 reports the joint statistics of the three variables excluded from the equation.

Table 4.10: Granger Causality/Block Exogeneity Wald Test for Malaysia

Dependent variable: REALGDP_L			
Excluded	Chi-sq	df	Prob.
REALEXP_L	15.68534	4	0.0035
REALIMP_L	10.69470	4	0.0302
REALFDI_L	9.238898	4	0.0554
All	24.55474	12	0.0171
Dependent variable: REALEXP_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	2.467139	4	0.6505
REALIMP_L	12.92560	4	0.0116
REALFDI_L	9.341260	4	0.0531
All	21.70638	12	0.0409
Dependent variable: REALIMP_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	25.05008	4	0.0000
REALEXP_L	93.08102	4	0.0000
REALFDI_L	62.68971	4	0.0000
All	122.8555	12	0.0000
Dependent variable: REALFDI_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	18.17507	4	0.0011
REALEXP_L	45.38248	4	0.0000
REALIMP_L	34.01062	4	0.0000
All	233.6008	12	0.0000

The GCBEW test suggests that the four variables—realGDP_L, realexports_L, realimports_L and realFDI_L—are not exogenous, because the P-values of the joint test for each equation of those variables are 0.0171, 0.0409, 0.000 and 0.000, respectively. The test also provides evidence that we can reject the null hypothesis of excluding almost all variables except one case. We fail to reject the null hypothesis of excluding realGDP_L from the realexports_l equation at a 0.100 significance level, due to the fact that chi-sq = 2.467 and the P-value = 0.6505. It suggests that GDP does not cause exports. This test provides some reason to believe that there are bidirectional causalities between FDI and imports, FDI and exports, FDI and GDP, GDP and imports and exports and imports. The only unidirectional causality is of exports on GDP. Causalities from FDI to GDP and from FDI to exports are significant at the 0.05 level, while all other causalities are significant at the 0.01 level. Tentatively, it looks as if FDI shows weaker signs of causal impact on GDP and exports than other causal relations. This conclusion needs to be compared with those from the impulse response function and the variance decomposition. These results are different from Fung et al. (1994). While Fung et al. (1994) did not find any causality of GDP on imports for Malaysia, my results do show that. While I did not find any causality of GDP on exports for Malaysia, Fung et al. (1994) did find it. My results are consistent with Malaysian economic policy (see Section 4.4.3.1). Therefore, the difference between my results and those of Fung et al. (1994) may be due to misspecification in the VAR model. However, this test does not provide information about the direction of the impact, nor the relative importance between variables that simultaneously influence each other. For example, this test shows the causality of exports on GDP and also of imports on GDP. Based on this test, we do not know whether or not exports and imports have a positive effect on GDP. It is also unclear whether or not the impact of exports on GDP is stronger than that of imports on GDP. To answer these questions, we analyze the impulse-response function and the variance decomposition.

Figure 4.3 exhibit the generalized asymptotic impulse response function. It includes 16 small figures which are denoted Figure 4.3.1, Figure 4.3.2 . . . Figure 4.3.16. Each small figure illustrates the dynamic response of each target variable (realGDP_L, realexports_L, realimports_L and realFDI_L) to a one-standard-deviation shock on itself and other variables. In each small figure, the horizontal axis presents the six years following the shock. The vertical axis measures the yearly impact of the shock on each endogenous variable.

Figure 4.3.1 presents the long-run positive effect on GDP of a shock to GDP. After slightly decreasing, GDP returns to its preshock level after five years. Thereafter, it reduces very slightly over time. The Granger causality /block exogeneity test shows that GDP does not affect exports. But Figure 4.3.2 shows that a shock to GDP has short-run positive impact on exports from the first through the third years. After that, the impact is not significant. This data conflicts with the GCBEW test. Under a shock to GDP, imports increases considerably after five years. The impact of a shock to GDP on imports turns out to be statistically insignificant thereafter (Figure 4.3.3). Figure 4.3.4 shows that shock to GDP leads to increase in FDI only in the third and fifth years. Outside of those years, the impact of a shock to GDP on FDI is not statistically significant.

Figure 4.3.1

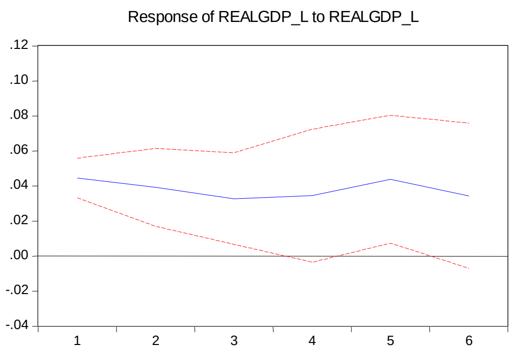


Figure 4.3.2

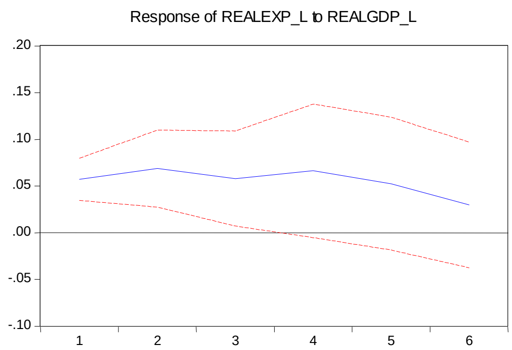


Figure 4.3.3

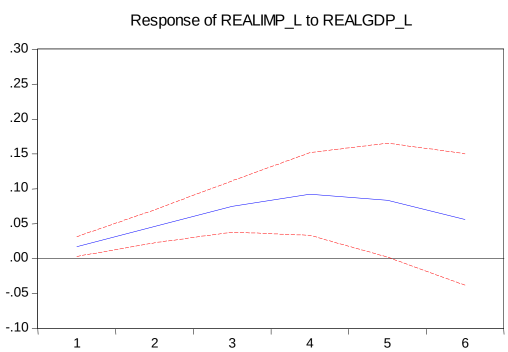
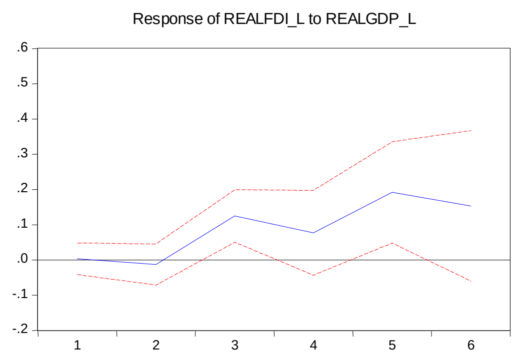


Figure 4.3.4



Figures 4.3.5 through 4.3.8 suggest that in the long run, a shock to exports has positive significant impact on GDP, imports, FDI and exports. The new equilibrium of all variables is reached after about five years. After reaching the minimum level in the third year, GDP increases over time. A shock to exports leads to an increase in imports for five years. It takes about six years to reach a new equilibrium, which is five times higher than the starting level. Before the second year, the impact of a shock to exports on FDI is not statistically significant. Thereafter, FDI increases over time and the response of FDI to export shock has a staircase shape. The response of exports to shocks on exports has a wave shape. It begins to increase

slightly and reaches a maximum in the second year, then returns to preshock level and down to a minimum level in the third year; thereafter, it increases again and reaches a maximum level in the fifth year, before decreasing again to the new equilibrium after the sixth year.

Figure 4.3.5

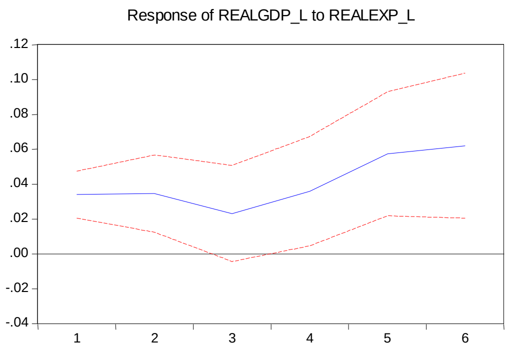


Figure 4.3.6

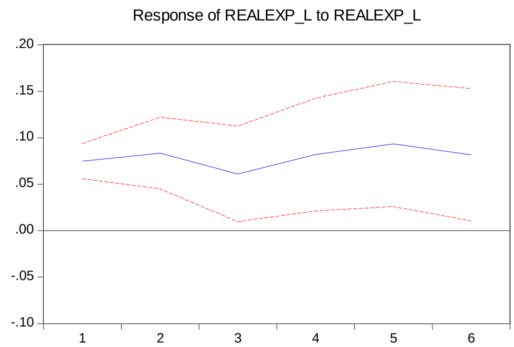


Figure 4.3.7

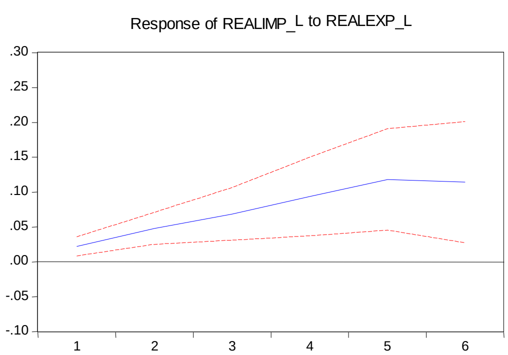
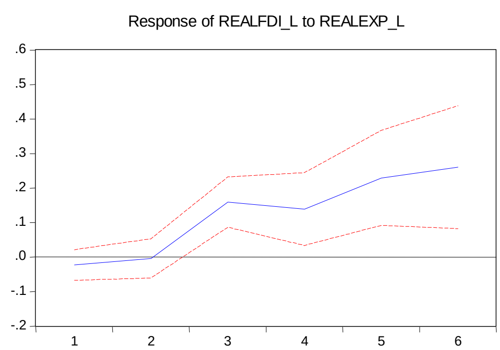


Figure 4.3.8



Figures 4.3.9 through Figure 4.3.12 show the responses of GDP, exports, imports and FDI to import shock. Import shocks have short-run positive effects on GDP, exports, and imports and FDI. In the first two years, import shock leads to an increase in GDP, exports and imports. Thereafter, the impacts of import shock on GDP as well as on exports and imports are

not statistically significant. Import shock has a positive effect on FDI only in the third year. For other years, the impact of import shock on FDI is not statistically significant.

Figure 4.3.9

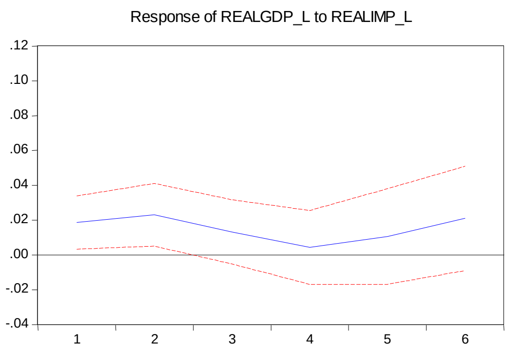


Figure 4.3.10

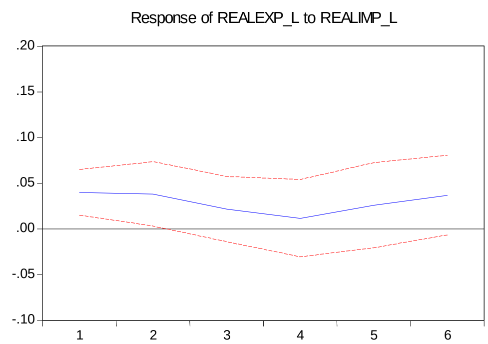


Figure 4.3.11

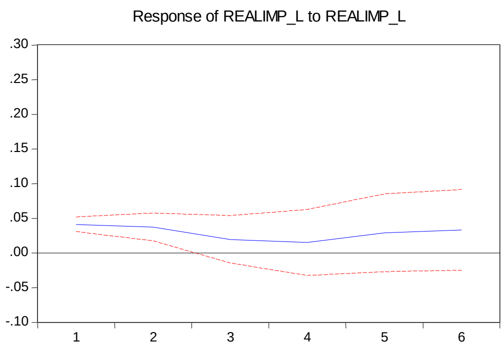
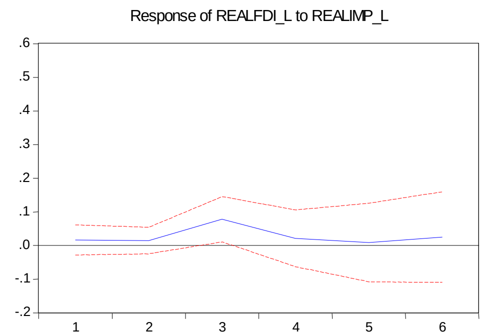


Figure 4.3.12



Looking at Figures 4.3.13 and 4.3.16, a shock to FDI has statistically insignificant effects on GDP, exports and imports. This is in conflict with the GCBEW test results. But, the shock to FDI has a short-run positive effect on FDI for the first two years. Thereafter, the impact of FDI shock on FDI is not statistically significant.

Figure 4.3.13

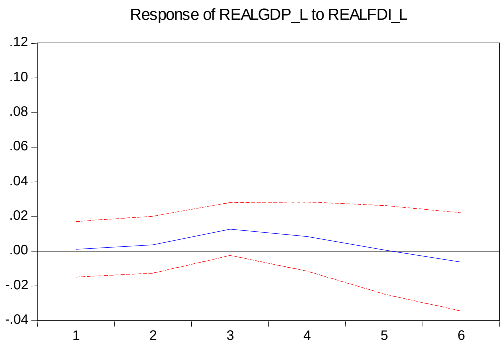


Figure 4.3.14

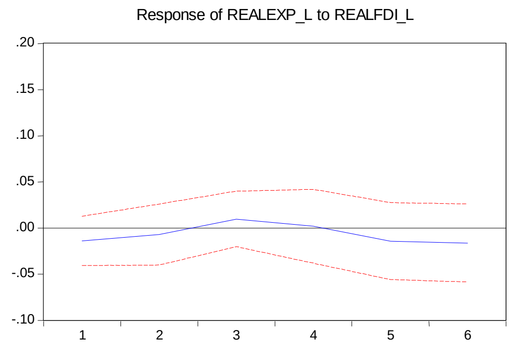


Figure 4.3.15

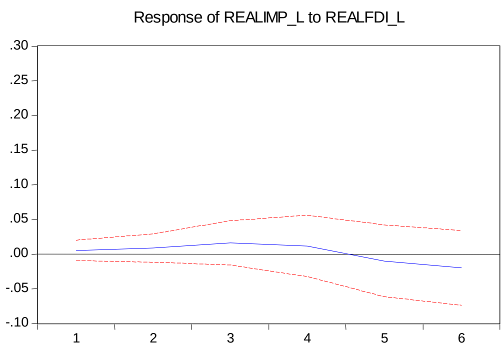
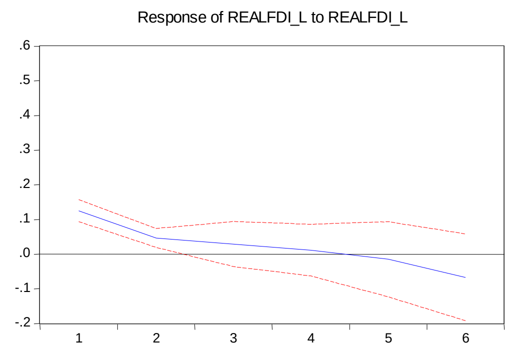


Figure 4.3.16



In summary, impulse response is mostly consistent with the GCBEW test, except for the impact of shock to FDI on GDP, exports and imports, and the impact of shock to GDP on exports. All significant impacts are positive. Based on analysis of the above estimated results and the performance of the Malaysia economic policy mentioned in section 4.4.3.1 and the accuracy of GCBEW test, I prefer the results from the GCBEW test.

Results from the GCBEW test are robust, since they are consistent with the economic facts of Malaysia from 1970 to 2004 (see Section 4.4.3.1). The misspecification in structuring the

VAR system makes the estimated results of Fung et al. (1994) different from my results. Fung et al. (1994) construct three variables in VAR based on three variables—exports, imports and GDP—and finds causality of GDP on exports, but I do not find evidence for this.

Table 4.11 reports the variance decomposition of each endogenous variable. This table contains four parts. The first part reports the variance decomposition of realGDP_L. The following parts present the variance decomposition of realexports_L, realimports_L and real FDI_L, respectively. In each part, there are six columns. The first column lists the time periods. The second column reports the standard error of the sample set. The remaining columns report the variance proportion of the shock to each variable in each time period. The number in the parenthesis reports the standard error of the coefficient of variance proportion.

Table 4.11: Variance Decomposition for Malaysia

Variance Decomposition of realGDP_L

Period	S.E.	REALEXP_L	REALGDP_L	REALIMP_L	REALFDI_L
1	0.044510	58.29825	41.70175	0.000000	0.000000
		(11.1220)	(11.1220)	(0.00000)	(0.00000)
2	0.060076	65.07595	33.77356	0.696485	0.454006
		(12.9930)	(12.5413)	(4.45809)	(0.70082)
3	0.069539	59.65168	36.51093	0.526018	3.311379
		(14.9958)	(14.1898)	(4.56535)	(2.19963)
4	0.083192	60.37793	27.19957	4.999343	7.423153
		(17.1632)	(15.0005)	(5.52887)	(3.92453)
5	0.105746	66.89622	16.83452	8.206329	8.062931
		(15.3455)	(13.9314)	(6.74347)	(3.85607)
6	0.126046	71.33686	14.38464	7.040865	7.237633
		(14.2664)	(12.9520)	(5.93970)	(3.54565)

Variance Decomposition of realexp_l

Period	S.E.	REALEXP_L	REALGDP_L	REALIMP_L	REALFDI_L
1	0.074821	100.0000	0.000000	0.000000	0.000000
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.112913	98.40425	0.460208	0.445332	0.690204
		(5.57647)	(3.47637)	(2.41383)	(0.83221)
3	0.132103	93.22448	2.117101	1.340131	3.318289
		(10.7244)	(6.41192)	(5.74238)	(2.57798)
4	0.162574	86.87339	1.525765	6.371994	5.228853
		(13.1734)	(8.79499)	(7.23310)	(3.58131)
5	0.192609	85.28043	3.320760	6.621013	4.777793
		(11.9220)	(8.78269)	(6.81159)	(3.30163)
6	0.215804	82.22300	8.088420	5.378865	4.309717
		(12.7645)	(10.4284)	(6.52262)	(2.93806)

Variance Decomposition of realimp_l

Period	S.E.	REALEXP_L	REALGDP_L	REALIMP_L	REALFDI_L
1	0.041315	28.64207	0.020316	71.33761	0.000000
		(13.5929)	(3.09017)	(13.2982)	(0.00000)
2	0.067397	61.41540	4.800254	30.98939	2.794949
		(11.9645)	(6.93608)	(11.0723)	(1.63977)
3	0.108082	64.28080	12.05942	15.78998	7.869790
		(13.7295)	(9.05271)	(6.83575)	(3.55625)
4	0.156624	66.39535	10.07907	14.72992	8.795664
		(15.9670)	(10.9640)	(7.97180)	(4.10882)
5	0.202545	73.75662	6.279328	12.77066	7.193393
		(14.3079)	(8.83909)	(8.69442)	(3.73181)
6	0.240906	74.60503	8.464300	10.80167	6.128996
		(13.5322)	(9.21920)	(8.61516)	(3.47272)

Variance Decomposition of realfdi_l

Period	S.E.	REALEXP_L	REALGDP_L	REALIMP_L	REALFDI_L
1	0.125165	3.452186	6.716352	7.153008	82.67845
		(7.33552)	(8.55318)	(8.18333)	(12.8071)
2	0.136942	2.962069	6.995421	8.116230	81.92628
		(7.43730)	(7.87631)	(8.84338)	(13.8846)
3	0.220332	53.45616	2.748089	3.287926	40.50783
		(13.1913)	(4.76177)	(5.13689)	(10.3520)
4	0.281224	57.28586	4.308757	6.899840	31.50554
		(13.5008)	(7.72989)	(6.07683)	(9.30283)
5	0.393450	63.33581	2.610052	15.37060	18.68353
		(14.1047)	(6.16625)	(9.14200)	(7.03473)
6	0.496962	67.13638	3.654766	16.88496	12.32390
		(13.7799)	(9.18469)	(9.94689)	(5.20484)

Looking at Table 4.11, the fluctuations of GDP are explained mainly by GDP shocks and export shocks, in the long run. GDP shock accounts for 41.7% in the first year. Its proportion in the variance of GDP decreases over time and reaches 15.75% in the sixth year. Export shock accounts for 58.29% in the first year. Its proportion increases over time and reaches 71.33% in the sixth year. Export shock, which is assumed to account for the whole variance of exports in the first year, continuously dominates in the following years. Its proportion decreases over time, but still accounts for 82.22% in the sixth year. In the long run, export shock is the most important source of imports variability. The role played by export shock increases over time and accounts for 74.6% in the sixth year. In addition, the fluctuation of imports is also explained by its shock. Import shock accounts for 71.33% in the first year and falls to 10.8% in the sixth year. The evidence suggests that FDI shock is the important factor explaining FDI variability. FDI shock accounts for 82.67%. Its proportion decreases over time and reaches 12.32% in the sixth year.

In summary, export shock is the most important source of shock to GDP and imports. Shocks to GDP, imports and exports are important sources of variability for themselves at first, but this self-effect diminishes for all variables except exports.

The estimated results from the Granger causality/ Block exogeneity test, the impulse-response function and variance decomposition confirm the exports-led growth hypothesis, imports-compression growth hypothesis and the intertemporal budget constraint hypothesis. The positive effect of trade liberalization results from positive effects of both imports and exports on economic growth.

4. 4.2.2 Korea

As with Malaysia, I construct a four-variable VAR system with four endogenous variables (realGDP_L, realexports_L, realimports_L and realFDI_L) and two exogenous variables (dummy98 and dummy01). The results from the test for lag length criteria, based on the four-variable VAR system with a maximum lag number of 5, is reported in Table 4.12. The lag order chosen by the LR test and the SC criterion is 1, (by the FPE criterion), 2, and, by the AIC and HQ criteria, 4.

Table 4.12: Test for Lag Length Criteria for Korea

Lag	LogL	LR	FPE	AIC	SC	HQ
0	11.70564	NA	1.21e-05	0.021805	0.597732	0.193058
1	128.4014	172.8827*	7.26e-09	-7.437143	-6.093312*	-7.037551
2	149.1957	24.64503	5.93e-09*	-7.792272	-5.680538	-7.164342
3	167.6133	16.37122	7.15e-09	-7.971355	-5.091718	-7.115088
4	188.9186	12.62539	1.07e-08	-8.364343	-4.716802	-7.279738
5	226.8587	11.24149	1.44e-08	-9.989531*	-5.574087	-8.676588*

Note:
(*) indicates the lag order selected by the criterion
LR: Sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC:Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hannan-Quinn Information Criterion

I run VAR with the lag order of 1, 2 and 5. For each lag order, I will apply the normality test and the LM test for VAR residuals. Since only a lag order of 2 satisfies both the normality test and the LM test, I choose a lag order of 2 as the appropriate order for the four-variable VAR system. The results of four-variable VAR with a lag order of 2 are reported in Table 4.13

Table 4.13: VAR Model of Korea with Lag of Two and Dummy Variables (1998 and 2001)

	REALGDP_L	REALEXP_L	REALIMP_L	REALFDI_L
REALGDP_L(-1)	1.023080	0.145202	-0.121273	-3.134711
	(0.25146)	(0.38365)	(0.30448)	(2.94745)
	[4.06848]	[0.37848]	[-0.39829]	[-1.06353]
REALGDP_L(-2)	-0.007714	-0.128993	0.191425	5.526554
	(0.24231)	(0.36968)	(0.29340)	(2.84015)
	[-0.03183]	[-0.34893]	[0.65244]	[1.94587]
REALEXP_L(-1)	0.828110	1.677445	0.736414	4.488236
	(0.18502)	(0.28228)	(0.22403)	(2.16870)
	[4.47567]	[5.94246]	[3.28706]	[2.06955]
REALEXP_L(-2)	-0.265466	-0.496184	-0.300288	2.980913
	(0.25078)	(0.38261)	(0.30366)	(2.93947)
	[-1.05854]	[-1.29685]	[-0.98890]	[1.01410]
REALIMP_L(-1)	-0.770692	-0.494140	0.615231	-2.608679
	(0.27335)	(0.41704)	(0.33098)	(3.20399)
	[-2.81941]	[-1.18488]	[1.85879]	[-0.81420]
REALIMP_L(-2)	0.181448	0.348080	-0.149837	-5.715754
	(0.30433)	(0.46430)	(0.36849)	(3.56708)
	[0.59622]	[0.74969]	[-0.40662]	[-1.60236]
REALFDI_L(-1)	0.000747	-0.014856	-0.006514	0.328179
	(0.02190)	(0.03342)	(0.02652)	(0.25674)
	[0.03413]	[-0.44457]	[-0.24560]	[1.27828]
REALFDI_L(-2)	0.001135	0.010671	0.028728	-0.320007
	(0.02076)	(0.03167)	(0.02514)	(0.24333)
	[0.05468]	[0.33691]	[1.14287]	[-1.31514]
C	0.240383	-0.986320	0.212286	-18.83481
	(1.18382)	(1.80608)	(1.43340)	(13.8756)
	[0.20306]	[-0.54611]	[0.14810]	[-1.35740]

DUMMY98	-0.515967	-0.186249	-0.525966	0.898778
	(0.06577)	(0.10033)	(0.07963)	(0.77084)
	[-7.84560]	[-1.85629]	[-6.60506]	[1.16597]
DUMMY01	-0.177022	-0.238609	-0.323665	-0.135480
	(0.07290)	(0.11121)	(0.08826)	(0.85442)
	[-2.42842]	[-2.14551]	[-3.66696]	[-0.15856]
R-squared	0.987374	0.976285	0.982264	0.841155
Adj. R-squared	0.980729	0.963804	0.972930	0.757553
Sum sq. resids	0.063088	0.146842	0.092494	8.667269
S.E. equation	0.057623	0.087912	0.069772	0.675405
F-statistic	148.5867	78.21949	105.2290	10.06138
Log likelihood	49.89827	37.22581	44.15896	-23.94350
Akaike AIC	-2.593218	-1.748387	-2.210598	2.329567
Schwarz SC	-2.079446	-1.234615	-1.696825	2.843339
Mean dependent	22.31521	21.21140	21.19537	16.52648
S.D. dependent	0.415093	0.462081	0.424067	1.371690

Determinant resid covariance (dof adj.)	1.66E-08
Determinant resid covariance	2.66E-09
Log likelihood	125.8843
Akaike information criterion	-5.458953
Schwarz criterion	-3.403863

The results from the VAR residual normality test and the VAR residual serial correlation LM test are reported in Table 4.14 and Table 4.15, respectively. By Table 4.14, we cannot reject the hypothesis of normality of properties, since P-values are 0.293, 0.267 and 0.218, for skewness, kurtosis and the Jarque-Bera test. Table 4.15 shows that we also cannot reject the null hypothesis of no autocorrelation up to lag 3, since P-values are 0.1305, 0.2684 and 0.6495 for lag orders 1, 2 and 3, respectively. Two tests support the contention that the assumptions of our model about white noise residuals are met.

Table 4.14: VAR Residual Normality Test for Korea

Component	Skewness	Chi-sq	Df	Prob.
1	-0.712472	2.538082	1	0.1111
2	0.659506	2.174739	1	0.1403
3	-0.327146	0.535121	1	0.4645
4	-0.226558	0.256643	1	0.6124
Joint		5.504585	4	0.2393
Component	Kurtosis	Chi-sq	Df	Prob.
1	4.901626	4.520226	1	0.0335
2	3.178346	0.039759	1	0.8420
3	2.444207	0.386132	1	0.5343
4	2.547986	0.255396	1	0.6133
Joint		5.201513	4	0.2672
Component	Jarque-Bera	df	Prob.	
1	7.058308	2	0.0293	
2	2.214498	2	0.3305	
3	0.921254	2	0.6309	
4	0.512039	2	0.7741	
Joint	10.70610	8	0.2189	

Table 4.15: VAR Residual Serial Correlation LM Test for Korea

Lags	LM-Stat	Prob
1	22.40837	0.1305
2	19.00505	0.2684
3	13.31700	0.6495

Probs from chi-square with 16 df.

The Johansen cointegration test results reported in Table 4.16 indicate that the four series are cointegrated and there is one cointegrating vector. Column 3 of the first part of Table 4.16 indicates that the value of λ_{TRACE} (1) = 19.893 is less than the critical value (29.797) at the 0.05 level, and therefore, we cannot reject the null hypothesis of $r \leq 1$ and reject the alternative hypothesis of more than two cointegrating vectors at the 0.05 level. Column 3 of the second part of Table 4.16 indicates that we cannot reject the null hypothesis r=1 against the specific alternative r=2 at the 0.05 level, because the value λ_{MAX}(1)= 17.294 is less than the 0.05 critical value of 21.131. This suggests that the number of cointegration vectors is 1.

Table 4.16: Johansen Cointegration Test with Optimal Lag Length of Three for Korea

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.652535	51.60650	47.85613	0.0213
At most 1	0.438136	19.89379	29.79707	0.4300
At most 2	0.049438	2.598905	15.49471	0.9821
At most 3	0.035290	1.077842	3.841466	0.2992

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.652535	31.71271	27.58434	0.0139
At most 1	0.438136	17.29488	21.13162	0.1585
At most 2	0.049438	1.521063	14.26460	0.9978
At most 3	0.035290	1.077842	3.841466	0.2992

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The GCBEW test reported in Table 4.17 suggests that the three variables realGDP_L, realimp_L and realFDI_L are not exogenous, since the P-values of the joint test for each equation of those variables are 0.000, 0.000, and 0.009, respectively. Exports are exogenous because we fail to reject the null hypothesis of excluding realGDP_l, real imp_l and realFDI_L from realexp_l at the 0.1 significance level, since chi-sq = 3.593 and P-value = 0.7315. This data implies that GDP, imports and FDI do not have causal on exports. We also fail to reject the null hypothesis of excluding realFDI_l from the realGDP_l equation and excluding realGDP_l and realFDI_l from the realimp_l equation.

Table 4.17: Granger Causality/Block Exogeneity Wald Test for Korea

Dependent variable: REALGDP_L			
Excluded	Chi-sq	df	Prob.
REALEXP_L	22.91372	2	0.0000
REALIMP_L	11.49603	2	0.0032
REALFDI_L	0.004291	2	0.9979
All	59.62624	6	0.0000
Dependent variable: REALEXP_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	0.144426	2	0.9303
REALIMP_L	1.413775	2	0.4932
REALFDI_L	0.300981	2	0.8603
All	3.593115	6	0.7315
Dependent variable: REALIMP_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	0.559915	2	0.7558
REALEXP_L	11.79093	2	0.0028
REALFDI_L	1.348383	2	0.5096
All	33.77495	6	0.0000
Dependent variable: REALFDI_L			
Excluded	Chi-sq	df	Prob.
REALGDP_L	5.617262	2	0.0603
REALEXP_L	10.98645	2	0.0041
REALIMP_L	9.695391	2	0.0078
All	16.98314	6	0.0093

This test provides some evidence that there are causalities from imports and exports on GDP; from exports on imports; from GDP, exports and imports on FDI. These findings are different from prior studies, such as Fung et al. (1994), Mahadevan et al. (2008) and Kim et al. (2009). While Fung et al. (1994) find the evidence of causality of GDP on exports, of GDP on exports and of imports on exports for Korea, my results reject these causalities. Kim et al. (2009) do not find causality of exports on GDP or of exports on imports for Korea, but I find evidence of this causality. However, my results and those of Kim et al. (2009) both find that Korean exports are exogenous. This is different from Mahadevan et al. (2008) who report that imports are exogenous in the case of Korea. The difference between my results and the results of the prior studies can be explained by the absence of FDI in their VAR model or by invalidity of the VAR system. My results are consistent with Korean economic policy (see Section 4.4.3.2).

As mentioned in section 4.3.6.1, because the estimated results from GIR are not consistent with those from the GCBEW test, we use OIR and change the prior ordering of the endogenous variables. Exports are not affected by any other variables, and thus exports are placed first in the ordering of the list. GDP is considered a target variable, and thus it is placed at the end of the ordering of the list. The magnitude of FDI is higher than that of imports, since FDI is affected by exports, imports and GDP, while imports are affected only by exports. For this reason, FDI is placed after imports in the ordering of the list. Thus, the ordering of variables in my VAR system is as follows: exports, imports, FDI and GDP. The estimated results from OIR (as mentioned below) are consistent with those from the GCBEW test with this ordering of variables, confirming the robustness of this ordering.

Figure 4.4 exhibits the Cholesky asymptotic impulse response function. It includes 16 small figures which are denoted Figure 4.4.1, Figure 4.4.2 . . . Figure 4.4.16. Each small figure illustrates the dynamic response of each target variable (realGDP_L, realexports_L, realimports_L and realFDI_L) to a one-standard-deviation shock on itself and other variables. In each small figure, the horizontal axis presents the six years following the shock. The vertical axis measures the yearly impact of the shock on each endogenous variable.

Figure 4.4.1 presents a short-run positive effect of GDP shock on GDP. Figures 4.4.2 through 4.4.4 show that GDP shocks do not have effects on exports, imports and FDI. Figures 4.4.5 through 4.7.7 suggest that, in the long run, export shocks have positive significant impacts on GDP, imports, and GDP itself. Under export shock, FDI increases little in the first and second years. Thereafter, the impact of export shock on FDI turns out to be insignificant (Figure 4.4.8).

Figure 4.4.1

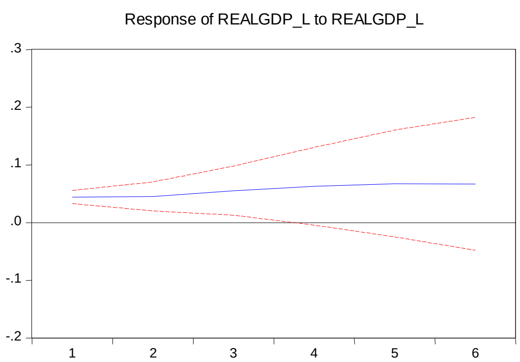


Figure 4.4.2

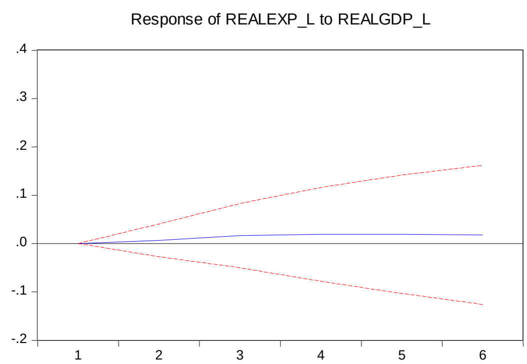


Figure 4.4.3

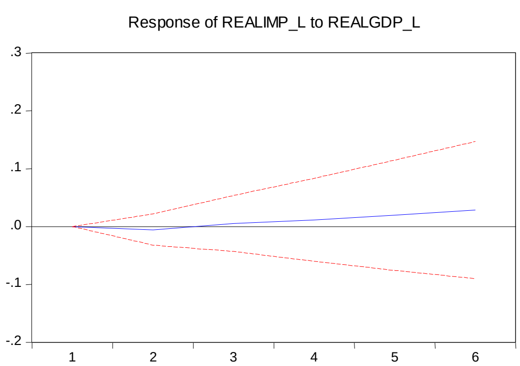


Figure 4.4.4

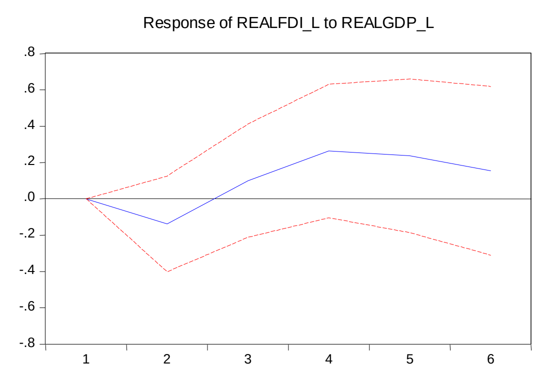


Figure 4.4.5

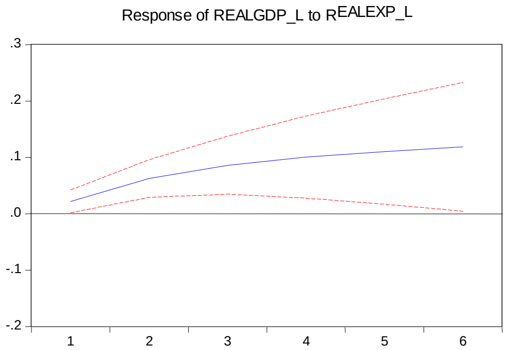


Figure 4.4.6

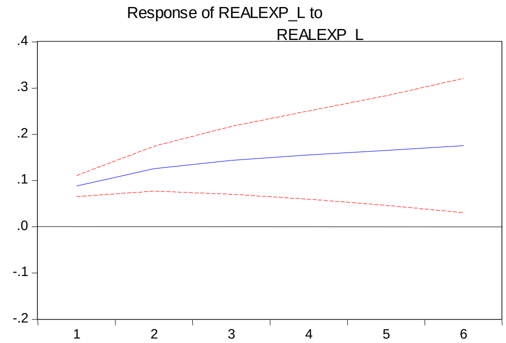


Figure 4.4.7

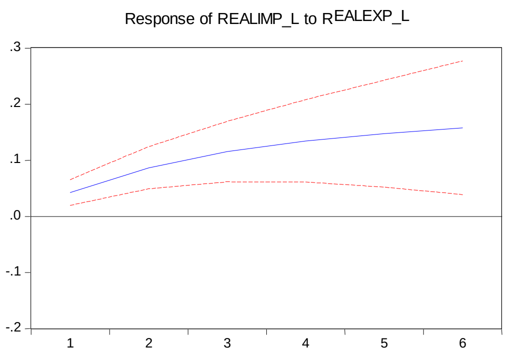


Figure 4.4.8

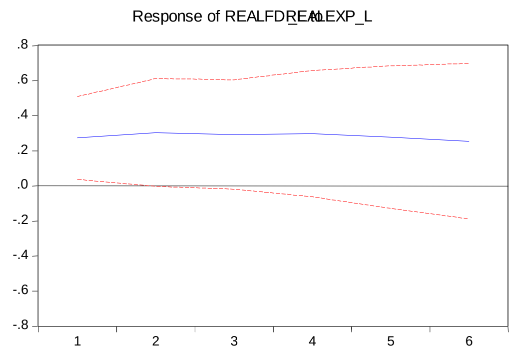


Figure 4.4.9 shows that import shock has a short-run positive effect on GDP at the beginning. Thereafter, this impact seems to be insignificant in the second year, and turns out to be negative in the third year. Finally, this impact becomes insignificant in the fifth year. There is no impact of import shock on exports in Figure 4.4.10. Figure 4.4.11 shows that import shock has a short-run positive effect on imports in the first and second years. After that, the impact is not significant. Import shock does not have an effect on FDI at the beginning. The impact of import shock on FDI turns out to be negative in the second, third and fourth years, and then becomes insignificant (Figure 4.4.12).

Figure 4.4.9

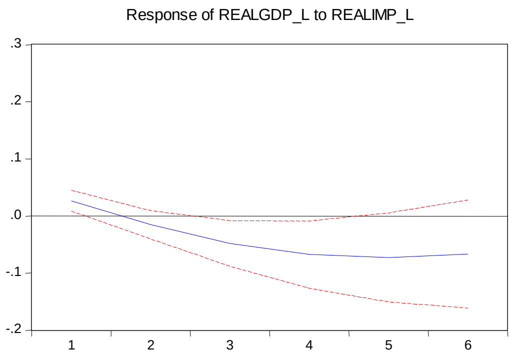


Figure 4.4.10

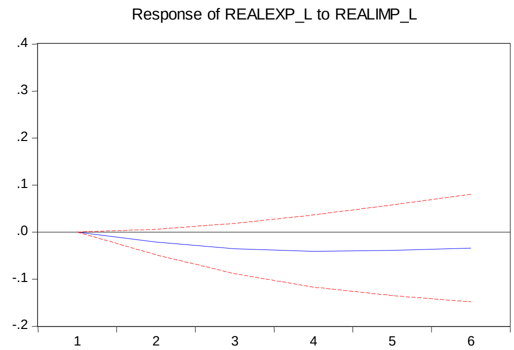


Figure 4.4.11

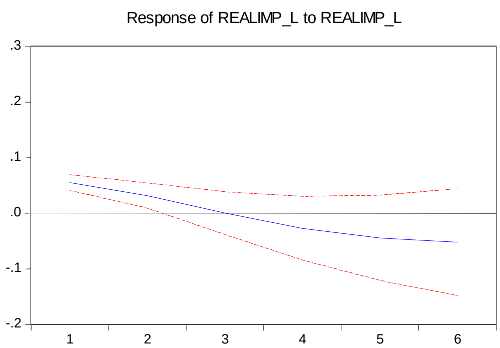
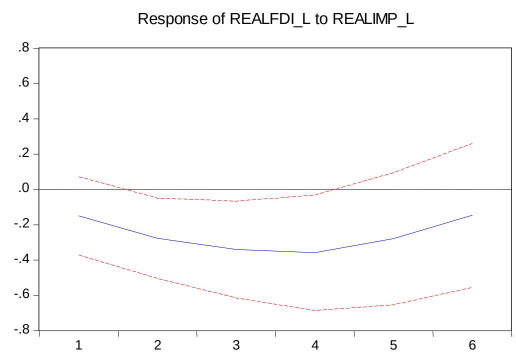


Figure 4.4.12



Looking at Figures 4.4.13 – 4.4.15, FDI shock is statistically insignificant in its effect on GDP, exports and imports. But, it has a short-run positive effect on FDI for the first two years. Thereafter, the impact of FDI shock on FDI is not statistically significant (Figure 4.4.16).

Figure 4.4.13

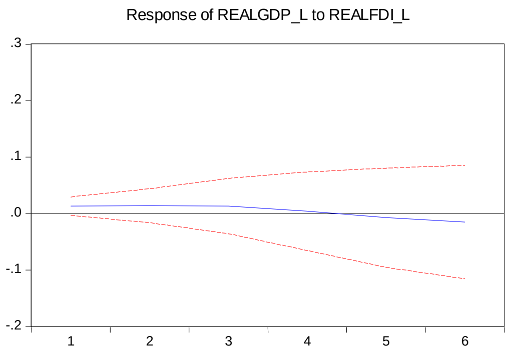


Figure 4.4.14

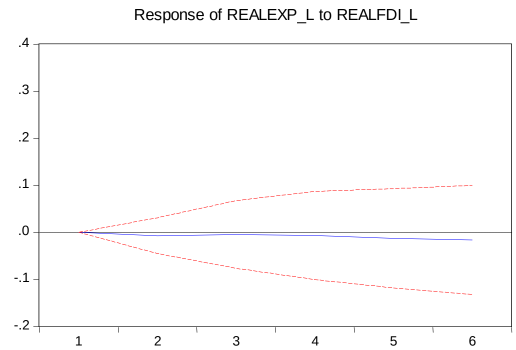


Figure 4.4.15

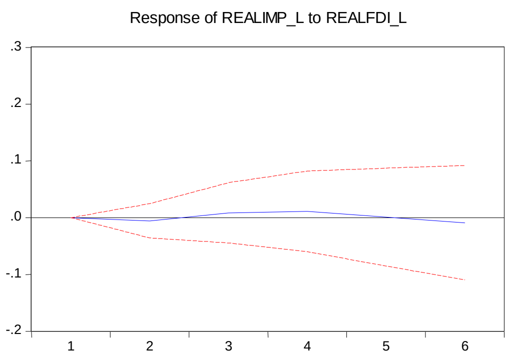
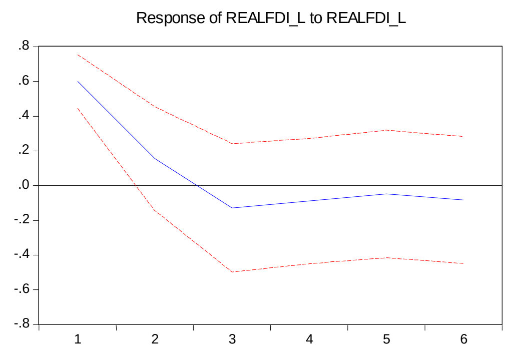


Figure 4.4.16



In summary, impulse response results are mostly consistent with the GCBEW test, except for the impact of GDP shock on FDI. There is a short-run negative effect of imports on GDP and FDI. The impact from exports on FDI and imports is positive. Exports are not affected by GDP, imports and FDI, which also differs from the Malaysian results.

Looking at Table 4.18, the fluctuations of GDP are explained mainly by GDP and export shocks. GDP shock accounts for 58.9% at the first year. Its proportion in the variance of GDP decreases over time and reaches 23.5% in the sixth year. Export shock accounts for 14.37% in the first year. Its proportion increases over time and reaches 55.51% in the sixth year. Export shock, which is assumed to account for the whole variance of exports in the first year, continuously dominates for the following years. Its proportion decreases over time but still accounts for 94.132% in the sixth year. Export shock is the most important source of import variability. The role played by export shock increases over time and accounts for 88.66% in the sixth year. In addition, the fluctuation in imports is also explained by import shock. Import shock accounts for 62.6% in the first year, falls to 15.1% in the third year and is not significant thereafter. FDI variability is due to FDI and export shocks. FDI shock accounts for 78.67% in the first year. Its proportion decreases over time and reaches 27.37% in the sixth year. Export shock is an important source of the variability of FDI. It accounts for 16.38% in the first year, and then increases over time and reaches 31.78% in the sixth year.

In summary, export shock is the most important source of effects on GDP, imports and also FDI. Shocks to GDP, imports and exports are also an important source of their own variability.

Table 4.18: Variance Decomposition for Korea

Variance Decomposition of realGDP_l

Period	S.E.	REALEXP_L	REALIMP_L	REALFDI_L	REALGDP_L
1	0.057623	14.37624	21.47465	5.185356	58.96375
		(13.3902)	(12.8812)	(5.06982)	(13.0743)
2	0.098492	45.15806	9.776402	3.758596	41.30694
		(15.9700)	(6.59574)	(5.37893)	(11.7953)
3	0.150483	51.93426	14.45985	2.394616	31.21128
		(18.1753)	(10.1176)	(5.61814)	(11.6293)
4	0.203151	52.91728	19.00384	1.354684	26.72420
		(21.0164)	(13.3413)	(6.37415)	(12.5086)
5	0.251680	53.65105	20.72171	0.969634	24.65761
		(23.6061)	(15.2541)	(7.16959)	(13.9573)
6	0.294294	55.51130	20.27906	0.974179	23.23546
		(25.4916)	(16.5155)	(7.93036)	(15.2886)

Variance Decomposition of realexp_l

Period	S.E.	REALEXP_L	REALIMP_L	REALFDI_L	REALGDP_L
1	0.087912	100.0000	0.000000	0.000000	0.000000
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.154972	97.75755	1.866846	0.203730	0.171877
		(5.87234)	(3.30693)	(2.59127)	(2.11274)
3	0.214860	95.53514	3.643932	0.152108	0.668822
		(11.6416)	(6.03718)	(5.62998)	(5.12109)
4	0.268790	94.33288	4.582398	0.158640	0.926087
		(15.5993)	(7.49658)	(7.62594)	(7.59332)
5	0.318477	93.96773	4.745874	0.269073	1.017319
		(18.2492)	(8.69080)	(8.72860)	(9.67019)
6	0.366074	94.13246	4.456714	0.400873	1.009949
		(20.1654)	(9.90842)	(9.35261)	(11.2609)

Variance Decomposition of realimp_l

Period	S.E.	REALEXP_L	REALIMP_L	REALFDI_L	REALGDP_L
1	0.069772	37.39146	62.60854	0.000000	0.000000
		(14.5798)	(14.5798)	(0.00000)	(0.00000)
2	0.115864	69.36945	30.19124	0.224812	0.214490
		(13.0188)	(12.2330)	(3.08541)	(2.41567)
3	0.163803	84.30055	15.10539	0.381512	0.212545
		(10.9766)	(8.48179)	(3.96507)	(3.69005)
4	0.214234	88.67431	10.42153	0.491330	0.412829
		(12.0321)	(7.32764)	(5.47868)	(5.17732)
5	0.264432	89.21776	9.645542	0.323847	0.812852
		(14.5487)	(8.24416)	(7.09742)	(6.83071)
6	0.313771	88.66792	9.623179	0.310414	1.398484
		(17.1925)	(9.76825)	(8.31776)	(8.48733)

Variance Decomposition of realfdi_l

Period	S.E.	REALEXP_L	REALIMP_L	REALFDI_L	REALGDP_L
1	0.675405	16.38801	4.933555	78.67843	0.000000
		(13.1526)	(9.18030)	(13.3483)	(0.00000)
2	0.817935	25.03464	14.82932	57.26041	2.875632
		(14.3157)	(11.2778)	(13.5534)	(5.57388)
3	0.947295	28.23029	23.97675	44.53591	3.257054
		(14.9717)	(12.3132)	(12.2491)	(6.50668)
4	1.091878	28.68329	28.85665	34.19319	8.266871
		(16.0531)	(13.3380)	(11.6244)	(8.60620)
5	1.185697	29.82354	30.02594	29.16363	10.98689
		(17.1086)	(14.1043)	(11.6183)	(11.1519)
6	1.234119	31.78338	29.13199	27.37955	11.70509
		(17.6951)	(14.0199)	(11.0690)	(12.6004)

The estimated results from the Granger causality/Block exogeneity test, the impulse response test and variance decomposition demonstrate the export-led growth hypothesis. There is causality of imports on GDP, but this impact is weak. We cannot give any conclusion about the impact of trade liberalization on economic growth in the case of Korea.

The differences in estimated results between Korea and Malaysia ask for explanationa. Section 4.4.3 will map the economic policies of Korea and Malaysia onto the results of the Granger causality/Block exogeneity test, the impulse response-function and variance decomposition.

4.4.3. Analysis, Comparison and Explanation of the Differences in the Estimated Results from Malaysia and Korea

The differences in the estimated results from Malaysia and from Korea are due to differences between the two countries' economic policies. The most fundamental differences arise from the governments' visions of the role of FDI at the times these data were collected. The Malaysian government considered FDI to be the country's leading industrialization program (Jomo, 2003, p.100), whereas South Korea built an integrated national economy based on the lead role of the "chaebol" (Kim, 1998, p. 81).

This section consists of two parts. The first part explains the estimated results through an analysis of Malaysian economic policy. The second part explains the estimated result through an analysis of Korean economic policy and points out the differences between the two countries.

4.4.3.1 Malaysia

Malaysia shifted from an import-substitution policy to an export-oriented policy in 1968 (Jomo, 2003, p. 36). In 1977, the policy substantially accelerated, when the government stimulated exports using tools such as insurance, credit-refinancing schemes, devaluation of the ringgit, and other methods (Jomo, 2003, p.49). From the 1970s on, the government considered the export-oriented policy to be the most important long-term policy for developing Malaysia's economy. Indeed, the success of this policy supports my finding that exports have had a positive effect on Malaysian economic growth. Table 4.19 shows that Malaysia's export share of GDP increased from 41.4% in 1970 to 110.2% in 2007. The average export growth rate and the average economic growth rate were 9.39% and 6.67%, respectively, from 1970 – 2007 (Table 4.19). In the economic and financial crisis, a heavy decrease in export growth rate led to a decrease in the GDP growth rate. Table 4.19 also reports the GDP export share, the export growth rate, and the GDP growth rate of Malaysia from 1970 to 2007. For example, in the 1974–75 oil crises, the export growth rate fell from 15.9% (1974) to -3% (1975), which partly led to a decrease in the GDP growth rate from 8.3% (1974) to 0.8% (1975). The 1998 Asian financial crisis caused the export growth rate to fall from 9.2% (1996) to 0.5% (1998), which led to a decrease in GDP growth rate from 10% (1996) to -7.4% (1998). These facts are consistent with one-way causality of exports on economic growth.

To promote exports, the Malaysia government exempted an import tax on intermediate input—capital goods—that were used for export production or import-substitution industries. Therefore, in Malaysia, imports of intermediate goods and capital goods promoted export manufacture and domestic production. In other words, imports had a causal relationship with exports and GDP. The export value of Malaysia increased from 1.17 billion USD in 1970 to 114 billion USD in 2004 (Table 4.19), and provided a foreign exchange source for reimporting intermediate input, capital goods, and consumption goods. One can see that the Malaysian import value also increased from 1.6 billion USD in 1970 to 119 billion USD in 2004 (Worldbank Dataset - WDI). In 2004, the intermediate goods and equipment for export manufacturing had not yet been produced by domestic industries, and thus the country still had to import. Therefore, an increase in GDP asks for increase in imports of intermediate goods and capital goods. These facts are consistent with the estimated results from Granger Causalities, that exports and imports as well as imports and GDP in Malaysia have two-way causalities.

Table 4.19: Export Share on GDP and Export Growth Rate of Malaysia, 1970-2007 (%)

Year	**Export Share on GDP**	**Export Growth Rate**	**GDP Growth Rate**	**Year**	**Export Share on GDP**	**Export Growth Rate**	**GDP Growth Rate**
YR1970	13.6	19.6	8.3	YR1989	30.8	-4	6.7
YR1971	15	21.7	8.2	YR1990	28	4.5	9.2
YR1972	19.4	37.2	4.5	YR1991	26.3	11.1	9.4
YR1973	28.7	56	12.0	YR1992	26.6	12.2	5.9
YR1974	26.7	-1.9	7.2	YR1993	26.5	12.2	6.1
YR1975	26.9	18.7	5.9	YR1994	26.6	16.3	8.5
YR1976	30	39.5	10.6	YR1995	28.8	24.4	9.2
YR1977	30.4	21.6	10.0	YR1996	27.9	12.2	7.0
YR1978	28.4	14.2	9.3	YR1997	32.4	21.6	4.7
YR1979	26.6	2	6.8	YR1998	46.2	12.7	-6.9
YR1980	32.1	8.2	-1.5	YR1999	39.1	14.6	9.5
YR1981	34.3	16	6.2	YR2000	38.6		
YR1982	33.2	8.2	7.3	YR2001	35.7	-3.4	4.0
YR1983	33	14.3	10.8	YR2002	33.1	12.1	7.2
YR1984	33.4	8.2	8.1	YR2003	35.4	14.5	2.8
YR1985	32	4.2	6.8	YR2004	40.9	19.7	4.6
YR1986	35.6	26.8	10.6	YR2005	39.3	7.8	4.0
YR1987	38.3	21.8	11.1	YR2006	39.7	11.4	5.2
YR1988	36.4	11.7	10.6	YR2007	41.9	12.6	5.1
				Average	31.5	15.1	6.9

Sources: World Bank, WDI.

Nearly three times larger than Korea, at 748 sq km, Malaysia has rich natural resources (Data source: U.S. Department of State) and primary goods (raw material and agricultural plants) as main export goods in the early stage of the export-oriented policy (Jomo, 2003, p. 28). Since the 1980s, resource-processing exports have fallen, and exports of manufacturing goods have increased significantly. Table 4.20 illustrates the changes in Malaysia's export structures from 1970 to 1995. In 1968, exports of metal accounted for 65.8%; however, in 1995, those exports fell to just 2.5 %. Exports of electronics accounted for only 0.7% in 1968, but have increased to 67.5% in 1995, and are dominated by foreign capital.

Table 4.20: The Component of Malaysian Exports on Manufacturing, 1970-1995 (%)

Industries	**1968**	**1973**	**1980**	**1985**	**1990**	**1995**
Food	17.5	19.6	5.7	6.2	3.8	1.8
Beverages and tobacco	0.9	2.9	0.3	0.2	0.2	0.3
Textile, clothing and footwear	1.4	6.1	10.5	11.9	8.8	4.6
Wood	3.4	9.7	5.7	3.2	3.4	4.4
Chemicals	3.0	5.2	2.0	3.8	2.9	4.0
Rubber	0.9	1.7	1.0	1.0	3.0	2.3
Non-metallic mineral	0.8	1.1	0.7	1.1	1.7	1.2
Iron and steel	0.5	1.9	0.4	1.2	1.4	0.9
Other metals	65.8	43.3	31.5	2.0	2.2	2.5
Machinery	2.5	3.8	2.6	5.8	8.1	7.0
Electrical machinery	0.7	2.1	32.8	51.4	50.5	67.5
Transport equipment	2.6	2.7	2.6	5.0	4.3	3.7
Other manufactures	NA	NA	4.2	7.2	9.7	NA
Total	100.0	100.0	100.0	100.0	100.0	100.0

Sources: UNCTAD (as cited in Jomo, 2003, p. 53)

According to Jomo (2003), foreign investment accounts for most manufacturing export sectors of Malaysia (Jomo, 2003, p. 41), not just in the electronics industry, and foreign investment policy is tightly related to the export-oriented policy. Attracting FDI is the goal of promoting exports (Jomo, 2003, p. 28). In the 1970s and 1980s, the Malaysian government established ten Free Trade Zones (FTZs), which provided government infrastructure subsidies. Foreign firm or joint-venture companies located in the FTZs received pioneer status (PS), such as a ten-year tax exemption. The export share of FTZ firms in total manufacturing exports increased from 1% in 1972 to 75% in 1979 (Jomo, 2003, p. 97). In the 1980s, the Malaysia government enacted the new Promotion Investment Act, intended to promote exports by relaxing regulation of ownership of foreign capital firms. This law allowed 100% foreign-owned firms, if they exported more than 80% of their manufactured products (Jomo, 2003, p. 99). The above examples are consistent with the fact that in Malaysia, FDI and exports have had two-way causalities.

As in the above analysis, FDI goes into Malaysia to enjoy pioneer status, no import tax on intermediate goods and also capital goods. Foreign firms, therefore, have higher added value than domestic firms, because they can import intermediate goods from their country with lower prices and no import taxes. This shows that imports lead to push up FDI. In contrast, a higher FDI demands higher imports of intermediate goods and capital goods. In other words, Malaysian imports and FDI have a two-way causality.

Among second tiger ASEAN countries (Malaysia, Indonesia, Thailand and the Philippines), Malaysia is the leader in attracting FDI. Foreign investment accounts for most manufacturing export sectors of Malaysia, while the country's domestic investment only focuses on resource-based industries such as palm oil or timber products. FDI in Malaysia plays a leading role in high technology. The new Promotion Investment Act in the 1980s attracted FDI with high technology products. A foreign firm received pioneer status if it satisfied four criteria: a 30-50% value added; a 20-50% local content level, a high technological level and an FDI contribution to l of Malaysia's industrial structure (Jomo, 2003, p. 100). In the 1990s, Malaysia continued to promote high technology through FDI activities. The Malaysian government enacted the second industrial plan, which increased the technological level and the value added of the assembly-dominated export industries by encouraging investment in the production component, design and R&D, as well as in trading, marketing and local brand development. An FDI project was awarded pioneer status if it satisfied three criteria: 30% or more value added, 15% local managerial, technical, or supervisory personnel, and a contribution level to Malaysia's industrial structure (Jomo, 2003, p. 100). FDI is preferred in high technology industries such as computers, LCDs (liquid crystal displays), medical equipment, bio-technology, automation equipment, advanced material, electronics, software, alternative energy and aerospace. In summary, FDI increased productivity through promoting technology and innovation, which then increased GDP. In contrast, when productivity increased, the cost per unit will decrease. This turns out to automatically lure FDI. This fact is consistent with two-way causality between FDI and Malaysian economic growth.

4.4.3.2. Korea

Korea is a smaller area, but has a larger population (48.63 million, which is nearly twice that of Malaysia) and poorer natural resources than Malaysia (data source: U.S. Department). Therefore, the Korean government chose their Growth-Industry Outward-Oriented strategy (GIO) (Song, 2003, p.113).

In the 1960s, Korea lacked foreign exchange, due to a decrease in US aid (Cho, 1994, p.153). Therefore, an export-oriented policy was central in their attempt to improve the payment imbalance. To promote exports, the Korean government provided tools, such as loans with low interests, permission in importing intermediate goods for export manufacturing and rewards for successful exporters. In the first five year plan (1960-1965), the export growth rate reached 44%

(Cho, 1994, p.147), which was higher than the export growth rate of Malaysia in the same period.

At the beginning of the export-oriented policy, Korea was different from Malaysia. While in the 1960s, exports of primary goods dominated the export goods of Malaysia, exports of manufacturing goods accounted for two-thirds of the total Korean export goods. Labor-intensive manufacturing goods accounted for 70% of total export-manufacturing goods (Cho, 1994, p.147). While Malaysia has continued to consider export orientation as its leading policy, from the 1960s to the present, Korea realized that maximizing exports was not always a good policy, and made an adjustment in economic strategy. Hence, the Korean export share of GDP increased from 13.6% in 1970 to 32.1% in the 1980s (Table 4.21), and was then kept around 30%–40% up to the present. However, the Malaysian export share of GDP increased continuously from 41.4% in 1970 to 110.2% in 2007 and had a high average level of 74.5% (Table 4.21).

Since the 1960s, Korea has realized that the value added of export-manufacturing industry was low because intermediate goods and capital goods were imported (Cho, 1994, p.147) and therefore immediately inaugurated a change in its economic development strategy. In the 1970s, Korea focused on developing heavy industries and a chemical industry, for exports through “chaebol”. Successful industrialization of Korea was represented by a change in the structure of export goods. The proportion of heavy industry exports, in total, increased from 14.2% in 1971 to 60.4% in 1992. Table 4.22 shows that the proportion of light industry products in total exports fell from 72.1% in 1971 to 32.4% in 1992. South Korea obtained a large market share for exporting ships and is a large exporter of automobiles, after the US, Japan and Western countries (Kim, 1998, p. 81). Industrialization success has enabled Korea to leave Malaysia behind. Due to lack of success in industrialization, the economic structure of Malaysia is unbalanced. Light industries dominate the Malaysia economy. Heavy industries are not developed.

Table 4.21: Export Share on GDP and Export Growth Rate of Korea, 1970 - 2007 (%)

Year	**Export Share on GDP**	**Export Growth Rate**	**GDP Growth Rate**	**Year**	**Export Share on GDP**	**Export Growth Rate**	**GDP Growth Rate**
YR1970	41.4	5	6.0	YR1989	71.4	15.2	9.1
YR1971	38.2	1.6	5.8	YR1990	74.5	17.8	9.0
YR1972	34	2	9.4	YR1991	77.8	15.8	9.5
YR1973	39.2	14.2	11.7	YR1992	76	12.6	8.9
YR1974	45.6	15.9	8.3	YR1993	78.9	11.5	9.9
YR1975	43	-3	0.8	YR1994	89.2	21.9	9.2
YR1976	48.9	17	11.6	YR1995	94.1	19	9.8
YR1977	47.4	4.2	7.8	YR1996	91.6	9.2	10.0
YR1978	48.3	7.6	6.7	YR1997	93.3	5.5	7.3
YR1979	55.2	18	9.3	YR1998	115.7	0.5	-7.4
YR1980	56.7	3.2	7.4	YR1999	121.3	13.2	6.1
YR1981	51.6	-0.8	6.9	YR2000	119.8	16.1	8.9
YR1982	50.1	10.7	5.9	YR2001	110.4	-6.8	0.5
YR1983	50.4	12.3	6.3	YR2002	108.3	5.4	5.4
YR1984	53.5	13.8	7.8	YR2003	106.9	5.1	5.8
YR1985	54.1	0.4	-1.1	YR2004	115.4	16.1	6.8
YR1986	55.5	11.8	1.2	YR2005	117.5	8.3	5.3
YR1987	62.9	14.6	5.4	YR2006	116.7	7	5.8
YR1988	66.4	10.9	9.9	YR2007	110.2	4.2	6.3
				average	74.5	9.4	6.7

Sources: World Bank, WDI.

In spite of the fact that export-oriented policy was not as appreciated in Korea as in Malaysia, the average Korean export growth rate from 1970 to 2007 was still 15.1% (Table 4.21), which is higher than the average Malaysian exports growth rate in the same period. The contribution of exports to Korean economic growth is not as great as in Malaysia, but the role of exports in Korean economic growth is still substantial. Therefore, the Korean economic model confirms the causality of exports on GDP.

Table 4.22: The Component of Korean Exports, 1971 - 1992 (%)

Year	**Manufacture Goods**		**Nonmanufacture Goods**
	Light Industry	**Heavy Industry**	
1971	72.1	14.2	13.7
1972	66.6	21.3	12.1
1973	63.4	23.8	12.8
1974	54.1	32.5	13.4
1975	57.4	25.0	17.6
1976	59.0	29.2	11.8
1977	53.6	32.2	14.2
1978	54.5	34.7	10.8
1979	51.4	38.5	10.1
1980	49.4	41.5	9.1
1981	49.4	41.6	9.0
1982	45.0	46.9	8.1
1983	41.1	50.6	8.3
1984	39.5	52.5	8.0
1985	38.6	53.4	8.0
1986	44.0	48.4	7.6
1987	43.8	49.1	7.1
1988	41.8	52.1	6.1
1989	42.0	52.2	5.8
1990	41.1	53.6	5.3
1991	37.8	56.1	6.1
1992	32.4	60.4	7.2

Sources: Korea Foreign Trade Association, the Statistics of Foreign Trade (as cited in Cho, 1994, p. 146)

In the 1980s, to expand exports, the Korean government created 12 General Trading Companies (GTCs) (Cho, 1994, p.150) from the largest firms, which satisfied some government criteria and gained cost advantages from economies of scale. The GCTs were successful in expanding exports and the companies became the leaders in Korean exports. The export share of GTCs in total exports in 1985 was 51.3% (Cho, 1994, p. 43). A characteristic of GCTs was that import volume was very small and the GCT import share on the total import of Korea was only 8.3% (Cho, 1994, p. 43). This showed that promoting Korean exports did not require an import increase as in Malaysian's economic model. In other words, in the Korean economic model, there was no causality of imports on exports—except at the beginning of the export-orientation policy in the 1960s. To promote GCT activities, the Korean government provided special benefits, such as low interest rates, priority on the foreign exchange, financial supports and others, if GCTs exceeded export goals. A GCT could borrow foreign capital with a low interest rate (Cho, 1994, p. 44); thus it did not use FDI to finance its activity, because it was afraid of losing market share. This explains why FDI did not promote exports in Korea and why there was no causality of FDI on Korean exports. In summary, exports become exogenous in that they do not depend on imports, FDI or, of course, GDP.

Success in export-oriented industrialization (EOI) led to an improvement in the Korean payment balance, as well as in firm and individual profits. Higher profits led to higher reinvestment in production, hence to an increase in imports of inputs. On the other hand, increases in individual income led to increased consumption spending, hence to increased importation of consumption goods. Therefore, an increase in exports led to an increase in imports; this explains the causality of exports on imports in the Korean economic model.

As mentioned above, in the 1960s, the Korean government provided export incentives, such as no import taxes on intermediate goods and capital goods, in order to promote export-oriented industrialization. In spite of that, there were still barriers to imports such as special laws, foreign exchange regulation, export obligation and import quotas (Cho, 1994, p.153-154).

However, imports increased considerably, from 22 million in 1967 to 68 million in 1968 (World Bank, WDI). In the 1970s, the government gave priority to imports in order to promote industrialization in the heavy and chemical industries. Therefore, imports of intermediate goods and capital promoted exports and GDP. Table 4.23 shows the increase in the import proportion of input to total imports of Korea, from 79.3.3% in 1971 to 89.0% in 1982. On the other word, imports have causal relationship with GDP. However, in the 1960s and 1970s, the effective rate of protection was very high, due to low tariffs on primary goods and high tariffs on consumption goods (Cho, 1994, p.156).

The big difference between the Malaysian and Korean economic systems was the role of FDI. The Malaysia government considered FDI to be the leading industrialization program, while the role of FDI was not promoted in Korea, where the government chose the leading role. The Korean average share of FDI in GDP was 0. 5 %, while the Malaysian average share of FDI in GDP was 4% from 1976 to 2007. According to Tcha and Suh (2003), FDI was not a good match with the size of the Korean economy (p. 300). The share of FDI in gross domestic investment was very small compared with that of Malaysia. From 1976–1980, they were 0.4 and 10.5 for Korea and Malaysia, respectively. From 1991–1993, they were 0.6 and 24.6 for Korea and Malaysia, respectively (Table 4.24). Due to a very small contribution of FDI to domestic investment and industrialization in Korea, FDI inflows into the country did not cause economic growth from 1970–2007. This is consistent with the results from the Granger causality/Block exogeneity test.

Table 4.23: The Component of Imports of Korea, 1971 – 1992 (%)

Year	Food and Consumption Goods	Industrial Supplies	Capital Goods
1971	21.0	50.6	28.4
1972	18.5	51.6	29.9
1973	18.3	55.0	26.7
1974	15.4	57.7	27.0
1975	16.2	57.2	26.5
1976	12.0	60.5	27.5
1977	10.9	61.4	27.7
1978	10.6	55.6	33.8
1979	11.5	57.5	31.1
1980	12.1	65.0	23.0
1981	14.2	62.2	23.6
1982	10.2	64.1	25.7
1983	10.7	59.5	29.8
1984	9.5	57.5	33.0
1985	8.5	55.9	35.6
1986	9.8	54.2	36.0
1987	9.7	54.8	35.5
1988	9.8	53.5	36.8
1989	10.2	53.3	36.4
1990	10.0	53.6	36.5
1991	11.2	52.2	36.6
1992	10.5	52.1	37.4

Source: Korea Foreign Trade Association, The Statistics of Foreign Trade (as cited in Cho, 1994, p. 148)

Table 4.24: The Share of FDI in Gross Domestic Investment, 1977 - 1993 (%)

	1971-75	**1976-80**	**1981-85**	**1986-90**	**1991-93**
Korea	1.9	0.4	0.5	1.3	0.6
Malaysia	15.2	10.5	10.8	10.5	24.6

Source: UNCTAD (as cited in Jomo, 2003, p. 24)

Before the financial crisis, the role of FDI was not recognized by the Korean government. It gave no incentives to attract FDI, due to fear that a foreign company would dominate the market. On the other hand, as mentioned above, the domestic firms did not have any incentive to use FDI because they could receive a government benefits to borrow foreign capital with low interest rates.

The 1997 Asian financial crisis changed the Korean government notions about FDI and it was forced by the IMF to make some changes in FDI regulation. “Economic and financial crisis in Korea is necessary evil” (Tcha and Suh, 2003, p. 300) because thanks to the crisis, the Korean government realized the role of FDI in economic growth. By comparison, the Malaysian economy, which is based on FDI, can confront the economic crisis without interference from the IMF (Tcha and Suh, 2003, p. 300). Since 1998, the Korean government has carried out a series of activities to attract FDI, such as enacting a foreign investment promotion act, establishing a Korean trade investment and promotion agency (KOTRA), establishing six sophisticated free-investment zones (FIZs) to provide tax priority, infrastructure support and low rate of utilities. The government also established a Korean investment service center to help foreign investors obtain investment licenses, foreign land ownership and cross-border mergers and acquisitions (Tcha and Suh, 2003, p. 300 and p. 156). Therefore, in 1999, FDI reached a maximum of U.S. $9333.4 million and continued high in 2000. In the 2001 U.S. crisis, FDI inflows into Korea were down to $3525 million. FDI in Korea improved after 2001 and reached a high in 2004 (U.S. $9246.2 million). In 2007, Korean FDI decreased to U.S. $1578.8 million due to the U.S. financial crisis (Table 4.25). In general, the future Korean FDI trend will increase.

Table 4.25: FDI inflows in Korea and Malaysia (USD million)

Year	Korea		Malaysia	
	FDI Share on GDP (%)	FDI Inflows (Million USD)	FDI Share on GDP (%)	FDI Inflows (Million USD)
1976	0.27	81	3.24	381.3
1977	0.25	94	2.90	405.9
1978	0.17	89	3.00	500.0
1979	0.05	35	2.65	573.5
1980	0.01	6	3.75	933.9
1981	0.14	102	4.97	1264.7
1982	0.09	69	5.12	1397.2
1983	0.08	68.5	4.11	1260.5
1984	0.12	110.2	2.31	797.5
1985	0.24	233.5	2.19	694.7
1986	0.41	459.6	1.73	488.9
1987	0.44	616.3	1.31	422.7
1988	0.54	1014.1	2.04	719.4
1989	0.49	1117.8	4.29	1667.9
1990	0.30	788.5	5.30	2332.5
1991	0.38	1179.8	8.14	3998.4
1992	0.22	728.3	8.76	5183.4
1993	0.16	588.1	7.48	5005.6
1994	0.19	809	5.83	4341.8
1995	0.34	1775.8	4.70	4178.2
1996	0.42	2325.4	5.04	5078.4
1997	0.55	2844.2	5.13	5136.5
1998	1.57	5412.3	3.00	2163.4
1999	2.10	9333.4	4.92	3895.3
2000	1.74	9283.4	4.04	3787.6
2001	0.70	3527.7	0.60	553.9
2002	0.42	2392.3	3.18	3203.4
2003	0.55	3525.5	2.24	2473.2
2004	1.28	9246.2	3.71	4624.2
2005	0.75	6308.5	2.87	3966.0
2006	0.38	3586.4	3.88	6063.6
2007	0.15	1578.8	4.53	8455.6
Average	0.5	2166.6	4.0	2685.9

Sources: World Bank, WDI.

In spite of the rapid increase in FDI from 1997 to 2007, the proportion of FDI in Korean domestic investment is still small. On the other hand, successful Korean industrialization has provided import-substitution goods with high technology and reasonable prices, including intermediate input and equipment and machinery for domestic production, which can be seen in Table 4.23. In spite of the FDI's increase six times from 1984 – 1992, the proportion of imported capital goods in total Korean imports increased only 2% in the same period (Table 4.23). This shows that an increase in FDI does not seem to cause an increase in imports. In addition, when productivity increases, production cost per unit reduces, which is an important factor in attracting FDI. Therefore, an increase in productivity or in GDP will increase FDI. Finally, FDI in export-manufacturing industries will be higher than others since FDI projects in those industries will receive pioneer status. This explains the causality of exports on FDI.

4.5. CONCLUSION

This chapter applies the four-variable VAR model, which is constructed from four endogenous variables—the logarithm of real GDP, the logarithm of real exports, the logarithm of real imports and the logarithm of FDI—in order to observe the integrated relationship between trade, FDI and economic growth for Malaysia and Korea during the time period from 1970 to 2004 (Malaysia) and from 1976 to 2007 (Korea).

The estimated results suggest that the four variables are cointegrated for both Malaysia and Korea. Exports are a long-run source of both Malaysian and Korean economic growth. The exports-led growth hypothesis, imports-compression growth hypothesis and intertemporal budget constraint hypothesis are confirmed in the case of Malaysia, but only the exports-led growth hypothesis and the intertemporal budget constrain hypothesis are found in the case of Korea.

For Malaysia, there is evidence to support two-way causalities between each couple among the four variables, except for the absence of causality of GDP on exports. All causalities have positive signs. For Korea, there is one-way causality of exports, imports and GDP on FDI, of exports and imports on GDP, and of exports on imports. Only causalities of exports on GDP and FDI, of GDP on FDI and of exports on imports have positive signs. Exports are not affected by the three other variables. Trade liberalization has a positive effect on Malaysian economic growth. The causality from trade liberalization on economic growth can be seen through export channel.

The difference in the estimated results is explained by the difference in the economic policies of the two countries. Both countries have implemented export-oriented industrialization, but while the Malaysian government has given the role of leading industrialization to FDI, the Korea government has built an integrated national economy, thanks to the industrial conglomerate chaebol stucture, and has not strongly promoted the role of FDI.

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APPENDIX

Appendix a: The Relative Weight of Social Welfare in the U.S. Government's Objectives

Goldberg and Maggi (1999) show that

$$\gamma = \frac{-\alpha_L}{\frac{\beta}{1-\beta} + \alpha_L} \quad \text{(A.1)}$$

,

$$\delta = \frac{1}{\frac{\beta}{1-\beta} + \alpha_L} \quad \text{(A.2)}$$

where γ is the coefficient on (z/e) and δ is coefficient on [PAC*(z/e)] in the ERP equation.

Divide γ by δ, and we have

$$\frac{\gamma}{\delta} = -\alpha_L \,. \quad \text{(A.3)}$$

Plug (2.3) into (2.2), and we have

$$\delta = \frac{1}{\frac{\beta}{1-\beta} - \frac{\gamma}{\delta}} \quad \rightarrow \delta\left(\frac{\beta}{1-\beta}\right) - \delta\left(\frac{\gamma}{\delta}\right) = 1 \quad \rightarrow \delta\left(\frac{\beta}{1-\beta}\right) - \gamma = 1$$

$$\rightarrow \delta\left(\frac{\beta}{1-\beta}\right) = 1 + \gamma \quad \rightarrow \delta\beta = (1+\gamma)(1-\beta) \quad \rightarrow \delta\beta = 1 + \gamma - \beta - \gamma\beta$$

$$\rightarrow 1 + \gamma = \beta + \gamma\beta + \delta\beta = \beta(1 + \gamma + \delta)$$

$$\rightarrow \beta = \frac{1+\gamma}{1+\gamma+\delta} \quad \text{(A.4)}$$

Appendix B: The Delta Method and Its Application to Calculating the Standard Error of β

Based on the Two-Variable Taylor Series Expansion, any functions f(x, y) can be written in the form:

$$f(x,y) = f(x_0 . y_0) + \left.\frac{\partial f(x,y)}{\partial x}\right|_{(x_0,y_0)} (x - x_0) + \left.\frac{\partial f(x,y)}{\partial y}\right|_{(x_0,y_0)} (y - y_0) + \ldots \qquad \text{(B.1)}$$

Therefore, β can be displayed under the form:

$$\beta(\gamma,\delta) = \beta(\gamma_0,\delta_0) + \left.\frac{\partial \beta(\gamma,\delta)}{\partial \gamma}\right|_{(\gamma_0,\beta_0)} (\gamma - \gamma_0) + \left.\frac{\partial \beta(\gamma,\delta)}{\partial \delta}\right|_{(\gamma_0,\delta_0)} (\delta - \delta_0) + \ldots \qquad \text{(B.2)}$$

$$\beta = \frac{1+\gamma}{1+\gamma+\delta}$$

$$\beta(\gamma_0,\delta_0) = \frac{1+\gamma_0}{1+\gamma_0+\delta_0} = C_0$$

$$\frac{\partial \beta(\gamma,\delta)}{\partial \gamma} = \frac{\delta}{(1+\gamma+\delta)^2} \qquad \text{(B.3)}$$

$$\left.\frac{\partial \beta(\gamma,\delta)}{\partial \gamma}\right|_{(\gamma_0,\beta_0)} = \frac{\delta_0}{(1+\gamma_0+\delta_0)^2} = C_1$$

$$\frac{\partial \beta(\gamma,\delta)}{\partial \delta} = -\frac{(1+\gamma)}{(1+\gamma+\delta)^2} \qquad \text{(B.4)}$$

$$\left.\frac{\partial \beta(\gamma,\delta)}{\partial \delta}\right|_{(\gamma_0,\beta_0)} = -\frac{1+\gamma_0}{(1+\gamma_0+\delta_0)^2} = C_2$$

$$\beta(\gamma,\delta) = C_0 + C_1(\gamma-\gamma_0) + C_2(\delta-\delta_0) + \ldots \qquad \text{(B.5)}$$

$$Var(\beta) = C_1^{\,2} Var(\gamma) + C_2^{\,2} Var(\delta) + 2C_1C_2Cov(\gamma,\delta) \qquad \text{(B.6)}$$

γ_0	$-1.555305\ 10^{-3}$
δ_0	$8.216\ 10^{-3}$
var(γ)	$0.515287\ 10^{-6}$
var(δ)	$15.6435\ 10^{-6}$
cov(γ, δ)	$-2.75303\ 10^{-6}$
C1	0.008107635
C2	-0.985275741

Plug the above value into the equation (2.10), we have Var (β) = $1.52302\ 10^{-5}$. Therefore, the standard error of β is $3.902593\ 10^{-3}$.