UNIVERSITY OF SOUTHAMPTON

FACULTY OF LAW, ARTS & SOCIAL SCIENCES

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Issues in International Economics: An Empirical Study on the Sustainability, External Debt and Reserves Management.

by

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ABSTRACT

FACULTY OF LAW, ARTS & SOCIAL SCIENCES
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ISSUES IN INTERNATIONAL ECONOMICS: AN EMPIRICAL STUDY ON THE SUSTAINABILITY, EXTERNAL DEBT AND RESERVES MANAGEMENT

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This thesis consists of three essays related to balance of payment or the external sector issues. These three essays include an analysis of a country's current account and fiscal sustainability position, the role of external debt in economic growth, and the reserves and debt management.

The main intention of the first essay (comprising Chapter 2) is to analyze the sustainability of the current account and fiscal position for high, middle and low income countries. This empirical analysis makes use of various panel unit root and cointegration tests, as well as fixed and random effects estimators. The results indicate that there is evidence of current account sustainability only for high-income countries indicating that the intertemporal budget constraints are being maintained. In contrast, the middle-income and low-income countries are found to be in an unsustainable current account position. In addition, this paper also finds that all groups of countries have a slow phase of convergence towards equilibrium which suggests that all countries are vulnerable to any sudden shock or stop. Besides that, there is evidence of sustainability on fiscal policy for the high and middle groups of countries.

Chapter 3 investigates the issue of whether external debt contributes to expansion in economic growth. This chapter attempts to answer this question by analyzing 31 developing countries over a period of 36 years (1970-2005). The results reveal that the accumulation of external debt is associated with a slowdown in the economies of the developing countries. Besides this, we find evidence that debt service ratio does not crowd out the investment rate in developing countries. In other words, even though the external debt is negatively associated with economic growth, countries are found to be safe from being in the debt overhang hypothesis. However, the negative effect could be interpreted as the main symptom of a country before it becomes involved in the debt overhang problem. In addition, fiscal balance,

government revenue, openness, and domestic credits are found to have a positive effect on investment and, to a lesser extent, economic growth. Furthermore, there is evidence to support the existence of spatial dependence in the growth model, suggesting the existence of positive spillover effect of growth among the neighbouring countries. This suggests that countries are found to have positive correlation with their neighbours' economic growth.

The main analytical contribution of the final chapter, which is chapter 4, is to analyze the cost of jointly holding reserves and sovereign debt decision. By analyzing the impact of holding reserves and sovereign debt on sovereign credit ratings, this provides the evidence of the costs of holding reserves and debt with respect to credit risk. As predicted by theory, the international reserves-holding is associated with good sovereign credit ratings as well as lower credit risk while the sovereign debt-holding leads to a lower sovereign credit rating and high credit risk. This implies that reducing (repaying) their sovereign debts is the best decision for countries to keep and maintain a good credit risk reputation. Meanwhile, the benefit of holding reserves has crowded out the cost of holding short-term debt, resulting in a net positive effect on sovereign ratings. This could imply that a country should hold more reserves with regard to the level of short-term debt which is a highly vulnerable liability for a country. The results reveal that the adequate level of international reserves in month of imports is slightly higher than with the conventional rule which at 3 month of imports.

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List of Abbreviations

ARDL	Autoregressive Distributed Lag
BOP	Balance of Payment
CIA	Central Intelligence Agency
FE	Fixed Effect
GDF	Global Development Finance
GMM	Generalized Method of Moments
IMF	International Monetary Fund
HIPC	Heavily Indebted Poor Countries
IV	Instrumental Variables
LDC	Least Developed Countries
MG	Mean Group
OECD	Organization of Economics and Co-Operation Development
OLS	Ordinary Least Squares
PMG	Pooled Mean Group
PVBC	Present Value Borrowing Constraint
RE	Random Effect
SEM	Spatial Error Model
SAR	Spatial Autoregressive Model
WDI	World Development Indicator

Declaration of Authorship

I, **Siti Nurazira Mohd Daud**

Declare that the thesis entitled

ISSUES IN INTERNATIONAL ECONOMICS: AN EMPIRICAL STUDY ON THE SUSTAINABILITY, EXTERNAL DEBT AND RESERVES MANAGEMENT

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this university;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this university or any other institutions, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- None of this work has been published before submission.

Signed:.....

Date:……

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Chapter 1

Introduction

The exposition of the law of comparative advantages by John Stuart Mill has provided the rational for country to interact with the rest of the world. In addition, with the international differences in productive resources and consumer preferences, the economic activities become wider, not only limited to international trade but also through investment and migration. As the number of transactions increases, a systematic record that recorded a transaction between resident of one country with the rest of the world has been introduced. Balance of payments (BOP) is a summary statement for all international transactions for a country during a specific period of time. In particular, the BOP records a nation's financial transactions with the rest of the world, which consist of exchange of goods and services, and income that involves financial claims on, and liabilities to the rest of the world (International Monetary Fund [IMF], 1993). In addition, gifts and transfers, which are payments not made, are also recorded. In other words, the BOP statement reflects country's external position. The balance of payment is divided into two major accounts: current accounts and capital (financial) accounts.[1]

According to IMF (1993), the linkages between the key aggregate of accounts of the total economy and balance of payment flows are as follows

$$GDP = C + I + G + (X - M) \tag{1.1}$$

where the X-M is a balance on goods and services in the balance of payments, C is private consumption expenditure, I is gross domestic investments, G is government consumption expenditure, X is the exports of goods and services, M is the imports of goods and services and GDP is the gross domestic product. Meanwhile,

[1] The current account measures exports and imports of goods and services, net investment income and net transfers. Meanwhile, the capital or financial accounts cover the portfolio investments, direct investments and other investments for both assets and liabilities position.

$$CAB = X - M + NY + NCT \quad (1.2)$$

$$GNDY = C + I + G + CAB \quad (1.3)$$

$$GNDY - C - G = S \quad (1.4)$$

$$S = I + CAB \quad (1.5)$$

$$S - I = CAB \quad (1.6)$$

$$S - I + NKT - NPNNA = CAB + NKT - NPNNA = NFI \quad (1.7)$$

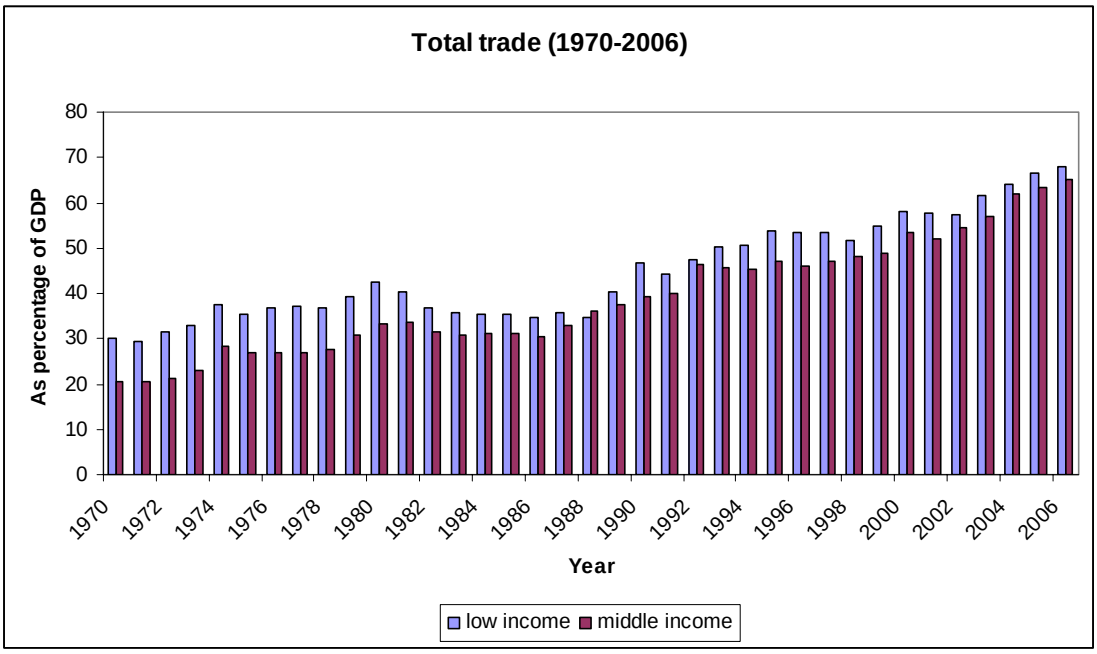
where NKT-NPNNA is a balance on the capital account of the balance of payments, CAB is the current account balance in the balance of payments, NY is net income from abroad, NCT is net current transfers, GNDY is gross national disposable income, S is gross savings, NKT is net capital transfer, NPNNA is net purchases of non-produced, non-financial assets, and NFI is net foreign investment or net lending/net borrowing with or to the rest of the world.

In addition, in the era of globalization where countries are interdependent with each other, the external sector plays an important role in helping to boost a country's economic growth. Furthermore, some developing countries such Malaysia, Greece, Thailand and Hungary nowadays are depending largely on international trade to generate economic growth. Figure 1.1 shows the pattern of trade as percentage of GDP for developing countries over the period 1970 to 2007. It shows that the total trade (comprised exports and imports of goods and services) has recorded an increasing pattern which suggests that the role of trade in developing countries economy has been increasing year by year. Furthermore, this could also have been interpreted as a higher degree of openness for the developing countries to the rest of the world from the period 1990 onwards. In addition, the role of foreign direct investments, which is a part of capital accounts, complements the contribution of the external sector to a country's economy. In other words, this could explain the importance and significant effect played by the external sector in the economy. Thus, despites focusing from the domestic economy point of view, an attempt to explore the external sector activity could provide a value-added to the frontier of knowledge that is useful for policy formulation.

As such, this thesis aims to analyze and investigate the most debatable and important issues concerning international economics or balance of payment, which include the

sustainability of current account (chapter 2), the role of external debt (chapter 3) and reserves and debt management issues (chapter 4).

Figure 1.1
The pattern of trade by developing countries



Source: World Development Indicator (WDI), World Bank

Based on standard neo-classical economic theory, capital-scarce countries should borrow abroad to finance domestic investment. In particular, governments borrow abroad to smooth domestic consumption or to undertake investment projects that could not have been financed by domestic capital. There have been widespread debates about the impact of high capital mobility in the era of globalization. Some stylized fact claims that countries with low mobility in capital could reduce their exposure to any macroeconomics vulnerability and shocks in the international capital market. China and India were the examples of countries that survived the substantial currency crisis and contagion effects during the 1997 financial crisis (Stiglitz, 2002). Thus, high capital mobility has contributed to macroeconomic vulnerability in the economy. In contrast, restriction of capital mobility is ineffective for the private sector in helping to boost domestic investment. Furthermore, the flexibility of exchange rate management and a sound financial system are more important than capital controls in protecting the economy from external shocks and fluctuations in the availability of

international capital (Cowan and De Gregorio, 2005). As such, any nation contemplating embracing free capital mobility must reckon with the possible cost and the probability of running into crisis (Bhagwati, 1998).[2]

External debt, one of the main important capital sources, is defined as a long-term and short-tem debt, in the public and private sectors, which is owed by a country to non-residents. Based on the CIA fact books (as at end June 2007), the United States ranks as the country with the highest level of outstanding external debt. With USD$ 10, 450 million of outstanding external debt, the United Kingdom ranks second, while Germany and 7 other highly developed countries monopolize the top of the list of countries with external indebtedness. China, South Korea and India, the three 'catching-up' economies rank at 21, 22 and 28 respectively. This development could explain the fact that neither developed, nor developing countries are immune from the capital-scarcity problem.

Meanwhile, a country that has borrowed is obligated to repay the principal and interest payment on time with respect to the terms and conditions in the contract. However, as explained by capital market imperfection, there is no effective mechanism to ensure that the borrower is not in default to the lender. The legal enforceability of sovereign debt contracts is very limited (Sandleris, 2008). Unlike in the case of firms or companies, there is no legal procedure that could prosecute a country for being classified and obligated to the law as bankrupt.[3] However, even with a high level of indebtedness where debt service could "crowd-out" investment, producing, to a lesser extent, stagnant or declining economic growth, most of the developing countries have tried their best not to default. Why would a government formulate policy with the aim of avoiding being in default and repaying their sovereign debt when there are no strings attached to the borrowing?

The incident of default could incur or impose reputational costs such as exclusion from the international capital market for future borrowing, international trade

[2] Bhagwati (1998) refers to the possible cost as the loss of political independence as well as selling domestic assets which are undervalued during the credit crunch.

[3] As such, this experience has given a lesson to the developed countries for not giving lending or capital investment, which resulted in less capital flow to the most developing countries. This phenomenon could be related to the Lucas paradox, where the flow of capital does not flow to the poor countries. For further review, please refer to Lucas (1990).

exclusion costs, costs to the domestic economy through the financial system and political costs to the authorities (Borensztein and Panizza, 2008). A novel work by Bulow and Rogoff (1989) has highlighted that lending to small countries must be supported by direct sanctions rather than a country's reputation for repayment. In addition, debt repayment has been used as a signalling device to reveal the ability of the government to positively affect the fundamentals of the economy (Sandleris, 2008). Thus it is important for a country to know the prudent and manageable level of external borrowing since this could relate to the probability of the country's to default. On the other hand, analysis of the probability of default (with a level of indebtedness and other economic fundamentals) is important for providing early warning signals of crisis.

However, determining the probability of default is not an easy task, as the notion of default is related to complex definitions and understandings by different researchers and institutions. In general terms, default is defined as the situation where the debtor has not met their obligation or by a precise failure to repay loans. However, there is no specific definition of default that has been agreed among the players in the market. Standard & Poor's defines default as the failure to meet a principal or interest payment on the due date. This could be interpreted as an occurrence of accumulated arrears on the principal and interest payment at any time. Meanwhile, according to Eaton and Gersovitz (1980), the event episode could be defined as the incidence of a rescheduling of principal or interest payment on existing debt contracts. As such, the definition for the default incidence is still ambiguous which makes the study of direct probability of default difficult to analyze.

On the other hand, the currency crisis in the 90s experienced by East Asian and Latin America countries has resulted in a new approach for macroeconomic policy in developing emerging economies in particular. As a result, it has led to the new policy objectives to reduce vulnerability to external shocks and lower the likelihood of external crises through policy formulation on maintaining public and external debt at manageable levels as well as accumulation of international reserves as a self-insurance mechanism (Edwards, 2007). This recommended policy could be seen as an effort to reduce the probability of a country being in default, from an external position point of view.

Apart from this fact, this thesis tries to examine further details on the probability of a country being in default with the country external position. Despite the difficulties which arise in determining and establishing the default definition, this thesis has tried to investigate from other perspectives on country sustainability and solvency position.

This thesis consists of three main chapters, analyzing the issues on balance of payment (external position) that is related to the assessment of probability of a country being in a default condition. Chapter 2 provides evidence on the sustainability of current account and fiscal position for developed and developing countries. The study in Chapter 3 analyzes the contribution of external borrowing to economic growth. Chapter 4 investigates the cost of jointly deciding on holding international reserves and sovereign indebtedness to the economy.

Chapter 2 investigates the sustainability of the current account and fiscal policy positions for developed and developing countries. The sustainability of the current account position is closely linked with the sustainability of external debt. It is also related to the ability of a country to repay its debt and accumulate savings (or reserves) for precautionary purposes such as sudden shocks. Continually financing large current account imbalances will lead to an increasing debt burden, perhaps undermining solvency, which may lead to external vulnerability from a liquidity perspective. Furthermore, a large current account deficit may cause a shift in investor confidence and a reversal of international capital flows as investors fear loans will not be repaid (Holman, 2001). In addition, these deficits tend to increase domestic interest rates relative to their foreign counterparts, while simultaneously imposing an excessive burden on future generations, who will have to pay back high amounts of accumulated external debt, thus lowering their standard of living.

On the other hand, fiscal sustainability reveals the government's effort to maintain strong momentum in economic growth. Despite a vast and growing amount of literature on current account and fiscal policy sustainability, particularly for developed countries, the literature on developing countries is more limited (Ghatak, 2007). With the growth in the literature for developed countries, any attempt to

investigate the sustainability of the developing countries might be feasible since this group also faces a high risk of vulnerability in the economy.

The objective of this chapter is to re-examine the sustainability position of developing and developed countries in their intertemporal budget constraint by using a panel study approach. Furthermore, the analysis will investigate two major aspects of sustainability which are current account and fiscal policy position. Finally, analysis on fiscal sustainability through public debt position using the model proposed by Bohn (1998) will be examined from a different point of view on sustainability.

The contribution of this chapter is the extension of the analysis to developing and developed countries using a panel study approach. In addition, this chapter tries to investigate several major aspects of sustainability, particularly current account and fiscal policy analysis. Thus, the evidence presented in this study will contribute an extra dimension to the earlier literature on the topic. In particular, estimation of the sustainability models is conducted by using recent panel cointegration pooled mean group heterogeneous (PMG), proposed by Pesaran, Shin and Smith (1999), and panel cointegration to detect potential multiple structural break, proposed by Westerlund (2006). In addition, several other panel estimations techniques, particularly fixed effects, have also been considered.

In chapter 3, issues related to the increasing level of external indebtedness have raised the concern of whether the external borrowing helps to boost domestic investment and capital accumulation as well as economic growth or whether it could become a burden that needs to be paid for by future generations. An analysis of the effect and relationship between external debt and economic growth could give us some intuition into whether countries have been benefited by external borrowing over the past 20 years. In contrast, this could also give a signal about the effectiveness of debt management policies in the developing countries. In other words, with regard to the findings of this chapter, governments could formulate policies that could prevent countries from being in default or in a debt-overhang situation.

The aims of this chapter are to analyze the debt-growth nexus, particularly the debt-growth and the debt-investment relationship. This could provide evidence on the

"disincentive effects" of high debts, due to the debt-overhang and to macroeconomic instability, as well as the liquidity constraint which could refer to the adverse effect of debt service on investment and growth. This chapter is also concerned with the importance of considering spatial dependence among developing countries in the growth model.

This analysis is important since any results found from the linkages between the external borrowing and economic growth would be useful for policy formulation. In this case, debt could boost or be an impediment to the economic growth. Besides that, this study could give an indirect signal to creditors, regarding a country's ability to service its debt in the future.

This chapter is distinct from other research in several aspects. Firstly, this chapter contributes to the small but growing empirical literature on debt-growth nexus. Furthermore, this analysis provides a more detailed examination of whether the relationship between debt and growth is robust for all the developing countries in the sample. This chapter also investigates the existence of the debt-Laffer curve relationship (a positive relationship becomes a negative effect after reaching a certain threshold). Thirdly, this is the first attempt to analyze the relationship of the debt-growth nexus by using a spatial correlation approach. Moreover, no empirical study has been carried out to determine whether location matters for the debt-growth model. An analysis of the contribution of external debt to economic growth from a panel spatial econometric approach rather than a cross-sectional or time series (country specific) analysis could provide a valuable contribution to existing empirical studies. Thus, this study attempts to fill this gap in the literature.

The main analytical contribution of chapter 4 is to analyze the cost of the joint decision of maintaining international reserves holdings and sovereign indebtedness for developing countries. In the era of financial globalization, where financial markets are integrated, countries are faced with the high probability of being more exposed to international financial market vulnerability. As such, the hoarding of international reserves could relate to the self-protection motive against sudden shocks. Besides that, an increase of international reserve holdings could also be interpreted as a mercantilist

motive, where a country accumulates international reserves to keep its currency low and to enjoy competitive prices in exports, thus leading to a trade surplus position.

On the other hand, a country simultaneously borrows from abroad to get external sources of capital to boost the domestic economy. With an accumulation of international reserves this could reduce the probability of the country repaying its sovereign debt and is highly associated with the probability of default. As a result, this may lead to the country being excluded from the international capital market and losing access to future borrowings. Even though reserves accumulation may reduce sustainable debt level, international reserves-holding is associated with the consumption-smoothing they allow in case the country defaults.

However, reserve holdings and a reduced amount of outstanding debt are not perfect substitutes even though reserves-holding reduces the amount of sustainable debt, or increases debt services for a given level of debt (Alfaro and Kanczuk, 2009). Thus, with a stockpile cushion of international reserves and liability on sovereign indebtedness, governments need to formulate a strategy on the joint decision of holding international reserves and sovereign indebtedness, since sovereign debt also plays an income-smoothing role in the economy. This raises issues about the cost of holding reserves which also incorporates the stock of indebtedness. In other words, is holding international reserves more or less costly with regard to the level of sovereign indebtedness? What are the real motives of the substantial increase in international reserves holdings? In addition, the question of the adequate level of international reserves holdings with a level of sovereign debt also could be raised. Recent development shows that most of the developing countries have an increasing level in stocks of international reserves (assets) and external indebtedness (liabilities) which make them perfect candidates to be analyzed.

Chapter 2

On the Sustainability of Current Account and Fiscal Position: Evidence from Developed and Developing Countries

2.1 Introduction

The persistent episodes of current account and fiscal deficits have been spotlighted by policy makers, researchers and investors. Due to the continuous deficit experienced by a country, issues on the sustainability of the imbalances in current account and fiscal policy become important. Is a country that had experienced long episodes of deficit still sustainable? A country with a current account (external) and fiscal policy (internal) sustainability position has advantages in attracting foreign capital and investors. As such a real picture of the sustainable position is important for government policy formulation as well as to an investor's ability to strategize their investment decision. In addition, a country with a sustainable current account and fiscal position might have advantages as compared to a country with an unsustainable position. However, if countries are found to be in an unsustainable position, at least something could be done to correct the unsustainable imbalances position rather than not knowing a country's real sustainability condition.

In contrast, due to the uncertain condition of a country's real sustainability position, investors that have an intention to invest in a country (that has experience with the imbalance position) might take the precautionary action of delaying the investment. As such, countries are potentially losing the opportunity to improve economic growth through incoming foreign investment capital and being in a vulnerable condition that has been exacerbated by various adverse developments. Furthermore, without knowing the real condition, a large current account deficit may cause a shift in

investor confidence and a reversal of international capital flows as investors fear loans will not be repaid (Holman, 2001).

A sustainable position could be defined as being in a condition that was maintained at a certain level indefinitely, while a sustainable economy position could be interpreted as an economy that could maintain economic development and growth at a certain (realistic) level with respect to any changes in regulation, current economic situation or unpredicted events in the long term. In reality, with the uncertainty of shock and fluctuation events in the economy, it is impossible for a country to record a continuous increase in economic growth all the time. Thus, despite the aim of an expansion in growth or development, a contraction in growth at a tolerable limit could also be seen as a sustainable economic position. In other words, it is not just about achieving economic growth year on year - it also depends on how a country maintains and stabilizes the economic position.

Meanwhile, sustainability of current account position is closely related to a country's ability to maintain economic growth with changes in current account position (i.e. surplus or deficit). In particular, any fluctuation or shock in the current account which results in either surplus or deficit might not have affected the economic growth in the long run. However, if a current account balance deficit persists, the country's external positions have a likelihood of becoming unsustainable. Continually financing large current account deficits by the issuance of debt instruments will lead to an increasing debt burden, perhaps undermining solvency, which may lead to external vulnerability from a liquidity perspective (IMF, 2003). In other words, sustainability of current account position is closely linked with the sustainability of external debt as well as it's ability of a country to repay its debt and accumulate saving (or reserves) for precautionary purposes such as a sudden stop.

In addition, a country has also been considered to be in a sustainable position if the intertemporal budget constraints hold. A violation of the intertemporal budget constraint would indicate that the current deficit is not sustainable. A country is considered to be in a current account sustainable condition if the shift in the current account does not generate economic forces that might result in a change in its path (Thanh, Minh, Huong, and Hong, 2001; Mann, 1999; Hudson and Stennett, 2003).

Furthermore, if the current account is sustainable, it would not require a drastic shift or a sudden stop (e.g. a sudden tightening of monetary and fiscal policy, causing a large recession), or lead to a crisis (e.g. sharp increases in interest rates, a sudden depletion of the reserves, or an exchange rate collapse).

According to Hakkio (1995), short-run or temporary current account deficits are not expected to create any serious problems as they reflect a reallocation of capital to the country where this factor of production tends to receive high possible returns. In contrast to this phenomenon, long-run or persistent current account deficits tend to have a certain harmful effect on the domestic economy. In addition, these deficits tend to increase domestic interest rates relative to their foreign counterparts, while simultaneously imposing an excessive burden on future generations, who will have to pay back high amounts of accumulated external debt, thus lowering standards of living. With a high-level external debt and a low level of saving (which is being used to finance the persistent deficit), a country is highly exposed to the probability of failing to repay its debt which is related to the default episodes. As such, the current account sustainability analysis is important as an early warning signal of default episodes.

It is worthwhile analyzing every aspect of the sustainability such as fiscal policy rather than focusing only on the current account deficit. Wu, Chen, and Lee (2001) stressed that the issue of current account sustainability is an important factor in measuring a country's overall indebtedness. On the other hand, fiscal sustainability reveals the government's effort to maintain strong momentum in economic growth through the formulated fiscal policy. Even though fiscal sustainability analysis could be related to a government's efforts to obey its intertemporal budget constraint, a sustainable fiscal policy position is also associated with the financial solvency of the government. In other words, it indicates the ability of the government to repay its stock of public debt in the future. As such, by analyzing the country's sustainability of fiscal policy position, a government could play its role in maintaining the economic growth even with a surplus or deficits fiscal policy. Besides that, the role and relationship of the current account and fiscal policy position to the economy could be explained from the national income identity (IMF, 1993).

$$GDP = C + I + G + (X - M) \quad (2.1)$$

Here *GDP* is gross domestic product and *C* represents private consumption expenditure. *I* and *G* represent gross domestic investment and government consumption expenditure respectively, while *X*-*M* measures the balance on goods and services in the balance of payments with *X* and *M* representing export and imports of goods and services respectively.

$$CAB = X - M + NY + NCT \quad (2.2)$$

$$GNDY = C + I + G + CAB \quad (2.3)$$

$$GNDY - C - G = I + CAB \quad (2.4)$$

$$GNDY - C - G = S \quad (2.5)$$

$$S = I + CAB \quad (2.6)$$

$$S - I = CAB \quad (2.7)$$

NY is defined as net income from abroad while *NCT* is net current transfer. *GNDY* is gross national disposable income, *S* represents gross savings and *CAB* is current account balance. In addition, the interrelation between internal and external sectors of an economy could be explained as

$$S - I = Sp + Sg - Ip - Ig \quad (2.8)$$

$$CAB = (Sp - Ip) + (Sg - Ig) = S - I \quad (2.9)$$

Here *Sp* is private savings, *Ip* is private investment, *Ig* is government investment and I is government savings. Any unsustainable position in either current account position could potentially affect fiscal policy position and vice versa. Furthermore, analysis of fiscal policy position would be value-added in the sustainability analysis since this could capture a government's effort to maintain the internal condition of the country. Thus, issues on the sustainability need to be considered and more attention given to each potential aspect, particularly current account and fiscal sustainability in order to gain an extensive picture of the country's real sustainability position.

Despite a vast and growing amount of literature on current account and fiscal policy sustainability, particularly for developed countries, the analytical literature based on

the developing countries is more limited (Ghatak, 2007). Most of the previous studies employ a country-by-country approach, in which conventional cointegration tests are applied to each country separately. Although this makes the results comparable across countries, it does not really bring any additional information into the analysis, since the information contained in the cross-sectional dimension is essentially disregarded (Westerlund and Prohl, 2006). Additionally, with a given short sample size of time series dimension, the results could be questioned.

To my knowledge, there is a lack of studies on current account and fiscal policy sustainability from a panel approach. In addition, most of the studies only focused on the United States and some other developed countries as well as the industrial countries' point of view. With the growth in the literature for developed countries, an attempt to investigate the sustainability position of the developing countries is feasible since this group also faces a high risk of vulnerability and uncertainty in the economy. Furthermore, most developing countries are expecting foreign direct investment to help generate domestic economic growth. Thus, any results or findings could help the government in formulating sound and resilient policies as well as helping investors with their investment decision strategy.

The objective of this chapter is to re-examine the sustainability position of developing and developed countries in their intertemporal budget constraint by using a panel study approach. Furthermore the chapter will investigate two major aspects of sustainability: current account and fiscal policy position. Finally, analysis of fiscal sustainability using the model proposed by Bohn (1998) will examine different points of view on sustainability.

The contribution of this chapter is the extension of the sustainability analysis to developing and developed countries using a panel data approach. In addition, this chapter tries to investigate several major aspects of sustainability, particularly current account, fiscal policy and debt analysis. Thus, the evidence presented in this chapter will contribute an extra dimension to the earlier literature on the topic. In particular, estimation of the sustainability models is conducted by using recent panel cointegration pooled mean group heterogeneous (PMG), proposed by Pesaran et al. (1999); panel cointegration with multiple structural break introduced by Westerlund

(2006) has also been applied in this study. Meanwhile, several panel technique estimations, particularly fixed effect have also been considered. Thus, the remainder of this chapter is organized as follows. Section 2.2 reviews the literature on the theoretical and empirical study respectively, while the specification of the model is explained in section 2.3. Section 2.4 clarifies the estimation procedure, while section 2.5 reports on the dataset used in this chapter. The empirical results are presented in section 2.6, and section 2.7 concludes the chapter.

2.2 Review of the literature

There are two main approaches to test the sustainability of a fiscal policy via the fulfilment of the government present-value borrowing constraints (PVBC). The first approach, introduced by Hamilton and Flavin (1986), explored the method of measuring fiscal sustainability by utilizing a PVBC. Based on the univariate time series properties of government deficit and debt, the United States was found to be in an unsustainable fiscal policy position, implying a chronic deficits condition. Next, Trehan and Walsh (1991), Haugh (1991), and Hakkio and Rush (1991) found the existence of a long-run linear cointegration relationship between government revenues and expenditures with the assumption of constant real interest rate. Trehan and Walsh (1988) prove that a country would satisfy its government budget balance (in present value) if the government expenditure (inclusive interest) and tax revenue is cointegrated. In addition, Hakkio and Rush (1991), Haugh (1991) and Quintos (1995) found that the expenditure and revenue are cointegrated for sample period. However, Bohn (1998) proposed a model that could analyze whether a government take some corrective action with regard to response of a primary budget surplus to changes in debt-to-income ratio. In addition, he claims that the model is more promising than the univariate time series analysis since the debt income ratio is practically bound around various shocks (GDP, interest rates, government spending) that make the mean reversion difficult to detect.

Meanwhile, by following the same approach of Hamilton and Flavin (1986), Husted (1992), Trehan and Walsh (1991), Ahmed and Rogers (1995), and Wu et al (1996) analyze the sustainable current account position for the United States. Except for Wu

et al. (1996), all studies concluded that the US current account deficit is sustainable for the period 1946 to 1987.

On the other hand, Campbell and Shiller (1986) examine the prediction of present value models by testing the implied cross-section equation restrictions on a vector autoregression (VAR). However, it is less feasible to implement this method since the econometrician has access to less information than individual firms and individual country (Kasa, 2003). In addition, Kasa (2003) also claims that if fundamentals are driven by unobserved permanent and transitory components, then a restriction of a standard present value model of the current account might not be testable with VAR.

Apergis, Katrakilidis and Tabakis (2000), Wu et al. (1996), Callaghan and Kan (2007), Irandoust and Ericsson (2004), Arize (2002) and Wu et al. (2001) use the intertemporal balance model proposed by Husted (1992) to analyze whether the country's current account budget constraint is intertemporally balanced. With the assumption of no government intervention and only a single goods produced and exported by the country, they found mixed results for all different sample countries.

The results for Greece and major industrial countries, namely, United States, United Kingdom, France, German, Italy, Canada, Sweden and Japan indicate that there exists a long-run steady-state relationship between imports and exports, which implies a current account sustainability position (Husted 1992; Apergis et al. 2000; Irandoust and Ericsson 2004; and Wu et al. 2001). In addition, Wu et al. (1996) found that the United States and Canada are not sustainable for the analysis during the period 1973-1994. Based on time series study, Arize (2002) found evidence of sustainability of current account position in 35 of the 50 countries. In addition, countries in the regions of the Middle East, Latin America and Europe have a cointegration relation that is more unstable than other regions.

Meanwhile, Callaghan and Kan (2007) found that the most crisis-hit countries, specifically Thailand, Philippines, South Korea and Indonesia, reveal the unsustainability of the current account position during the pre-Asian crisis period. In addition, a study by Baharumshah, Lau and Fountas (2003) found that current account deficits in Indonesia, Philippines and Thailand were not in the long-run steady state,

implying violation of the intertemporal balance model prior to the Asian crisis. In other words, the unsustainable current account positions could be a signal that the crisis might erupt.

Meanwhile, studies on the fiscal sustainability failed to find unanimous evidence on the sustainability of fiscal policy particularly for the developed countries. Studies conducted for developed countries, mainly the European Union (EU) and Organization for Economic and Co-operation Development (OECD) countries, found mixed results. Afonso (2005) found an unsustainable fiscal position for Austria, Germany, Finland, Netherlands and Portugal. In addition, a sustainable fiscal policy position has been found for Austria, France, Netherlands, United Kingdom and Germany, while others in the EU are in an unsustainable fiscal position (Santos-Bravo and Silvestre, 2002). Besides that, there is no evidence that the governments of Belgium and Italy can attain a sustainable position (Papadopoulos and Sidiropoulos, 1999). Meanwhile Westerlund and Prohl (2006) provide strong evidence of sustainability for European Union countries and eight rich OECD countries which is based on panel data analysis.

Several further studies of developing countries have been conducted by Kalyoncu (2005) and Archibald (2003). It is found that South Korea, Turkey and Barbados are sustainable in fiscal position, while Mexico, Philippines and South Africa are unsustainable in the long run. Ghatak and Sanchez-Fung (2007), Leachman, Bestar, Rosas, and Lange (2005) and Greiner, Koller and Jemmler (2007), applied the debt dynamic analysis introduced by Bohn (1998) to analyze whether governments have taken corrective measures in order to control the process of rising indebtedness. Studies on selected European Union countries reveal that governments do take corrective action over the increasing level of debt for Norway, UK, US, Germany, France, Italy and Portugal. Meanwhile, the federal governments of Thailand, Peru and Venezuela are found to have taken corrective measures in order to improve their countries' fiscal position. Furthermore, Leachman et al. (2005) developed criteria for testing sustainability of the fiscal budgeting process by using a multicointegration methodology. By testing the government spending and revenue system of 15 industrialized countries, they found that only Norway and United Kingdom are sustainable in their fiscal policy position. Even though they have a different approach

to fiscal budgeting, with Norway experiencing surplus and United Kingdom experiencing deficits, both governments' budgeting processes indicate that their fiscal systems are characterized by policy responses that are consistent with fiscal policy sustainability criteria.

As a conclusion, most of the studies have focused on the developed countries, particularly the European Union and the industrialized countries. In addition there was no conclusive evidence found to confirm the sustainability of current account and fiscal position for the developing countries. Under these circumstances, this area is still feasible and interesting to be examined empirically with a vast development in theory and econometrics approach.

2.3 Model Specification

In this paper, we will use a dynamic approach by Husted (1992) to examine the current account sustainability position of the developing and developed countries. With the assumption that individuals live in small open economies where individual is allows to borrow and lend in the international market, the intertemporal budget constraint in the current period *t* is given by

$$C_t = Y_t + B_t + I_t - (1 + r_t)B_{t-1} \tag{2.10}$$

where C_t is the current consumption; Y_t is output; B_t is international borrowing which could be positive or negative; I_t is investment; and r_t is the one-period world interest rate, respectively. $(1 + r_t)B_{t-1}$ represents the net debt, corresponds to the country's external debt from the previous period. In addition, the individual is assumed to maximize lifetime utility subject to its budget constraints. By holding (2.10) in every period:

$$B_{t+1} = -(Y_{t+1} - C_{t+1} - I_{t+1}) + (1 + r_{t+1})B_t$$
$$B_{t+2} = -(Y_{t+2} - C_{t+2} - I_{t+2}) - (1 + r_{t+2})(Y_{t+1} - C_{t+1} - I_{t+1}) + (1 + r_{t+2})(1 + r_{t+1})B_t$$
.
.
.
$$B_{t+n} = -(Y_{t+n} - C_{t+n} - I_{t+n}) - (1 + r_{t+n})(Y_{t+n-1} - C_{t+n-1} - I_{t+n-1}) - .....$$
$$-(1 + r_{t+n})(1 + r_{t+n-1}).....(1 + r_{t+2})(Y_{t+1} - C_{t+1} - I_{t+1}) + (1 + r_{t+n})(1 + r_{t+n-1})..(1 + r_{t+1})B_t$$

By rearranging and letting *n* approaching infinity:

$$B_t = \sum_{i=1}^{\infty} \lambda_i [Y_{t+i} - C_{t+i} - I_{t+i}] + \lim_{n \to \infty} \lambda_n B_{t+n} \qquad (2.11)$$

Where $\lambda_i = \prod_{j=1}^{i} \frac{1}{1 + r_{t+j}}$

where $X_t - M_t = (Y_t - C_t - I_t = -B_t + (1 + r_t)B_{t-1}$ represents the trade balance in period *t*, (exports, X-imports, M) and λ_i is the discount factor. In equation 2.11, the first term represents the trade balance while the second term explains the country's external debt. If the second terms equals to zero, the total amount that country borrow in international market equals the present value of the future trade balance. On the other hand, if the limit term is non-zero and B_t is positive, this could explain that country is "bubble-financing" its external debt. While in the case where B_t is negative and the limit is non-zero, the country is making pareto-inferior decision where welfare could be raised by lending less (Husted, 1992).

In order to derive a testable empirical model, Husted (1992) rewrites the equation (2.10). First, by assuming that the world interest rate is stationary with unconditional mean *r*, the equation (2.10) could be expressed as

$$Z_t + (1 + r)B_{t-1} = X_t + B_t \qquad (2.12)$$

Here $Z_t = M_t + (r_t - r)B_{t-1}$. It can be resolved forward to obtain:

$$M_t + r_t B_{t-1} = X_t + \sum_{j=0}^{\infty} \lambda_i^{j-1} [\Delta X_{t+j} - \Delta Z_{t+j}] + \lim_{j \to \infty} \lambda_i^{t+j} B_{t+j} \quad (2.13)$$

where Δ is the first difference operator. The left-hand side of (2.12) represents spending on imports as well as interest payments on net foreign debt. X_t is subtracted from both sides (2.13) and each side becomes the economy's current account. Assume that X and Z are both non-stationary processes, each integrated of order 1, I(1),

$$X_t = \alpha_1 + X_{t-1} + \varepsilon_{1t} \quad (2.14)$$

$$Z_t = \alpha_2 + Z_{t-1} + \varepsilon_{2t} \quad (2.15)$$

where α_j are drift parameters (possibly equal to zero) and the ε_{jt} are stationary processes. In this case, equation (2.14) can be re-expressed as

$$X_t = \alpha + MM_t - \lim_{j \to \infty} \lambda^{t+j} B_{t+j} + \varepsilon_t \quad (2.16)$$

where $MM_t = M_t + r_t B_{t+j}; \alpha = [(1+r)^2 / r](\alpha_2 - \alpha_1)$; and $\varepsilon_t = \sum \lambda^{j-1} (\varepsilon_{2t} - \varepsilon_{1t})$.

Assuming that the limit term in equation (2.16) equals to zero and can be transformed into a standard testable equation:

$$X_t = a + \beta MM_t + e_t \quad (2.17)$$

where X_t is exports of goods and services and MM_t is imports of goods and services plus net interest payment and net transfer payment. Cointegration is a necessary condition for the economy to be obeying its intertemporal budget constraint. While $\beta = 1$ is a sufficient condition for the budget constraint to be obeyed for the cointegrated series. This indicates that an increase in MM_t are equal with grows in X_t. In other words, the cointegration framework could be related with the sustainability position where the X_t and MM_t cannot drift apart too far. Despite obeying its intertemporal budget constraint the coefficient must be equal to one to provide sufficient condition of current account sustainability.

Meanwhile, in the literature, there are two main approaches to test the sustainability of a fiscal policy via the fulfilment of the government present-value borrowing constraints (PVBC). The first approach, introduced by Hamilton and Flavin (1986), is based on the univariate time series properties of government deficit and debt. While the second approach starts with the works by Trehan and Walsh (1991), Haugh (1991), and Hakkio and Rush (1991) found the existence of a long-run linear cointegration relationship between government revenues and expenditures with the assumption of constant real interest rate. In addition, Haugh (1991) and Quintos (1995) assumed that the breakpoint is exogenously given. The study was used to analyze the sustainability of the budget deficits by using stationary test for the stock of public debt and cointegration test between government expenditure and government revenue.

This chapter dwells on the second approach which is proposed by Hakkio and Rush (1991) to analyze fiscal sustainability position. Government budget constraint is naturally the starting point to derive the present value of the budget constraints. Writing the budget constraint in real terms, we have

$$G_t + (1 + r_t)B_{t-1} = R_t + B_t \tag{2.18}$$

where G_t is government expenditures, R_t is government revenue, B_t is public debt and r_t is the real interest rate. Rewriting equation (2.18) period t+1, t+2, t+3…. and recursively solving the equation leads to the following intertemporal budget constraint:

$$B_t = \sum_{S=1}^{\infty} \frac{R_{t+s} - G_{t+s}}{\Pi_{j-1}^{5}(1 + r_{t+s})} + \lim_{s \to \infty} \Pi_{j=1}^{s} \frac{B_{t+s}}{(1 + r_{t+j})} \tag{2.19}$$

To derive the implication of equation (2.19) for the government conduct of fiscal policy, there are two assumptions. The first assumption is that the real interest rate is stationary with an unconditional mean given by *r*. Secondly, the real supply of bonds does not grow, on average, at a rate in excess of the average rate of interest. These two assumptions imply that

$$\lim_{s\to\infty} \frac{B_{t+s}}{(1+r)^s} \tag{2.20}$$

Equation (2.20) states that the debt stock, when measured in present value terms, vanished in the limit. By definition, this excludes Ponzi financing. It also implies that the government does not have the option of running perpetual primary deficits.

However, as noted by Hamilton and Flavin (1986), equations (2.19) and (2.20) do not necessarily exclude a permanent conventionally-measured budget deficit. As long as the deficits are such that the debt stock grows at a rate that is less than the rate of interest the equation will be satisfied. Given this equation, it follows that the intertemporal budget constraint equation (2.10), can be written as

$$G_t - R_t = \sum_{s=0}^{\infty} \frac{1}{(1+r)^{s-1}} (\Delta R_{t+s} - \Delta G_t + r\Delta B_{t+s-1}) \tag{2.21}$$

Here G_t is government expenditure. The intertemporal budget constraint, under the no-Ponzi scheme rule, imposes restrictions on the time series properties of government expenditure and revenue. These follow from the specification of the right-hand side of equation (2.21). This will be stationary as long as government expenditure, revenue and the stock of the debt are all stationary in first difference. The stationary property restricts the extent to which G_t and R_t can deviate from each other over time. The idea is to establish if there is cointegration between R_t, revenues and G_t, government expenditure.

In particular, if G_t and R_t are I(1), they will be cointegrated. Intuitively, cointegration implies that if there exists an error correction mechanism pushing government finances towards the level required by the intertemporal budget constraint, evidence of sustainability position for that particular country is revealed. In the absence of cointegration, the error correction mechanism will not operate and there is no likelihood that equation (2.21) will hold.

Therefore the procedure to assess the sustainability of the intertemporal government budget constraint involves testing the following cointegration regression:

$$R_t = \alpha + \beta G_t + \upsilon_t \tag{2.22}$$

where R_t is the total revenues and G_t is the total expenditures. To establish the sustainable position of equations (2.17) and (2.22), integration and cointegration tests need to be conducted. If both series in (2.17) and (2.22) are found to be stationary in level I(0), the sustainable condition is satisfied. Meanwhile, if the tested equation is a non-stationary variable, a further cointegration test is employed. Cointegration is a necessary condition for the economy to be obeying its intertemporal budget constraint. As such, panel unit root test has been employed as a preliminary test before proceed to the cointegration test. Thus, panel unit results provide the evidence either both variables are integrated at order zero, I(0), or order one, I(1). If the two variables are found to be integrated at order zero, the intertemporal budget constraint is hold, suggesting a sustainable position. While if both variables integrated at order one, the process will proceed to cointegration test. If both variables are found to be cointegrated, this could interpreted as country's is obeying their intertemporal budget constraint suggest a sustainable of current account or fiscal position. While in the absence of cointegration relationship, the current account and the fiscal policy position are found to be unsustainable position.[4]

By using the same approach on intertemporal budget constraint, Hakkio and Rush (1991) also demonstrate that if government revenues and expenditure are non-stationary variables in levels, the condition $0 < \beta \leq 1$ is a sufficient condition for the budget constraint to be obeyed. β represents the coefficient of the MM and G. In addition, the condition of $0 < \beta \leq 1$ explain that as long as the coefficient lies between zero and one, it indicates that an increase in MM and G are associated with an increase in X and R which at least more than zero and equals to one. However, when revenues and expenditures are expressed as a percentage of GDP or in per capita terms, it is necessary to have $\beta = 1$ in order for the trajectory of the debt to GDP not to diverge in an infinite horizon. This indicates that the increase in MM and G are equal with grows in X and R. This condition could be explained as a sustainable

[4] The flow chart is attached at Appendix 2.2.

current account and fiscal position where the two series are not drift. By contrast, if $\beta < 1$ then the hypothesis of sustainability position is violated. In other words, if β is less than 1, the economy will fail to satisfy its budget constraint where grows in MM and G are not been supported with the same grows in X and R.

The third analysis applied to the debt dynamic sustainability test is proposed by Bohn (1998). The model tries to analyze whether there is any corrective action taken by the government due to the increasing debt level. Bohn (1998) introduces a procedure that determines if a government is taking corrective actions to comply with its intertemporal budget constraint by analyzing the relationship between the budget surplus *(S/Y)* and the debt to GDP *(D/Y)* ratios. Bohn assumes that if *(S/Y)* reacts positively to *(D/Y)* this could be interpreted as a signal showing that the government is undertaking the necessary actions to achieve fiscal policy sustainability.

The relevant equation for analyzing the relationship between the S/Y and the D/Y ratios can be written as

$$(S/Y)_t = \beta_0 + \beta_1 (D/Y)_{t-1} + \beta_2 GVAR_t + \beta_3 YVAR_t + \varepsilon_t \qquad (2.23)$$

In equation (2.23), the variables *GVAR* and *YVAR* should help in accounting for temporary government spending and business cycle factors, respectively. It is derived from Barro's (1979) fiscal policy model. Furthermore, controlling for these factors could also help in accounting for the potential impact of omitted variables. Therefore, it follows that, in equation (2.23), β_1 should be positive if fiscal policy is complying with an intertemporal budget constraint, while β_2 and β_3 are expected to have negative signs. In other words, the surplus would decrease if the government was spending more than usual, or if the economy was contracting.

Variables GVAR and YVAR are constructed as in Barro (1979). The formulae are

$GVAR_t = (g_t - g_t^*)/y_t$ and

$YVAR_t = (1-(y_t - y_t^*) * (g_t^* / y_t)$

The variables g and y refer to government expenditure and GDP respectively. Meanwhile, g^* and y^* are calculated by applying the Hodrick-Prescott filter to the original series and assigning λ a value of 6.5 as suggested by Ravn and Uhlig (2002) for annual data. In addition to the equation (2.23), Bohn (1998) also introduced the debt-dynamic approach.

$$(\Delta D/Y)_t = \alpha_0 + \alpha_1 (D/Y)_{t-1} + \alpha_2 GVAR_t + \alpha_3 YVAR_t + \zeta_t \quad (2.24)$$

Equation (2.24) measures if changes in the debt-to-GDP ratio displays mean reversion, which would imply that the government is complying with an intertemporal budget constraint. Consequently, in equation (2.24) α_1 is expected to be negative, whereas α_2 and α_3 should be positive. In addition, a positive response of the primary surplus to the development in the debt-to-income ratio conveys reliable information. This approach is suitable for developing countries because the test is more flexible since there is no additional assumption about the interest rates (Ghatak and Sanchez-Fung, 2007).

2.4 Estimation Procedure

For the current account and fiscal analysis which is based on the intertemporal budget constraint, the analysis starts with panel unit root tests to assess the order of integration of the variables. The panel unit root tests are based on Levin, Lin and Chu (2002), and Im, Pesaran and Shin (2003),which allow for panel homogeneity as well as ADF and PP- Fisher tests by Maddala and Wu (1999) which allow for panel heterogeneity across units to the coefficient on the lagged variables. In addition, the test proposed by Hadri (2000), with the null of no unit root, is also conducted. Then, estimation of the results proceeds to the cointegration test if both variables are found to be cointegrated at order one, I(1). The panel tests for cointegration in this analysis will follow the Pooled Mean Group (PMG) estimator developed by Pesaran et al. (1999) which assumes a homogeneous long-run coefficient. This chapter also employs a panel cointegration test with multiple structural breaks proposed by Westerlund (2006) to consider any structural breaks during the period. Meanwhile, to re-examine the sustainability of debt and fiscal policy position, the model proposed by

Bohn (1998) has been applied. In addition, panel fixed effect (FE) and random effect (RE) estimators have been used to estimate the model.

2.4.1 Panel Unit Root

A panel unit root test determines the stationarity status of all variables or to determine the order of integration. Recent literature suggests that panel-based unit root tests have higher power than unit root tests based on individual time series. To provide some robustness check on the stationarity of the variables, this chapter makes use of various method of panel unit root test. Even though the PMG estimator could be estimated irrespective the regressors are I(0) or I(1), the panel unit rot test has been carried out to confirm none of the variables cointegrated at order two, I(2). This paper employs panel tests which are based on Levin et al. (2002), Im Pesaran and Shin (2003), and ADF and PP- Fisher test by Maddala and Wu (1999) and Hadri (2000). In particular the Levin, et al. (2002) test suppose a common unit root under the null while, Im, Pesaran and Shin (2003), and ADF and PP- Fisher test by Maddala and Wu (1999) allow for individual unit root. Consider a simple model that follow an AR(1) process:

$$y_{it} = \rho_i y_{it-1} + x_{it}\delta_i + \varepsilon_{it} \tag{2.25}$$

where $i = 1,2,3,...N$ cross-section units and y_{it} series that are observed over period $t = 1,2,3,...T$. x_{it} is the exogenous variables, ρ_i is the autoregressive coefficients and ε_{it} is the error term where the null hypothesis is unit root and the alternative hypothesis is level stationary as follows:

$$H_o : \rho_i = 0 \tag{2.26}$$

$$H_o : \rho_i < 0 \tag{2.27}$$

The Levin et al. (2002) panel unit root test assumes homogenous autoregressive coefficient between individual for all cross-section unit, *i*. The tested hypothesis tests the null of non-stationary and homogenous across unit

$$H_0 : \rho_i = \rho = 0 \tag{2.28}$$

$$H_a : \rho_i = \rho < 0 \text{ for all i} \tag{2.29}$$

By using a pooled t-statistic test, a cross-section restriction on the first-order partial autocorrelation coefficient has led the method to estimate a superconsistency estimator. The structure of the model is

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{j=1}^{pi} \beta_{ij} \Delta y_{it-j} + x'_{it} \delta_i + \varepsilon_{it} \tag{2.30}$$

where $i = 1,2,3,...N$ and ε_{it} is assumed to be independently distributed across individual and follow a stationary invertible autoregressive moving average (ARMA) process.

Levin et al. (2002) show a modified t-statistic for the resulting ρ, and it is asymptotically normally distributed

$$t^*_\rho = \frac{t_{\rho=0} - N\widetilde{T}\hat{S}_N \sigma_\varepsilon^{-2} se(\rho) \mu^*_{m\widetilde{T}}}{\sigma^*_{m\widetilde{T}}} \rightarrow N(0,1) \tag{2.31}$$

where t_ρ is the standard t-statistics for $\rho = 0$, σ^2 is the estimated variance of the error term, $se(\rho)$ is the standard error of ρ and $\widetilde{T} = T - (\sum_i p_i / N) - 1$. However, Levin et al. (2002) test is more relevant on the panel of moderate size and it depends upon on the independent assumption across individual.

Meanwhile, Im et al. (2003) test proposed a panel unit root test that allows for heterogeneity across individual unit root and residual serial correlation in the model

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{j=1}^{pi} \beta_{ij} \Delta y_{it-j} + x'_{it} \delta_i + \varepsilon_{it} \tag{2.32}$$

where $i = 1,2,3,...N$ the cross-sectional unit and $t = 1,2,3,...T$ time period. In other words, ρ_i may vary across cross-section. Im et al. (2003) unit root test involves pooling and averaging (mean) of ADF statistics for each cross-section unit with the null of

$$H_o : \rho_i = 0 \tag{2.33}$$

for all *i*, against the alternatives of

$$H_a : \begin{pmatrix} \rho_i < 0 \\ \rho_i = 0 \end{pmatrix} \text{for} \begin{matrix} i = 1,2,...N \\ i = N_1 + 1,...N \end{matrix} \tag{2.34}$$

In addition, Im et al. (2003) also proposes the use of group-mean $\bar{t}$ where the t-statistics are from each ADF that is estimated (by averaging) across the panel. Thus, the t-statistic test is

$$\bar{t}_{NT} = \left(\sum_{i=1}^{N} t_{iT}(p_i) \right) / N \tag{2.35}$$

where t_{iT} is assumed to be independent, independent, identically distributed (i.i.d.) and has finite mean and variance. In addition, the Im et al. (2003) also demonstrates that their test has better finite sample performance than the Levin et al. (2002).

Maddala and Wu (1999) and Choi (2001) proposed a panel unit root test that is derived from the combination of p-values of individuals or cross-sectional units. Based on the non parametric approach, the test statistic is

$$P = -2 \sum_{i=1}^{N} \ln(\rho_i) \rightarrow \chi^2_{2N} \tag{2.36}$$

Where ρi is the p-value of a unit root test for cross-sectional unit. $\rho_i = F(G_{it})$ where $F(\bullet 1)$ is the distribution function of G that is a non-degenerate random variable. The p-value is a combination of the p-value from unit test for each cross-section *i*. Under the null of unit root, the test could be estimated even with the

unbalanced panel and it is possible to use different lag length in the individual ADF regression.

Meanwhile, Hadri (2000) derives a residual- based Lagrange Multiplier (LM) procedure to test the null of stationary against the alternative unit roots in the panel data. In addition, the test is an extension to the panel data of the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test for the individual series. Hadri (2000) consider the following model

$$y_{it} = r_{it} + \varepsilon_{it} \tag{2.37}$$

where $r_{it} = r_{i,t-1} + u_{it}$ is a random walk. The u_{it} are i.i.d. $(0,\sigma_u^t)$. Under the null hypothesis $(H_0 : \sigma_u^t = 0)$, y_{it} is stationary around the level (r_0) against the alternative of unit root $(H_0 : \sigma_u^t > 0)$. The LM test statistics is given by:

$$LM = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\frac{1}{T^2}\sum_{t=1}^{T} S_{it}^2}{\hat{\sigma}_{\varepsilon}^2}\right) \tag{2.38}$$

where S_{it} is the cumulative sums of residual. While Hadri (2000) suggests an alternative LM test that allows for heterocedasticty across i,

$$LM = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\frac{1}{T^2}\sum_{t=1}^{T} S_{it}^2}{\hat{\sigma}_{\varepsilon,i}^2}\right) \tag{2.39}$$

However, the Hadri panel unit root test experiences a significant size of distortion in the presence of autocorrelation if there is no unit root.

2.4.2 Panel Cointegration

The Pooled Mean Group (PMG) estimation technique for dynamic heterogeneous panel introduced by Pesaran et al. (1999) is applied in this paper. The maximum likelihood estimation of the parameter represents an intermediate case between the Mean Group (MG) and the traditional pooled estimation technique (fixed and random effects). The MG estimation averages coefficients to obtain means of the parameter estimates. The traditional pooled estimator such as Fixed and Random effect estimator allowed only the intercept to differ across group while all other coefficients and error variance are constrained to be the same (homogeneity).

PMG estimation, which involves pooling and averaging, constrained the long-run coefficient to be the same across countries. Besides that, the intercept, short-run coefficient as well as error variances are allowed to differ. One advantage of the PMG estimators over the traditional Dynamic Fixed Effect (DFE thereafter) model is that they can allow the short-run dynamic specification to differ from one country to another. Based on basic Autoregressive Distributed Lag (ARDL) (p, q_1, q_2,…q_n) model:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} x_{i,t-j} + \mu_i + \varepsilon_{it} \tag{2.40}$$

where x_{it} (k x 1) is the vector of explanatory variables for group i, μ_i represent the fixed effects, the coefficient of the lagged dependent variables, λ_{ij} are scalars, and δ_{ij} are (k x 1) coefficient vectors. Written in error correction form, the specification for the PMG estimators is as follows:

$$\Delta y_{it} = -\Phi_i (y_{i,t-1} - \beta_i x_{it} - \theta_{0i}) + \sum_{j=0}^{q-1} \lambda'_{ij} \Delta x_{i,t-j} + \varepsilon_{it} \tag{2.41}$$

where β_i is the long-run parameter and $\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$. Φ_i is the error correction parameter which explain the speed of adjustment of the estimated model to converge back to equilibrium if there is shocks. In addition, for small T, the estimator will be subject to the familiar downward bias in the coefficient of the lagged dependent

variable (Pesaran et al.,1999). Furthermore, the PMG estimator could also be computed irrespective of whether the regressors are I(0) or I(1) variable.

This chapter tries to provide additional insight evidence on the cointegration relationship by employing Westerlund (2006) panel unit root test which allows for multiple structural breaks. Westerlund (2006) proposed a Lagrange Multiplier (LM thereafter) test for the null hypothesis of cointegration that allows for the possibility of multiple structural breaks in both constant and trend of a cointegrated panel regression. The test is based on the LM test of McCoskey and Kao (1998) and is able to accommodate the unknown number of breaks in both constant and trend of the individual regression, which may be located at different dates for different individuals. Using sequential limit argument, it is shown that the test has a limiting normal distribution. The test statistics are derived when the location of the break is known a priori and when they are determined endogenously from data. In addition, results from Monte Carlo experiments suggest that the test has small size distortion and reasonable power. To test the null hypothesis of cointegration, the test statistics of the panel LM statistics is defined as follows:

$$Z(m) \equiv \sum_{i=1}^{N} \sum_{j=1}^{M_i+1} \sum_{t=T_{ij-1}+1}^{T_{ij}} (T_{ij} - T_{ij-1})^{-2} \hat{\omega}_{i1.2}^{-2} S_{it}^2 \tag{2.42}$$

where M= (M_1, M_2,……M_n) to denote that it has been constructed for a certain number of breaks for each cross-section, $S_{it} = \sum_{k=t_{ij}+1}^{t} \hat{e}_{ik}^{*}$ and its asymptotic distribution depends on it. With $\omega_{i1.2}^2$ being a consistent estimate of the long-run variance, e_{it} is obtained using any semiparametrical kernel estimator. Meanwhile, the unknown break points are obtained using the method proposed by Bai and Perron (1998, 2003) which obtains the location of the breaks by globally minimizing the sum of squared residual.[5]

[5] To the author best knowledge, there is no available method of panel cointegration that allow for cross-sectional dependence.

2.4.3 Panel Fixed Effect

This paper also employs fixed and random effects estimators which have been used to estimate equation (2.23) and (2.24), i.e Bohn's model. The static fixed effect model is

$$y_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it} \qquad i=1,\ldots\ldots N, \quad t=1\ldots T \tag{2.43}$$

where α_i is unit-specific characteristic, while ε_{it} is *i.i.d.* A pooled OLS estimator that is based on the time-demeaned variables is called the fixed effects estimator. Meanwhile, the random effect estimator is a feasible Generalized Least Squares (GLS) estimator where the unobserved effect is assumed to be uncorrelated with all the explanatory variables in each time period. The Hausman test is used to determine the appropriate estimator for the model for each sample: it is either a fixed or random effect estimator. The null hypothesis of the test is no correlation between the individual effects and the explanatory variables. This implies that both fixed and random effect estimators are consistent but only the random effect is efficient. The alternative hypothesis explains that the individual effects are correlated with the explanatory variables showing that only the fixed effect estimator is consistent and efficient.

2.5 Data set

Data are on an annual basis from the period 1978 to 2004 for high-, middle- and low-income countries. Data have been collected from various sources. The data of X (exports of goods and services), MM (imports of goods and services plus the net transfer and income), R (government revenue) and GG (government expenditures) and government debt for the middle- and low- income countries are collected from the IMF/IFS statistics and the WDI, World Bank. Meanwhile, all variables, X (exports of goods and services), MM (imports of goods and services plus the net transfer and income), R (government revenue) and GG (government expenditures) and D (government debt) are for the high-income countries, are gathered from the *OECD,* National Account statistics. X, MM, R, GG and D expressed as a percentage of real GDP (based year = 2000) and in natural logarithmic.

2.6 Empirical Results

In the first and second parts of the empirical analysis we examine the sustainability of current account and fiscal position by using the intertemporal budget constraint approach proposed by Husted (1991) and Hakkio and Rush (1991). Next, we re-examine the fiscal position with the model introduced by Bohn (1998) to analyze whether governments take some corrective action in respect of their increasing debt level.

2.6.1 Current account sustainability

The results of panel unit root test of Levin, et al. (2002), Im, et al. (2003), and ADF and PP-Fisher test by Maddala and Wu (1999) and Choi (2001), and Hadri (2000) are reported in Table 2.1 in levels and in first differences, respectively.

The test statistics of Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003), and ADF and PP-Fisher test by Maddala and Wu (1999) are found to reject the null hypothesis at 5 percent significance level for X and MM at first difference for all group countries. In consensus with the other panel unit root results, the Hadri (2000) panel unit root test reveals evidence of rejection of the null of stationary (at 5 percent significance level) at level for all group countries. Furthermore, the test could not find evidence to reject the null at first difference suggesting X and MM are I(1) variables. Thus, the reported results confirmed that the X and MM variables are first difference variables, I(1) for high-, middle- and low-income countries.[6]

[6] This results holds even if the constant term and trend are been used in the panel unit root tests.

Table 2.1
Panel unit root test for current account sustainability analysis

	High income		Middle income		Low income	
	Level	First differences	Level	First differences	Level	First differences
X			Test statistics			
Levin, Lin & Chu	-0.248	-23.12*	4.656	-14.73*	1.135	-14.91*
Im, Pesaran and Shin	-0.161	-21.53*	6.638	-16.98*	1.010	-15.251*
ADF-Fisher	48.60	431.26*	33.17	407.26*	37.28	268.22*
PP-Fisher	46.89	478.73*	41.11	429.73*	38.64	327.27*
Hadri	11.61*	0.838	20.16*	0.232	8.873*	0.881
MM			Test statistics			
Levin, Lin & Chu	-1.500	-24.20*	2.452	-19.61*	1.053	-17.384*
Im, Pesaran and Shin	1.415	-22.65*	2.995	-19.53*	2.398	-17.74*
ADF-Fisher	55.26	453.17*	62.10	454.88*	41.79	310.57*
PP-Fisher	53.79	485.86*	61.89	470.70*	49.81	305.01*
Hadri	11.72*	0.298	17.132*	-1.282	7.213*	-1.131

Notes: * and ** denotes rejection at 5 and 10 percent significance level. The null hypothesis for Levin, Lin & Chu, Breitung, Im, Pesaran and Shin, AD-Fisher, and PP-Fisher test is that the series is a unit root process. The null hypothesis for Hadri test is the series has no unit root. The unit root test is based on the case series with constant term. Variable X represents exports of goods and services, MM denotes imports of goods and services plus current transfer and income, and GDP represents the gross domestic product.

After confirming the non-stationarity of the variables, we proceed by estimating equation (2.17) applying the PMG estimation technique. The lag order was first chosen for each country on the unrestricted model by the Schwarz Bayesian Criterion (SBC), with subject to a maximum lag of 2. Then, using these SBC criteria selections of lag for orders, homogeneity was imposed. The most common choice by the country was an ARDL (1, 1), i.e. one lag for both X and MM variables. Thus, the autoregressive distributed lag (ARDL) (1, 1) equation is as follows

$$X_{it} = \mu_i + \delta_{1i} MM_{it} + \delta_{2i} MM_{i,t-1} + \lambda_i X_{i,t-1} + \varepsilon_{it} \tag{2.44}$$

The error correction equation is given by

$$\Delta X_{it} = \phi(X_{i,t-1} - \theta_{0i} - \theta_{1i} MM_{it}) - \delta_{2i} \Delta MM_{it} + \varepsilon_{it} \tag{2.45}$$

By using Gauss[7], optimization of the log-likelihood function was performed by applying the Newton-Raphson method and using the mean group estimates as initial values. Table 2.2 reports the estimated long-run relationship of the pooled mean group (PMG) for both developed (high-income countries) and developing countries (middle-income and low-income countries). PMG estimator imposes a common long-run effect and short-run relationships to differ.

In practice, for a cointegration (long-run relationship) to hold, it is required that ϕ coefficient is statistically negative. For high-, middle- and low-income countries, the results revealed that the error correction coefficient is statistically negative at 5% level of significance suggesting a rejection of the null hypothesis of no cointegration between X and MM.[8] Thus, the coefficient of parameter MM is evaluated to confirm the sustainability position. Since we used the ratio variables, it is sufficient to have $\beta = 1$ or (-1) in order for the trajectory of the debt to GDP not to diverge in an infinite horizon.

Table 2.2
Cointegration test on current account sustainability position

	High-income countries	Middle-income countries	Low-income countries
	Pooled Mean Group estimator ARDL (1,1)		
MM	-1.162 (0.028)*	-0.538 (0.035)*	-0.566 (0.025)*
ϕ_i	-0.140 (0.027)*	-0.170 (0.034)*	-0.296 (0.075)*
No of observations	26	36	19
LR statistic	42.38 [0.000]*	111.39[0.000]*	31.55 [0.000]*

Notes: * and ** indicates significance at 5 and 10 percent respectively. Numbers in brackets represent the standard error. ϕ_i denotes speed of the adjustment (error correction term). The null hypothesis is no cointegration. The LR statistics testing for equal long-run parameter. Numbers in parenthesis represent the p-value.

While the MM estimated coefficient for the high-income countries group is estimated at 1.162, this suggests a strong sustainability position for high-income countries. In addition, the results also indicate that MM grows equally with the X. For middle- and low-income group countries, the results reveal that the estimated MM coefficient is

[7] Thank you to Professor Dr Hashem Pesaran and Dr Joakim Westerlund for providing the Gauss routines.

[8] For a robustness check, this paper also tests the sustainability position by employing other approaches, dynamic fixed effect, and static fixed effect and mean group estimation, and the results do not vary sensibly.

found to be less than one with -0.538 and -0.566 respectively, which indicates the MM grows more than the increase in X, implying the unsustainable condition of current account. We could also confirm that PMG estimators are robust to the choice of lag order as claimed by Pesaran et al. (1999).[9] In addition, the likelihood ratio provides evidence of rejection of the null of no equal long-run parameter at 5 percent significance level, suggesting that the long-run parameters are homogenous among the countries in the sample.

The error correction term explains the speed of convergence towards equilibrium if shocks (sudden stop) occur. Based on the adjustment coefficient, all group countries (high income, middle income and low income) are found to have a slow phase of speed of convergence to equilibrium ranging from 14 percent to 29.6 percent. In other words, if a shock occurs in the economy, a country takes about 14 percent to 29.6 percent of speed convergence back to equilibrium. As has been discussed earlier, sustainability has also been defined as the likelihood that a country will not undergo a sudden stop. With a slow phase of speed this could also indicate that the speed of divergence from equilibrium, if there is a shock, is considerable fast. Thus, even for the high-income countries which are found to have strong current account position, the likelihood of divergence from the equilibrium is considerably fast. Additionally, middle- and low-income countries which have an unsustainable of current account also could be considered as highly vulnerable.

Furthermore, the PMG estimator allowed us to estimate a country-specific long-run relationship by using the error correction coefficient for a long-run relationship (Appendices 2.4). In other words, we could reveal those countries where both variables, X and MM are cointegrated, which indicate a sustainable current account position. It shows that the error correction coefficient for Canada, Japan, Australia, New Zealand, Denmark, France, Germany, Netherlands and Spain could reject the null of no cointegration at 5 percent significance level while it could reject the null for Italy at 10 percent significance level implying a sustainable current account position. In addition, with the coefficient of MM equal to 1, we could conclude that Canada, Japan, Australia, New Zealand, Denmark, France, Germany, Netherlands and Spain are in the current account sustainability position.

[9] Results estimation by using the SBC criteria selection is attached in the Appendix 2.3.

To provide robust evidence of cointegration between the X and MM variable, this chapter also re-examines the cointegration relationship with the panel cointegration test proposed by Westerlund (2006) which considers any potential of structural breaks with the null hypothesis of cointegration. The results of cointegration are shown in Table 2.3 where the test statistics are based on FMOLS for constant and constant with deterministic trend. For high income countries, the case without structural break (ignoring the possibility of structural change), shows that the test statistic of 0.253 and 0.632 for constant and constant with trend respectively failed to reject the null of cointegration among the variables. However, after taking into consideration the structural breaks, the LM test statistics for constant and constant with trend are 0.122 and 13.188 respectively, found to reject the null at 5 percent significance level, implying no cointegration relationship between the variables only for the case constant and trend.

Meanwhile, for middle income group countries, the test statistics show rejection of null hypothesis of cointegration for case without structural break with the test statistics of 4.299 (with constant) at 5 percent significance level and 4.299 (constant with trend). In addition, for the case with structural break, the LM test statistics are 4.299 and 14.877 for constant and constant with trend respectively, implying a rejection of the null of cointegration at 5 percent significance level.

Table 2.3
Panel cointegration with multiple structural breaks

	High income countries		Middle income countries		Low income countries	
	Constant	Constant and trend	Constant	Constant and trend	Constant	Constant and trend
Model without structural break	0.253	0.632	4.299*	4.269*	3.367*	0.962
Model with structural break	0.122	13.188*	5.299*	14.877*	2.572*	5.928*

Notes: The test statistics are based on FMOLS estimation for the case with constant and trend. Maximum number of break allowed is 5. * denotes significant at 5 percent significance level and the null hypothesis is an existence of cointegration.

In addition, the results found for the low income countries shows that the test statistics of the model without structural break reject the null of cointegration at 5 percent significance level with the estimated value of 3.367 (with constant term), while the model that takes into consideration structural break able to reject the null with the test statistics of 2.572, implying evidence of no cointegration relationship for the low

income countries. While, the case that includes constant and trend recorded a test statistic of 5.928 for the case with structural break.

However, according to Westerlund (2006), for the cases of cointegration with structural break, the performance of test with shifts in both intercept and trend can be poor unless the time series of each sub-sample after each break is sufficiently long.

As such, by ignoring the possibility of structural break, there is an evidence of sustainable current account position for the high-income countries. Meanwhile, the sustainable of current account position for the high-income countries are robust even after taking into consideration of the structural breaks in the estimated model. However, the unsustainable of current account position for the middle-and low-income countries are robust even after taking into consideration of the structural breaks in the estimated model. This finding is in line with the results of cointegration relationship provided by the PMG method which confirms the sustainable current account position of high-income countries, while an unsustainable current account position for middle- and low-income countries for the period 1978- 2004.

In addition, the Westerlund (2006) cointegration test is also able to detect the structural/ break point. The estimated structural break point for all groups of countries is reported in Appendix 2.6. 27, 24 and 11 correspond to the number of breaks are found to occur from the period of 1978-2004 for the high- middle- and low-income countries respectively. The points of breaks are determined by Westerlund (2006) using Bai and Perron (1998, 2003), which obtains the location of the breaks by globally minimizing the sum of squared residuals. The breakpoints show that most of the high-middle and low-income countries are having structural break at the end of 70's plausibly due to the post-oil war crisis

It seems reasonable that, for the period 1978-1980, most of the countries around the world, including the high-, middle- and low-income countries, were suffering from the post-oil war crisis impact. Between 1975 and 1978, policy stance shifted towards restriction in many countries, and policy was aimed at controlling inflation with substantial exchange rate pressure. Meanwhile, for the period 1988-1989, it appears that the impact of trade liberalization through tariff reduction could be the plausible

explanation for the breaks for some General Agreement on Tariff and Trade (GATT) members such as the United Kingdom and Canada.

It is notable that Finland, France, Greece, Iceland, Ireland, Italy and Portugal experienced structural change for the year 1999. According to the OECD's Economic Outlook (1999), current account imbalances experienced by some OECD countries are due to the counterpart adjustment of the financial crisis in South East Asia, differences in economic growth and cyclical position, and changes in competitiveness as well as underlying structural factors. Meanwhile structural reforms among the developing countries (low income) have shown different results (Shafaeddin, 2005).

To provide additional robust evidence of the long-run cointegration between the variables, this paper tries to investigate whether the results hold for the entire period. The results by sub-period analysis are presented in Table 2.4. The sample has been divided into two sub-periods which is based on the structural break points, found by using Westerlund's (2006) cointegration test. By dividing the sample into two sub-periods there is additional evidence on the sustainability position for the high-, middle- and low-income countries.[10] Based on the error-correction term, it is found that, the cointegration relationship is hold for the high-, middle-, and low-income countries. This implies that, a necessary condition of a sustainable current account position are been satisfied for the overall sample for the period of 1978-2004. However, the sufficient condition ($\beta = 1$) could not be detected for the high-income countries during the period 1978-1990. Furthermore, there is no sufficient evidence of current account sustainability found for the middle-and low- income countries for the overall period (1978-2004).

As a conclusion, for high-income countries, the current account sustainability position is found to be present in the period 1990 to 2004. In contrast, 12 years before the period 1990, the current account position is found to be unsustainable. While results for middle- and low-income countries are robust over time, this indicates that the unsustainability of current account position is robust for the overall period (1978-2004).

[10] The author is aware that, by dividing into two sub-samples, the analysis might lose some degree of freedom on the estimation.

Table 2.4
PMG estimation with sub-period breaks

	1978-1989	1990-2004
	High-income	
MM	-0.854	-1.062
	(0.026)*	(0.032)*
ϕ_i	-0.539	-0.511
	(0.137)*	(0.082)*
	Middle-income	
MM	-0.242	-0.799
	(0.036)*	(0.017)*
ϕ_i	-0.607	-0.516
	(0.035)*	(0.075)*
	Low-income	
MM	-0.323	-0.636
	(0.009)*	(0.023)*
ϕ_i	-0.935	-0.546
	(0.097)*	(0.090)*

Notes: * and ** indicates significance at 5 and 10 percent respectively. Numbers in brackets represent the standard error. ϕ_i denotes speed of the adjustment (error correction term). The null hypothesis is no cointegration.

2.6.2 Fiscal sustainability

The analysis of fiscal sustainability begins with the examination of government intertemporal budget constraint. Two panel unit root tests, developed by Im et al. (2003) and Hadri (2000) are been employed. The results are reported in Table 2.5. The panel unit root test results reveal that both variable R and G are cointegrated at level form indicates that both series are stationary variables. In addition the results hold for all group sample countries, high-, middle- and low-income countries. A country is considered sustainable when both variables are stationary at level or first difference. While for the both variables that cointegrated at first difference, I(1) variables, the next step is to proceed with the cointegration relationship (Appendix 2.2). This implies that the government in high-, middle- and low-income countries are found to obey their government intertemporal budget constraint suggesting a sustainable fiscal position.

Table 2.5
Panel unit root test for fiscal sustainability analysis

	High income		Middle income		Low income	
	Level	First differences	Level	First differences	Level	First differences
R			Test statistics			
Im, Pesaran and Shin	-3.378*	-15.66*	-1.784*	-25.50*	-3.043*	-15.96*
Hadri	10.67	3.136*	5.371	6.143*	8.9402	1.2265*
G			Test statistics			
Im, Pesaran and Shin	-2.584*	-11.31*	-3.564*	-23.64*	-3.602*	-18.54*
Hadri	6.638	2.195*	4.215	5.177*	7.2257	2.5417*
SP/GDP			Test statistics			
Im, Pesaran and Shin	-2.372*	-15.45*	-4.175*	-18.16*	-0.614	-13.53*
Hadri	6.005	-0.913*	5.254	0.298	4.4710*	1.580*
DEBT/GDP			Test statistics			
Im, Pesaran and Shin	-4.068*	-9.981*	-2.880*	-8.925*	3.223*	-6.605*
Hadri	9.813	5.371	0.782	1.743*	7.086	1.780*
YVAR			Test statistics			
Im, Pesaran and Shin	-13.37*	-13.03*	-12.43*	-16.44*	-7.882*	-10.77*
Hadri	-2.00469	-0.01358	0.131	-2.067	-0.634	-0.711
GVAR			Test statistics			
Im, Pesaran and Shin	-11.56*	-16.042*	-11.73*	-17.809*	-9.231*	-12.64*
Hadri	-2.229	0.522*	0.010	1.302**	-0.500	3.093*

Note: The results are based on the Im, Pesaran and Shin (2003), and Hadri (2000) models. REV represents government revenue, EXP is government expenditure, SP is government budget surplus and DEBT is a public debt. * and ** denotes significance at 5 and 10 percent respectively.

As a result, the high- and middle-income countries as well as the low-income countries are found to be sustainable for their fiscal position which is in line with results obtained by Westerlund and Prohl (2006) who analyze the case of developed countries.

To provide additional insight and evidence on the sustainability of government fiscal policy position, we make use of the debt dynamic model proposed by Bohn (1995). Before estimating equations (2.23) and (2.24), this study starts with the panel unit root test which is to determine the stationary condition for all variables. The results of the panel unit root test of Im et al. (2003) and Hadri (2000) have also been reported in

Table 2.5. Results for high-, middle- and low-income countries confirm that variables SP/GDP, Debt/GDP, YVAR and GVAR are found to be stationary at level, indicating that they are I(0) variables. After confirming the stationarity status, we next estimate equation (2.23) by employing the fixed effect model.

Estimations of the interaction relationship between SP/GDP (primary surplus) and DEBT/GDP debt variables by using panel OLS with fixed effect models are reported in Table 2.6 for all group countries. For high-income countries, results reported by fixed effect estimators found that debt-to-GDP variables are consistently positive and significant at least at 5 percent significance level. In other words, a one percent increase in the debt/GDP is associated with the increase in the primary budget surplus for about 0.028 percent, thus indicating that the fiscal policies in the high-income countries are complying with their intertemporal budget constraints. The positive relationship shows that governments take some corrective action to increase their budget surpluses with an increase in debt levels.

In addition, the GVAR and YVAR variables are also consistently negative and significant (at 5 percent significance level) for all estimates, implying that the surplus would decrease if the government spent more than usual or the economy was contracted.

Table 2.5
Government surplus function

	Fixed effect estimation		
	High-income countries	Middle-income countries	Low-income countries
Intercept	-0.033 (0.002)*	-0.053 (0.010)*	-0.024 (0.003)*
$Debt/GDP_{t-1}$	0.028 (0.009)*	0.029 (0.017)**	0.001 (0.007)
GVAR	-1.250 (0.184)*	-0.036 (0.017)*	-0.888 (0.215)*
YVAR	-1.305 (0.367)*	0.124 (0.070)**	-0.476 (0.274)**
No of observations	14	16	5
Adjusted R-squared	0.14	0.51	0.19

Notes: * and ** denotes significance at 5 and 10 percent respectively. Numbers in brackets indicate the robust standard error.

Meanwhile, for the middle-income countries group, the debt/GDP variables are found to have been positive and significant (10 percent significance level) with the movement in the primary budget surplus. An increase in debt/GDP by one percent is associated with the increase in primary budget surplus of 0.029 percent. However, the debt/GDP is found to be insignificant to have an impact on government surplus function for the low-income countries. It also shows that the debt/GDP variable is consistently positive even though it is insignificant. In addition, there is less evidence to provide the information that governments perform some correction with regard to their increasing debt levels.

For a robustness check, this paper also considered the panel random effect estimation. However, the Hausman test provides evidence with a chi-square statistic of 86.7 rejecting the null hypothesis of no correlation between the individual effect and the explanatory variables. Thus, it explains that the individual effect is correlated with the explanatory variables, implying that only the fixed effect estimator is consistent and efficient.[11]

In summary, the debt/GDP contributes to explaining the variation in budget primary surplus and indicates that governments take some corrective action over the increasing debt level, particularly in the high- and middle-income countries. In other words, governments try to correct the imbalances in the primary budget deficit by increasing the primary surplus in order to maintain a government solvency position in the future. As a result, this may indicate a sustainable condition in fiscal position for the high- and middle-income countries group. Besides that, the coefficients on GVAR and YVAR are negative and significant as predicted by Barro's tax-smoothing model.

Additionally, Bohn proposed a model that examines the interaction of growth rate of debt with the current level of debt to GDP. Results estimated by fixed effect on debt modelling are shown in Table 2.7. It is found that, for the high-income countries group, debt/GDP variable negatively and significantly (at 5 percent significance level) affects the growth in debt. In addition, an increase in debt/GDP is associated with a decrease in the growth rate of debt in the next period. The results are found to be

[11] Results on random effect estimation are attached in Appendix 2.7.

consistent with the previous analysis which is based on the primary surplus function and their intertemporal budget constraint.

Table 2.7
Debt reaction function

	Fixed effect estimation		
	High-income countries	Middle-income countries	Low-income countries
Intercept	0.069 (0.003)*	0.010 (0.022)*	0.013 (0.010)
Debt/GDP	-0.141 (0.074)**	0.202 (0.045)*	0.016 (0.031)
GVAR	-0.163 (0.46415)	-0.084 (0.04589)**	0.312 (0.394)
YVAR	0.889 (0.717)	0.225 (0.203)	0.652 (0.849)
No of observations	14	16	5
R-squared	0.140	0.183	0.067

Notes: * and ** denotes significance at 5 and 10 percent respectively. Numbers in brackets indicate the standard error and have been estimated using robust standard error.

However, for middle-income countries, the debt/GDP is positive and significant for the movement in the growth rate of debt. A 1 percent increase in debt/GDP is associated with the increase in the growth of debt of about 0.202 percent. Meanwhile, for the low-income countries, the debt/GDP variable is insignificant for the growth in debt.

Given this development, there is convincing and conclusive evidence to confirm that the fiscal policy position for the high-income and middle income countries is sustainable. This evidence is in line with Westerlund and Prohl (2006) who found the evidence of fiscal sustainability for the European countries and eight OECD countries. However, it is noted that, the results also reveal that government also increase the growth in public debt.

In addition, given the insignificant efforts of governments in the primary budget surplus function and the debt function model, there is no evidence that could relate to a sustainable fiscal policy position for the low-income countries.

2.7 Conclusion

The main intention of this paper is to analyze the sustainable condition of developed and developing countries based on the current account and fiscal policy position. The rationale behind this notion is twofold: Analysis of the sustainability could provide information on imbalances and be useful for policy formulation purposes since it might give an early warning signal of crises erupting: in addition, comprehensive analysis of the current account (external) and fiscal policy (internal) position could give an extensive picture of the real sustainability position.

After identifying various possibilities for models of sustainable position, it is found that the high-income countries are in a sustainable position for current account, indicating that the intertemporal budget constraints are being maintained. In addition, Canada, Japan, Australia, New Zealand, Denmark, France, Germany, Netherlands and Spain are found to have a current account sustainability position for the period 1978-2005. In contrast, the middle- and low-income countries are found to be classified as in an unsustainable position of current account throughout the period. In addition, this paper also found that all group countries have a slow phase speed of convergence towards equilibrium which suggests that they are exposed to a high degree of vulnerability to any sudden shock or stop in the economy. Thus, governments need to formulate policy that could increase savings (domestic and international) to correct the imbalances and protect the country from any sudden stop or shock. Thus, further analysis of the impact of sudden shock on the external sector could be considered for future study.

Conclusive evidence on the sustainability of fiscal policy position is found for the high and middle income countries. There is evidence that governments in the high-income countries obey their intertemporal budget constraints and take some corrective action to improve and maintain government financial position. Meanwhile, for the case of middle-income countries, government policy formulation is subject to their intertemporal budget constraint and does take corrective action to improve budget surplus with regard to the increase in the level of public debt. This evidence could shed light on the sustainability of fiscal policy. This implies that, with an increasing debt level, governments in the high- and middle-income countries are capable of repaying their public debts with an effective fiscal policy implemented. This may also

give a positive signal to the creditors that their financing is profitable and repayable. Besides that, the issues of the increasing level of public debt which are associated with in increase in growth of public debt in the next period need to be analyzed in further detail. This plausible reason could be related to the effects of government borrowing to help domestic investment as well as growth, which will be analyzed in Chapter 3. Furthermore, this could also potentially be due to the fact that benefits received from the public debt are more than the cost incurred, which also will be examined in Chapter 4.

In addition, according to Freund (2000), the current account adjustments of developed countries are closely related to the business cycle. Furthermore, during the recession, demand for foreign goods declines and current account improves. In contrast, based on the experience of some emerging market economies' currency crisis in the 90s, postponing the current account adjustment will result in a high stock of foreign indebtedness and increase the probability of being in default. Thus, Rogoff (2006) suggests that the global imbalances have to be considered a vulnerability in the global economy and sensible risk management would seen to call for some effort to mitigate the problem.

Chapter 3

Debt growth nexus: Evidence on developing countries

3.1 Introduction

There is a vast body of empirical literature analyzing the factors that contribute to a country's economic growth. On the other hand, issues on high levels of indebtedness among developing countries and the impact on economic growth also gain attention among policy makers, researchers and academics around the world. In the past two decades, due to scarce resources in domestic economies, external debt has become one of the important sources for domestic capital, (i.e. domestic investment) which in turn could help to generate economic growth.[12] In a world of diminishing returns, it is noted that the developing countries should gain from capital flight through mechanisms such as international trade and foreign investment from the developed countries. This is a reflection of the higher marginal product of capital in less productive economies (less developed, which is a feature of developing countries) that attract new investment and continue until the capital-labour ratios, wages and capital returns equalize (Lucas, 1990). Besides of capital flight through foreign direct investment and portfolio investment, the role of external borrowing to help the domestic economy has started to gain interest among the policymakers. Otani and Villaneuva (1989), Agenor (2000), Villaneuva (2003), and Mariano and Villaneuva (2006) has highlighted the role of external borrowing in economic growth. As such, external borrowings are aim to boost the domestic investment and economic growth as well as a sustainable economy position.

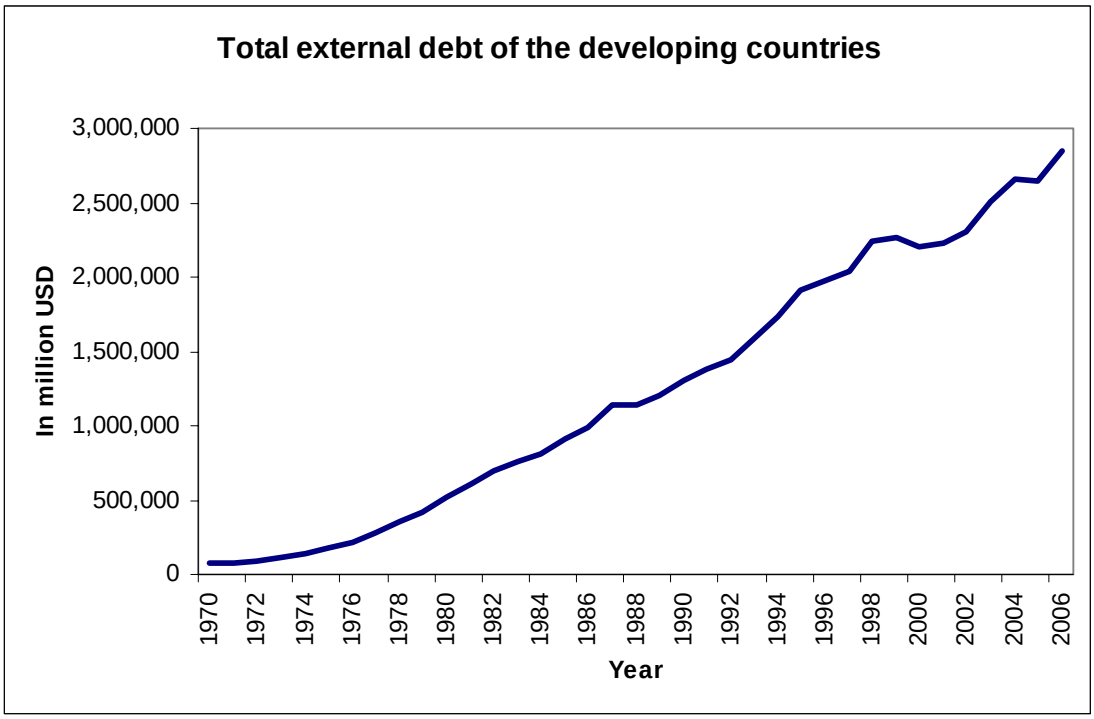
As at the end of 2006, total outstanding external debt of the developing countries is recorded at US$ 2, 843,800 million has shown an increasing pattern since the 1970's.

[12] Total external debt is defined as, at any given time, the outstanding amount of those actual current and non-contingent liabilities that require payments of principal and/ or interest by the debtor at some point in the future and that are owed to non-residents by residents of an economy (IMF, 2003).

(Figure 3.1). This tremendous increment is about 39.6 percent from the year 1970 with the total outstanding amounting to US$ 70, 067 million. The increasing pattern of external borrowing indicates that external debt has become one of the important potential sources for helping boost domestic economic growth.

However, the Heavily Indebted Initiatives that were launched in 1996 by the World Bank had raised the issue of whether the external borrowing has been allocated efficiently to investment. In other words, with the main objective of boosting domestic economies which has resulted in high levels of external indebtedness, countries, mostly the low-income ones, are still faced with the difficulties of unsustainable debt which is also associated with high levels of poverty (which make them eligible to receive the initiatives). As such, this development has raised the issue of the impact or role of external debt in boosting domestic economic growth.

Figure 3.1
The total outstanding external debt of the developing countries up to 2006



Sources: World Development Indicator (WDI), World Bank.

Theoretically, the positive effect of external debt to country's economic growth could be seen, if the external debt has been efficiently allocated to the domestic investment. In return, this could generate economic growth in the long run. In addition, having the benefit of economic growth this could also improve the capability of servicing the debt without crowding out the country's investment. Despites the positive impact of external borrowing, a country also experiences a negative (adverse) impact on economics growth which is related to debt management issues where debt has not been productively channelled into investment as well as economic growth. As such, with high level of indebtedness, countries would not be able to generate more economic growth and fail to repay debt. Furthermore, the repayment of debt could squeeze the investment which sequentially resulting in lower economic growth. With the high level of indebtedness, low level economic growth and low capability to repay debt, this situation could also be explained as the debt-overhang situation.

Besides that, as explained by capital market imperfection, there is no effective mechanism to prevent the borrowers (who are normally the developing countries) from being in default to the lenders (who are normally developed countries). As such, this experience has given a lesson to the developed countries to withhold lending or capital investment, which has resulted in less capital flow to the most of developing countries.[13] Even with a high level of indebtedness where debt service could "crowd-out" investment or, to a lesser extent, cause stagnant or declining economic growth, most of the developing countries have tried their best not to default. This is because the incident of default could have incurred or imposed costs such as reputational costs (exclusion from the international capital market for future borrowing), international trade exclusion costs, costs to the domestic economy through the financial system and political costs to the authorities (Borensztein and Panizza, 2008). Meanwhile, debt-overhang could be explained by the situation where, with additional external debt, a country has too much debt that is not effectively contributing to economic growth. In addition, this could affect the ability of the country to repay its debt and interest payments while more interest payments (arrears) are added when the country delayed the repayment. Furthermore, the interest payment could also affect the investment rate as well as economic growth.

[13] This phenomenon could be related to the Lucas paradox where the flow of capital does not flow to the poor countries.

Being neither in default, nor in a debt-overhang situation is not the best solution for a country to maintain a sustainable position. Thus, by analyzing the effects and relationship between external debt and economic growth, we could intuit whether countries have benefited from external borrowing over the past 20 years. In contrast, this could also give a signal about the effectiveness of debt management policies in the developing countries. In other words, with regard to the findings of this paper, governments could formulate policies that could prevent countries for being in default or in a debt-overhang situation. This raises the issue of whether external borrowing helps to boost domestic investment and capital accumulation as well as economic growth, or whether it could become a burden that has to be paid for by future generations?

Besides that, the impact of large indebtedness on a country's growth might have a different effect, related not only to macroeconomic performance, but also to political, geographical and institutional matters. Traditionally, each economy has been considered as an independent unit and the possible space-interaction among countries has been ignored (Ray and Montouri, 1999). Furthermore, interaction among neighbouring economies is also an important factor in explaining economic growth. Countries could interact strongly with each other through channels such as trade, technological diffusion, capital inflows and common political, economic and social policies (Ramirez and Loboguerrero, 2002), while international trade could explain the interdependence among the countries. Anselin (1988), states that spatial correlation can be understood as the lack of independence among observations in cross-sectional or panel data. Moreover, spillover effect constitutes an important element in explaining growth among countries. Thus the geographical aspect is important and should be considered when analyzing the growth model.

The main objective of this paper is to gauge the role of external debt to economic growth. Furthermore, this paper also aims to analyze the debt-investment relationship for the developing countries. This could provide evidence on the "disincentive effects" of high debts, due to the debt overhang and to macroeconomic instability, as well as the liquidity constraint which could refer to the adverse effect of debt service on investment and growth. This chapter is also concerned with the importance of considering spatial dependence among developing countries in the growth model.

This analysis is important since any results found from the linkages between the external borrowing and economic growth would be useful for policy formulation. In this case, debt could boost or impede economic growth. Regardless of whether there is a positive or negative relationship between external debt and economic growth, the non-linear relationship of debt and growth is important for providing an optimal level or threshold for a country to manage its debt position. Besides that, this chapter could give an indirect signal to creditors regarding a country's ability to service its debt in the future.

This chapter is distinct from other research in several aspects. Firstly, this paper contributes to the small but growing body of empirical literature on the debt-growth nexus. Furthermore, this analysis provides more detailed analysis to investigate whether the relationship between debt and growth is robust for all the developing countries in the sample. This paper also investigates the existence of the debt-Laffer curve relationship. Thirdly, this is the first attempt to analyze the relationship of the debt growth nexus by using a spatial correlation approach. Moreover, no empirical study has been carried out to determine whether location matters for the debt-growth model. An analysis of the contribution of external debt to economic growth from a panel spatial econometric approach rather than a cross-sectional or time series (country specific) analysis could provide a valuable addition to existing empirical studies. Thus, this study attempts to fill this gap in the literature. This chapter is organized as follows**.** Section 3.2 reviews the theoretical model and empirical literature on the debt-growth nexus. Section 3.3 reports on model specification. The procedure of the estimation and the data set that has been used in the analysis are explained in section 3.4 and 3.5 respectively. Meanwhile, the empirical results are presented in section 3.6, and section 3.7 concludes the chapter.

3.2 Literature review

In the neoclassical growth theory developed by Solow-Swan (1956), the domestic saving financing the aggregate investment with labour-augmenting technological change is exogenous in determining the equilibrium growth of per capita output. However, the growth model is feasible in the closed economy where there is no interaction with the rest of the world. In addition, Mankiw, Romer, and Weil (1992)

extend the Solow-Swan model to include human capital in the growth model by retaining the assumption of constant returns to scale in all inputs (diminishing returns to physical and human capital). Relatively small changes in resource devoted to physical and human capital may lead to large change in output per worker. In the era of globalization, the interdependence among countries in the world through trade and capital flow has inspired Otani and Villaneuva (1989), Agenor (2000), Villaneuva (2003), and Mariano and Villaneuva (2006) to develop a growth model for the open economy that incorporated a global capital market role. The framework is an extension of a neoclassical growth model with slight modification that incorporates endogenous technological change. The works starts with Otani and Villanueva (1989) that developed a simple aggregate growth model that is capable of assessing the impact of macroeconomic policies on the long-term performance of a developing country. Precisely, the model analyzes the accumulation of capital and the dynamic of external debt. With an expenditure on human capital play a critical role in development process, the higher marginal product of capital, it will increase the warranted rate of growth to a higher rate. Furthermore, the development of human capital is also essential when the external debt burden is already excessive. In addition the fiscal policy adjustment does not only reduce the foreign debt burden, by raising the capital effective labor ratio, it also has permanent positive growth effect (Agenor, 2000). Meanwhile, the aggregate capital stock is defined as the accumulated sum of domestic saving, global capital market, and net external borrowing (Villaneuva, 2003). In addition, the difference between the expected marginal product capital, net of depreciation, and the marginal cost of funds in the international capital market determine the proportionate rate of change in the external debt-capital ratio. Furthermore, Villaneuva (2003) added that when the expected net marginal product of capital matches the marginal cost of funds at the equilibrium capital-labor ratio, the proportionate increase in net external debt is fixed by the economy's steady-state output growth and the external debt to output ratio stabilizes at a constant level. Meanwhile Mariano and Villaneuva (2006) correct the shortcoming of the Villanueva (2003) where the model is unable to settle the steady-state external debt ratio that is consistent with maximum consumer welfare. As such, on the balance growth path, Mariano and Villanaeuva (2006) choose the domestic savings rates that maximize social welfare by maximizing long-run consumption per unit of effective labor.

According to Krugman (1988), high debts have adverse effects on the economic growth and this situation could be related to the debt-overhang theory. Moreover, he defines debt-overhang as a situation in which the expected repayment on external debt falls short of the contractual value of the debt. If there is some likelihood that, in the future, debt will be larger than the country's repayment ability, the expected debt-service cost will discourage further domestic and foreign investment (Pattilio, Porison and Ricci, 2002). In other words, large debt burdens could squeeze investments because returns are "taxed away" through debt service payment by foreign creditors. Furthermore, high debts have a negative impact on the rate of investment and economic growth because of disincentive, cash flow and moral hazard effects (Claessens, Detagiache, Kanbur, and Wickham 1997).

However, at a reasonable level of foreign borrowing, external debt could have a positive impact on investment and growth. The relationship between the face value of debt and investment can be represented by a "Laffer Curve". If the outstanding debt increases beyond a threshold level, the expected repayment begins to fall as a consequence of adverse effect. In other words, on the upward-sloping or good section curve the implication is that an increase in the face value of debt is associated with an increase in expected repayment up to a threshold level. Along the bad section of the "Laffer Curve", an increase in the face value of debt reduces expected payment.

Besides that, the uncertain condition of the outstanding stock of external debt could result in a low level of economic growth. Risk of default, rescheduling and arrears are likely to increase the volatility of future inflows and additional lending, while the access to capital market depends on the perceived sustainability (Gunning and Mash, 1998). As a result, investors would choose to wait before entering the market. Moreover, an unstable macroeconomic environment could lead to misallocation of resources which reduces the efficiency and productivity of capital and leads to a slowdown in economic growth. Pattillo et al. (2004) argue that the main channel through which debt affects economic growth is the quality and efficiency of investment rather than its level, because the exclusion of the investment rate from the growth regression does not change significantly the adverse debt effect.

A high-level stock of indebtedness and low level of investment in the 1980s by several Latin America countries has inspired Cohen (1995) to analyze whether the high debt stock could be the best predictor for the low level of investment rate. However, large debtors do not expect to service their debt, thus investment should not be crowded out. Surprisingly, the impact of debt flows (debt service) could affect economic growth by crowding out private investment or altering the composition of public spending. Higher debt service can raise the government budget deficit thus reducing the public savings**.** This in turn may either raise interest rates or crowd out credit available for private investment, dampening economic growth (Clements, Bhattaoharya and Nguyen, 2003). Higher debt service payments can also have adverse effects on the composition of public spending by shrinking the amount of resources available for infrastructure and human capital, with a negative effect on growth.

Over the past decades, academicians and policymakers have shown a consistent interest in and effort to investigate and develop the theory on the link between debt and economic growth. However, to the best of my knowledge, there have been few empirical studies done to analyze the linkages between debt and economic growth and most of the empirical studies have investigated for the period 1969-1999. Furthermore, none of the empirical studies have incorporated the spatial approach in this study.

Previous empirical evidence has found mixed results to support the debt-overhang hypothesis. Clements et al. (2003), Abdelmawla Mohamed (2001), Chowdury (2001), Wijeweera, Dollery and Pathberiya, (2005) and Sen, Kasibhatla and Stewart, (2007) found evidence to support the negative effect of external debt to country's economic growth. In other words, an increase in the stock of debt has a negative impact on economic growth. Results from a large dataset of 61 developing countries indicates that the negative impact of high debt on growth operates both through a strong negative effect on physical capital accumulation and on total productivity growth (Pattilio et. al. 2004). In addition, Wijeweera et al. (2005) found a negative but insignificant long-run relationship between debts and economic growth for Sri Lanka, while the study by Clements et al. (2003) found that the stock of external debt has an indirect effect on growth through its effect on public investment.

Pattilio et al. (2002, 2004), Cordella, Ricci and Ruiz-Arranz, (2005) and Imbs and Ranciere (2005) found evidence of non-linearity in the debt growth relationship. Furthermore, Patillio et al. (2002) found that the average impact of debt on per capita growth appears to become negative for debt levels above 160-170 percent of exports and 35-40 percent of GDP. Furthermore, Clements et al. (2003) found that, above the threshold of 20-25 percent of GDP and 101-105 percent of exports, external debt is associated with lower rates of growth for 55 low-income countries. However, the study done by Schclarek (2004) is in contrast to the others since there is no evidence of non-linearity (inverted –U shape relationship) for selected developing countries.

Meanwhile the flow of debt, particularly the debt service of external debt, could affect growth by crowding out private investment or public spending. Study by Iyoha (1999) provide the evidence of the crowding-out effect in the Sub-Saharan African countries, implying that the heavy external debt stock and debt service payment act to reduce investment. Clement et al. (2003) also support the crowding-out effect for 55 low-income countries. On the other hand, Pattillio et al. (2004) found that one-third of the effect of debt on growth occurs via physical capital accumulation and two-thirds via total factor productivity growth.

3.3 Model Specification

The dual-gap theory that is an extension of Harrod-Domar growth model has highlighted the motivation of the introduction of debt in a growth model. The model explain the two gaps, namely savings gap and foreign exchange gap could be inadequate and not sufficient to support the expected level of growth. As such, the role of external or foreign borrowing to economic growth has been discovered even though it depends on the condition of the two gaps whether savings-investment gap is larger or import-export gap is larger. The increase of foreign borrowing will increase until the gaps are narrowing-down and the expected marginal product of capital is equal to the marginal cost of funds.

Inspired by the dual-gap theory Otani and Villaneuva (1989), Agenor (2000), Villaneuva (2003) and Mariano and Villaneuva (2006) developed a theory on the relationship of external debt with economic growth through several mechanism such

as fiscal policy adjustment. This has reveals the role of external debt in contributing to country's economic growth. On the other hand, Villanueva (2003) has extent the standard neoclassical growth model that incorporates endogenous technical change and global capital market. Inspired by the basic Solow growth model

$$y = LK^{\infty} \tag{3.1}$$

where the output level y are a function of effective labor L and the capital stock, K. In addition, Villanueva (2003) defines the aggregate capital stock is the accumulated sum of domestic saving and net external borrowing. As been explained in the neoclassical growth model, a country that intends to increase the economic growth could increase their saving which lead to the increase in investment to a lesser extent economic growth. In addition, Villanueva (2002) claims that economic growth will not increase until capital stock has risen up to a certain level. As such, a rise in capital through debt accumulation will resulted in increase in saving rate, investment rate and economic growth. Thus, to investigate whether the external debt or the borrowing has contributed to the economic growth, a modified reduced form of debt-growth model by Clements et al. (2003) are estimated as follows:

$$y_{it} = \alpha_i + \beta_1 y_{i,t-1} + \beta_2 debt_{it} + \sum_{j=1}^{k} \beta_j x_{itj} + \varepsilon_{it} \tag{3.2}$$

where y_{it} is the output level for country *i* at time *t*. Meanwhile, the $y_{i,t-1}$ is the lagged on income (output from the previous period) that aim to capture the convergence of income effect across countries. Meanwhile debt is included as an exogenous variable. x_{it} is a set of independent variables include lagged per capita income, debt service ratio, population, gross investment, secondary enrolment rate, term of trade growth, openness and fiscal balance in the debt-growth nexus model.. ε_{it} represent the error term and α_i represent the country specific effect. Lagged per capita income is included as in the standard Barro growth model in order to test for convergence across countries over time. Population and gross investment represent the rates of growth of factor inputs in the production function, while secondary school enrolment rate is used as a proxy for the quality of human capital. Meanwhile, changes in terms of

trade variables represent the external shocks to the economy and the openness is included as additional control variables. The fiscal balance captures the role of government in economic growth. Thus, the growth model to be estimated is

$$y_{it} = \beta_0 + \beta_1 y_{i,t-1} + \beta_2 X_{1,it} + \beta_3 X_{2,it} + ... + \beta_9 X_{8,it} + \varepsilon_t \quad (3.3)$$

where (for country *i*, at time *t*) y_{it} is growth rate of GDP per capita, $y_{i,t-1}$ is lagged of initial income, $X_{1,it}$ is external debt to GDP, $X_{2,it}$ is a debt service ratio, $X_{3,it}$ is secondary education, $X_{4,it}$ is gross investment, $X_{5,it}$ is fiscal balance, $X_{6,it}$ is openness, $X_{7,it}$ is changes in terms of trade, and $X_{8,it}$ is population growth. The lagged of initial income and external debt to GDP are expressed in natural logarithmic. In addition, external debt, gross investment, fiscal balance and trade openness are calculated as percentage of GDP while debt service ratio is calculated as a percentage of GNI.

To provide an in-depth analysis of the impact of external debt on economic growth, the investment model has also been examined. Based on a basic model in (3.2), we employ the model proposed by Presbitero (2005) and analyze the impact of external debt and debt service to investment directly. The dependent variable is gross investment rate while χ represents lagged of investment rate, GDP growth rate, aid, secondary enrolment rate, domestic credit, openness, government revenue and debt service ratio. The growth of GDP is expected to capture the investment accelerator (Iyoha, 1999).The investment model is

$$I_{it} = \alpha_0 + \alpha_1 I_{i,t-1} + \alpha_2 X_{1,it} + \alpha_3 X_{2,it} + ... + \alpha_9 X_{8,it} + \upsilon_t \quad (3.4)$$

where (for country *i*, at time *t*) I_{it} is investment rate, I_{it-1} is lagged of investment rate, $X_{1,it}$ is GDP growth rate, $X_{2,it}$ is aid , $X_{3,it}$ is domestic credit, $X_{4,it}$ is revenue, $X_{5,it}$ is openness, $X_{6,it}$ is term of trade, $X_{7,it}$ is debt service ratio and $X_{8,it}$ is external debt. The external debt is expressed in natural logarithmic. Besides that, total aid and debt service payment are computed as a percentage GNI. Meanwhile, domestic credit, government revenue, trade openness and external debt are calculated as a percentage of GDP.

Studies by Wijeweera et al. (2005) and Abdelmawla (2005) have focused on a time series (country specific) cointegration approach while Chowdhury (2001), Iyoha (1999), Pattilio et. al. (2002, 2004), Clements et.al. (2003), Presbitero (2005) and Sen et al. (2007) are interested in analyzing the linkages by using a panel econometrics approach. However, none has employed the recent technique of spatial econometrics to incorporate the neighbour effect in the debt-growth model.

3.4 Estimation Procedures

Within a dynamic panel data of System-GMM estimation framework, we examine the role of external debt in economic growth for the sample of 31 developing countries within the period 1970-2005. To provide an additional insight into the role of external debt in a country's economic growth, this chapter also divided the sample into 2 sub-samples: the Heavily Indebted Poor Countries (HIPC) and non-Heavily Indebted Countries (non-HIPC). Furthermore, we also estimate the model by using a recent spatial econometrics technique to capture any interdependence effect among the countries.

3.4.1 Generalized Method of Moments (GMM)

A general dynamic panel model for country *i* at time *t*:

$$Y_{it} = \delta Y_{it-1} + X_{it}\beta_1 + X_{it}\beta_2 + ... + \varphi_i + \varepsilon_{it} \qquad (3.5)$$

where φ_i is the vector of country effect, x_{it} is a N x *p* matrix of *p* explanatory variables, and ε_t is the error term and is assumed to be normally distributed. A common approach to estimate a dynamic panel data model in the first difference Generalized Method of Moments (different-GMM) estimator has been proposed by Arellano and Bond (1991):

$$\Delta Y_{it} = \delta \Delta Y_{it-1} + \Delta X_{it}\beta_1 + \Delta X_{it}\beta_2 + ... + \varphi_i + \Delta\varepsilon_{it} \qquad (3.6)$$

The idea of this estimator is to take the first differences to eliminate the source of inconsistency (country specific effect φ_i,) and use the levels of the explanatory

variable lagged two and further periods as instruments. In order for the first difference GMM estimators to be consistent it needs to be assumed that the errors are not second order serially correlated and that explanatory variables are weakly exogenous. However, Blundell and Bond (1998) point out that when explanatory variables are persistent, the lagged level of the explanatory variables is weak instruments for the variables in differences. They show that, in a small sample, the shortcomings of weak instrument translate into large finite sample bias. By adding (3.4) into the original equation (3.5), a level to a system of equations that also include equation in first differences, the system Generalized Method of Moments (system–GMM) estimators is particularly useful in controlling for country-specific effects. Additionally, it preserves the cross-country dimension of the data that is lost when only the first differenced equation is estimated (Arellano and Bover, 1995; and Blundell and Bond, 1998).

In the system-GMM estimator, the equations in first differences eliminate the fixed effect in the model. Moreover, the difference equations are combined with equation in levels, which are instrumented with the lagged first differences of the corresponding explanatory variable. In other words, the system-GMM estimators control for the potential endogeneity of all explanatory variables by using the instrumented variable. In order to use these additional instruments, we need the identifying assumption that the first difference of the explanatory variables is not correlated to the explanatory variables; the correlation is supposed to be constant over time. If the moment conditions are valid, Blundell and Bond (1998) show that, in Monte Carlo simulations, the system GMM estimators perform better than the first difference GMM estimator. We can test the validity of the moment conditions by using the conventional test of over-identifying restrictions proposed by Sargan (1958), testing the null hypothesis that the error term is not second order serially correlated. The system GMM procedure has several advantages in analyzing the economic growth model. In particular, by taking a first difference to remove unobserved time-invariant country specific effect, this has eliminates the bias by any omitted variable that are constant over time (Bond et al. 2001). In addition, the use of instrumental variables allow the parameter to be estimated consistently which could eliminate the potential of endogeneity problem as well as in the presence of measurement error.

3.4.2 Spatial dependence

According to Anselin (1988), spatial econometrics is a subfield of econometrics that deals with the treatment of spatial interaction, spatial autocorrelation, and spatial structure (spatial heterogeneity) in regression models for cross-sectional and panel data. Despite the fact that the theoretical mechanisms of technology diffusion, factor mobility and transfer payment, which arguably drive the regional convergence phenomenon, have an explicit geographical component, the role of spatial effects in regional studies has been ignored (Rey and Montouri, 1999). Moreover, the assumption of independence across units is inappropriate because countries are probably going to be exposed to common disturbances which will produce correlation among efforts from different cross-sectional units, (Driscoll and Kraay, 1995).

If the first law of geography - "everything is related to everything else, but near things are more related than distant things" - holds, the i.i.d. assumption (independently, identically, distributed) of efficient and unbiased ordinary least squares (OLS) estimator is void. Thus the OLS estimators could produce biased and inefficient results and, to a lesser extent, a misleading conclusion. In other words the OLS estimation is inappropriate for the model that includes spatial effect. According to Elhorst (2003), the OLS estimation of the response parameter will lose its properties of unbiasedness and consistency in the case of a spatially lagged dependent variable while, in the case of spatial error autocorrelation, the OLS estimation of the response parameter will lose its property of efficiency even though it is unbiased.

In general, spatial dependence can be incorporated in two distinct ways: in the error structure ($(E[\varepsilon_j, \varepsilon_j] \neq 0)$ or as an additional regressor in the form of spatially lagged dependent variable (Wy). Thus, spatial correlation among the observation could be described by a model of spatial autoregressive process in error term, or a model that contains a spatial autoregressive dependent variable, known respectively as spatial error model (SEM) and spatial lag model (SAR), (Anselin, 1988). The SEM could be specified as

$$y = X\beta + \phi \tag{3.7}$$

$$\phi = \delta W\phi + \varepsilon \tag{3.8}$$

$$E(\varepsilon) = 0 \quad , \quad E(\varepsilon, \varepsilon') = \Omega(\theta)$$

Equations (3.7) and (3.8) could be rewritten as

$$(I - \delta W)\phi = \varepsilon$$

$$\phi = (I - \delta W)^{-1}\varepsilon$$

$$y = X\beta + (I - \delta W)^{-1}\varepsilon$$

where δ is spatial autocorrelation coefficient (with W the weight matrix) displaying the strength of correlation between the disturbance term ϕ and the weighted average of the disturbance terms of neighbouring countries $W\phi$, and θ is a vector of parameter. A SEM is a special case of regression with a non-spherical error term, in which the off-diagonal elements of the covariance matrix express the structure of spatial dependence (Anselin, 1999). In spatial econometrics, W denotes a (N x N) spatial weight matrix describing the spatial arrangement of the spatial units and w_{ij}, the (i,j)th element of W, where i and j = (1,…, N). It is assumed that W is matrix of known constant, that all diagonal elements of the weight matrix are zero, and the characteristic roots of W denoted ω_i. As such, OLS remains unbiased, but it is no longer efficient and the classical estimate for standard error will be biased. The spatial dependence could be present in the residual when there are some omitted unobserved variables that can be spatially correlated.

Meanwhile the traditional model with spatially lagged dependent (SAR) is defined as

$$y = \delta Wy + X\beta + \varepsilon \tag{3.9}$$

$$E(\varepsilon) = 0, \quad E(\varepsilon, \varepsilon') = \sigma^2 I_N$$

in which W is the weight matrix, δ is the spatial autoregressive coefficient and ε_{it} is vector of error term which is assumed independently of the probability model under

the hypothesis that all spatial dependence effects are captured by the spatially lagged variable. Thus, it could be rewritten as

$$y = (I - \delta W)^{-1} X\beta + (I - \delta W)^{-1} \varepsilon \quad (3.10)$$

in which each inverse can expanded including both the explanatory variable and the error term at all locations. Consequently, the spatial lag term must be treated as an endogenous variable and a proper estimation method must correct for this endogeneity (OLS estimation will be biased and inconsistent due to the simultaneity bias). The spatial econometrics field has first been introduced and analyzed from a cross-sectional approach. This latter approach has been extended to a panel approach since panel data give more information, more variability, less collinearity among the variables, a larger degree of freedom, and more efficiency (Hsiao 1986; Baltagi 1995).

However, the spatial structure could be specified in a number of different ways (Anselin, 1999). By adding some restrictions to the parameter, Kukenova and Jose-Antonio (2008) describe the structure of spatial correlation in a dynamic panel model as

$$Y_{it} = \delta Y_{it-1} + \rho(W_t Y_t)_i + EX_{it}\beta + EN_{it}\gamma + \varphi_i + \varepsilon_{it} \quad (3.11)$$

where Y_t is a N x 1 vector, and W_{1t} and W_{2t} are N x N spatial weight matrices which are non-stochastic and exogenous to the model. φ is the vector of country effect, μ is the vector of time effect, EX_{it} is a N x p matrix of p exogenous explanatory variables and EN_{it} is N x q matrix of q endogenous explanatory variables while ε_t is assumed to be normally distributed. The lag spatial dependent variable allows us to determine if the variable y is positively affected by the Y_t from other nearby locations weighted by distance. This could capture the impact of Y_t from neighbourhood locations.

As has been noted, the spatial lag model faces a simultaneity and endogeneity problem which leads to biased and inconsistent estimation (Anselin, 1988). To overcome this problem, Kukenova and Jose-Antonio (2008) proposed to use the

system-GMM (which estimates the level and difference simultaneously in one system equation) in which the estimation is proved to be consistent. Thus, the system-GMM with spatial lag interaction is as follows:

$$Y_{it} = \delta Y_{it-1} + \rho(W_t Y_t)_i + EX_{it}\beta + EN_{it}\gamma + \varphi_i + \varepsilon_{it}$$

$$\Delta Y_{it} = \delta \Delta Y_{it-1} + \rho \Delta(W_t Y_t)_i + \Delta EX_{it}\beta + \Delta EN_{it}\gamma + \varphi_i + \Delta\varepsilon_{it} \qquad (3.12)$$

As mentioned above, the W matrix represents a weight matrix associated with the autoregressive spatial process of dependent variables. The weighted matrix is exogenous variables which deal with the location or distance issues. W is a block of diagonals matrix of dimension N X N and time-invariant. There are three different spatial weight matrices that had been applied in spatial econometrics literature. The first method reflects the relative position in space, of one regional unit of observations to another unit which is known as a contiguity matrix. The simple contiguity matrix schemes are where countries are defined as neighbours if they share a common border. The second method is based on the shortest great circle distance between each country while the third distance-based weight matrix is specified as a general contiguity matrix where the two countries are defined as neighbours if the distance between the centroids is less than a predetermined critical value.

Besides the assumption that excludes the possibility of the spatial weight being parametric, there is no spatial unit that can be viewed as its own neighbour. In addition, the row and column sum of W must be bounded uniformly in absolute value as $N \to \infty$. Thus the condition is satisfied when the spatial weight matrix is a binary contiguity matrix and is an inverse distance matrix.

However, there is no agreement as to which type of weight matrix should be used in spatial econometric analysis (Anselin, 1988). This paper uses spatial weight matrix that is calculated using a simple inverse distance function which is based on the latitude and longitude coordinates of the main important city (in terms of population). This weight matrix enables us to capture the geographical proximity of the "island" countries (Eliste and Fredriksson, 2004). It could represent the real picture of the

dependency relationship between countries in the region since this study involved missing sample countries due to unavailability of data.

3.5 Data Set

The data set consists of a panel of 31 developing countries during the period 1970 to 2005.[14]. However, due to unavailability of data, the analysis could proceed with only 31 countries out of 149 developing countries. Data are collected from the World Bank, World development indicator (WDI) and Global Development Finance (GDF), IMF/IFS statistics, World Economic Outlook database, and Barro-Lee dataset. Distance measurements (latitude and longitude of the main important city) are taken from Centre D'Etudes Prospectives Et D'information Internationales (CEPII)[15]. The used of flow of borrowing could provide an evidence on the immediate effect to country's economic growth ('credit impulse'). However, due to the unavailability of data on the international borrowing, the analysis is estimated using the stock of debt variable. The observations were averaged over 5 years interval which resulted in t =7. This is to avoid modelling the cyclical dynamic of the output variable which is a highly persistent series (Bond et al., 2001).

3.6 Empirical Results

In this section empirical evidence on debt growth nexus is presented. A System-GMM has been employed to analyze the role and impact of external debt on growth. Furthermore, the effect of debt service payment on investment rate has also been estimated in the investment model. In addition, the growth model has also been estimated by quadratic function to investigate the existence of the Laffer-Curve (inverted U- shaped) relationship. On the other hand, to provide robust evidence on the relationship between external debts and growth, this paper also estimates the growth and investment model, samples of which are divided into sub-samples; HIPC and non-HIPC.

[14] Details on the countries are in Appendix 3.1
[15] http://www.cepii.fr/anglaisgraph/bdd/distances.htm

3.6.1 Growth and Investment Model

Table 3.1 presents the results of the growth and investment model for the overall sample (31 countries) for the period 1970 to 2005 estimates by System-GMM estimator. The reported results are based on the one-step GMM estimators where standard errors are asymptotically robust to heterocedasticity.[16] The results in panel a show that external debt to GDP variable has a negative and significant (at least at 5 percent significance level) impact on economic growth. The estimated coefficient is -5.71, indicating that an increase of 1 percent of external debt stock is associated with a decline in growth of GDP per capita of least 0.06 percent. This could support the negative impact of external debt to economic growth. These results are found to be in line with the study done by Pattillo et al. (2004), who also found that a high level of external debt caused a significant slowdown of economic growth. In addition, the result shows that the debt service has a negative but insignificant effect in explaining the growth rate of GDP per capita. However, the elasticity of the debt service with regard to economic growth is -0.03, implying that an increase of 1 percent in debt service payment is associated with a slowdown of the economy by at least 0.03 percent of per capita income.

Other control variables, such as gross investment, fiscal balance and population growth, are found to have a positive and significant (at 5 percent significance level) effect in explaining the growth rate of GDP per capita, while the openness variable is significant in contributing to economic growth with a positive sign and significant at 10 percent significance level. Despite the positive relationship between gross investment and fiscal balance, the changes in terms of trade variable is found to have a negative and significant (at 5 percent significance level) effect on economic growth. This indicates that external shock contributes negatively to economic growth in developing countries (Clements et al. 2003). In other words, countries would receive a positive effect when they open their economies to the rest of world but need to be prepared with a precaution guideline, to face any sudden shock to their economies.

Besides that, the p-values of 0.87 reported by Sargan test could not reject the null hypothesis of no over-identifying restriction for the estimation. This shows the

[16] According to Blundell and Bond (1998), the one-step GMM estimators are also reliable for finite sample inference, while a Monte Carlo study has shown that by estimating the two-step estimator are gain small efficiency slow in converging to its asymptotic distribution (Bond, Hoeffler and Temple, 2001).

system-GMM estimator does not indicate a serious problem with the validity of these instrument variables.

Table 3.1
The impact of external debt in developing economies

	System- GMM
A)Growth model	
Initial income$_{(t-1)}$	-13.123 (5.626)*
External debt	-5.714 (2.040)*
Debt Service	-0.035 (0.028)
Secondary education	0.146 (0.097)
Gross investment	0.364 (0.099)*
Fiscal balance	0.123 (0.041)*
Openness	0.081 (0.041)**
Term of trade	0.000 (0.000)*
Population growth	1.908 (0.292)*
Constant	85.929 (113.06)
Sargan test	0.869
Instrument for first difference	L.(1/.) external debt
Instrument for level	D. external debt
B)Investment model	
Investment rate $_{(t-1)}$	0.222 (0.063)*
Debt service	0.054 (0.035)
External debt	-0.744 (1.735)
GDP growth rate	0.225 (0.041)*
Aid	0.040 (0.043)
Secondary education	0.126 (0.087)
Domestic credit	0.024 (0.012)**
Openness	0.113 (0.020)*
Government revenue	0.004 (0.004)
Constant	65.852 (126.64)
Sargan test	0.543
Instrument for first difference	L(1/.) debt service
Instrument for level	D. debt service

Notes: * and ** denotes significant at 5 and 10 percent significance level respectively. Numbers in brackets represent the robust standard error. The value reported for Sargan test is the p-value for the null hypothesis, valid specification. The initial income and external debt are expressed in natural logarithm. Data are for five-year intervals.

With the aim of providing an in-depth analysis of the debt growth nexus, this study also analyzed the direct link between debt and investment. The results are shown in lower panel (panel B) of Table 3.1. The negative but insignificant sign obtained from the relationship between external debt and investment rate could also suggest that external debt are not been allocated efficiently to the investment. In addition, these findings support the results obtained from the growth model estimation which suggest negative effect of external debt and economic growth. Meanwhile, other explanatory variables, domestic credit and openness are found to have positive and significant impact to investment rate at 10 and 5 percent, respectively.

The debt service payment is found to have a negative but insignificant impact in explaining the movement in the investment model. The debt repayments coefficient is also found to have a small effect on the investment rate with a considerably small coefficient of 0.05. Meanwhile the external debt to GDP variable shows a negative but insignificant effect on the investment rate, suggesting no conclusive evidence regarding the relationship between external debt and domestic investment. The p-value of 0.543 reported by Sargan test in the investment model also could not reject the null hypothesis, suggesting that a valid specification without an over-identifying problem exist in the estimated model.[17]

It is noted that the total sample in this analysis includes countries with different levels of indebtedness: less indebted, moderately indebted, and severely indebted countries. To provide robust evidence of the relationship between external debt and economic growth, this paper split the sample into two sub-groups: Heavily Indebted and Poor Countries (HIPC) and non- Heavily Indebted and Poor Countries (non-HIPC). By dividing the sample, we could establish evidence of the impact of external debt on the economy, and examine whether the negative relationship represents the real relationship between external debt and economic growth for all developing countries. Furthermore, this paper estimates the growth model for the overall and non-HIPC group for the period 1996 to 2005. Out of 31 countries in the sample, only 9 are

[17] This paper also tests for a robustness check with the bias-corrected least-squares dummy variable estimators which hold with a small number of cross-sectional units in panel data. By adapting Kiviet and Bun's (2001) bootstrap procedure to estimate the asymptotic variance-covariance matrix, Bruno (2005) has extended Bun and Kiviet (2003) to accommodate the unbalanced panel. The results reveal consistent results with the estimated system-GMM to provide robust evidence of negative effect of external debt on economic growth. Results are attached in Appendix 3.6.

classified as heavily indebted poor countries (HIPC) by the World Bank. The HIPC group is a set of countries that are eligible to receive debt relief due to several debt indicator variables that are above the HIPC initiatives thresholds. [18]

Results for the growth model on the overall sample reveal a negative and significant (at 5 percent significance level) effect of external debt on economic growth (Table 3.2). In addition, the coefficient of external debt shows that an increase in external debt stock by 1 percent is associated with a decline of 0.064 percent in the growth rate per capita. The results are consistent with regard to the negative and significant effect of external debt on economic growth for the overall sample (31 developing countries) which is useful for further analysis. However, when estimating the non-HIPC growth model, the external debt variable is found to be negative but insignificant in contributing to economic growth.

Intuitively, the strong evidence of negative effect of external debt on economic growth provided by the overall sample represents the existence of a negative relationship between external debt and economic growth for the HIPC-group and left the relationship of the debt to growth for the non-HIPC group ambiguous. However, it is noted that even though the external debt variable is not significant, the sign of the coefficient is negative with respect to growth.

On the other hand, the debt service payment was also found to have a negative and significant (at 5 percent significant level) impact on a country's economic growth for the overall sample for the period 1996 to 2005. An increase in 1 percent of debt service payment has a negatively significant impact on growth with a decline in economic growth of 0.30 percent. The elasticity of the debt service payment in the growth model for the overall period (1970-2005) is found to be smaller than the estimation for the sample 1996 to 2005.

This could be due to the post-crisis (recovery period) effect for several Asian and Latin America countries when the recovery process has slowed down the growth while the debt is required to be repaid at the scheduled time. In particular, estimation

[18] The HIPC initiatives were launched in 1996, when 33 countries were defined as heavily indebted poor countries and eligible to receive debt relief. Debt relief provided is in terms of reducing the external public and publicly guaranteed debt.

of debt service payment in the growth model for the non-HIPC countries was found to have a negative and insignificant effect on economic growth. In addition, the elasticity (coefficient) is relatively small as compared to the overall sample (for the period 1996-2005), implying that an increase in debt service payment in the non-HIPC countries has a slower effect on economic growth when compared to the HIPC or the overall sample. Therefore, the results also suggest that the negative effect is predominantly among the HIPC countries.

Table 3.2
Impact of external debt on growth (1996-2005)

	System-GMM	
Growth model	Non-HIPC	Overall
Initial income$_{(t-1)}$	-58.46 (11.178)*	-59.94 (17.03)*
External debt	-3.923 (2.885)	-6.440 (2.308)*
Debt Service	-0.098 (0.144)	-0.299 (0.124)*
Secondary education	0.255 (0.271)	-0.088 (0.302)
Gross investment	0.338 (0.156)*	0.165 (0.110)
Fiscal balance	0.129 (0.119)	0.107 (0.077)
Openness	-0.018 (0.034)	-0.008 (0.028)
Term of trade	0.001 (0.000)	0.001 (0.000)
Population growth	4.490 (5.987)	2.860 (2.252)
Constant	-186.17 (432.95)	-428.51 (354.14)
Sargan test	0.979	0.996
Instrument for first difference	L(2/.)investment, external debt	L(1/.)investment, external debt
Instrument for level	DL. investment, external debt	D. investment, external debt
Investment model		
Investment rate $_{(t-1)}$	0.383 (0.102)*	0.243 (0.186)
Debt service	-0.066 (0.174)	-0.010 (0.200)
External debt	-0.310 (1.552)	-0.205 (2.559)
GDP growth rate	0.398 (0.096)	0.332 (0.117)*
Aid	-0.296 (0.353)	-0.115 (0.154)
Secondary education	-0.047 (0.187)	-0.278 (0.177)
Domestic credit	0.0437 (0.024)**	0.069 (0.060)
Openness	0.072 (0.026)*	0.086 (0.033)*
Government revenue	0.003 (0.005)	-0.010 (0.010)
Constant	362.14 (1.49)	211.69 (0.89)
Sargan test	0.99	0.99
Instrument for first difference	L(1/.)investment, GDP growth	L(2/.)investment, GDP growth
Instrument for level	D. investment, GDP growth	DL. investment, GDP growth

Notes: * and ** denotes significant at 5 and 10 percent significance level respectively. Numbers in brackets represent the robust standard error. The value reported for Sargan test is the p-value for the null hypothesis, valid specification. The initial income and external debt are expressed in natural logarithm. The number of observations for the non-HIPC countries is 22 out of a total number of 31 countries.

Meanwhile, in the investment model, external debt and debt service payment are not significant in contributing to a movement in investment rate for the overall sample and the non-HIPC group, while the openness is found to contribute positively and significantly (at 5 percent significance level) to the investment rate.

Results on Table 3.3 is been estimated by using the system-GMM test. As shown in Table 3.3, there is no evidence to support the existence of an inverted-U shape relationship between the debt stock and growth. The inverted-U relationship explains that an increase in debt stock has a positive effect to economic growth until it achieves its optimal level (up to certain level). Beyond the threshold level, an increase of stock of indebtedness is associated with negative effect to economic growth. The negative effect could be related where it is not been efficiently allocated to investment as well as too much debt holding that might squeeze the investment through debt repayment. However, the results shows that the external debt ^2 variables is insignificant which suggest that there is no evidence of inverted-U shape relationship in the debt-growth model. This finding is also in line with the study done by Schclarek (2004).

Table 3.3
Debt-Laffer curve of growth model

	System- GMM
Initial income$_{(t-1)}$	-18.89
	(7.076)*
External debt	-6.950
	(3.077)*
External debt^2	-0.493
	(0.984)
Debt Service	-0.022
	(0.038)
Secondary education	0.185
	(0.110)**
Gross investment	0.402
	(0.085)*
Fiscal balance	0.103
	(0.049)**
Openness	0.065
	(0.034)**
Term of trade	-0.000
	(0.000)*
Population growth	0.674
	(0.399)**
Constant	144.94
	(127.14)
Sargan test	0.99
Instrument for first difference	L(1/.) external debt
Instrument for level	D. external debt

Notes: * and ** denotes significant at 5 and 10 percent significance levels respectively. Numbers in brackets represent the robust standard error. The initial income and external debt are expressed in natural logarithm. Data are for five-year intervals

3.6.2 Spatial dependence

To allow for the spatial interaction in the debt-growth model, this chapter makes use of the aforementioned method of System-GMM with spatially lagged dependent. Prior to the test, a preliminary analysis is conducted to detect the existence of spatial correlation and it is presented in Table 3.4. We start to investigate the existence of spatial correlation among the countries in the sample with a general diagnostic test to detect for spatial correlation. In particular, four different tests are considered; The Moran's I test, LM error test for spatial correlation in residuals, LR test, and Wald test, to detect the existence of spatial autocorrelation in the residuals from a least-squares model. To the best of my knowledge, no diagnostic statistics have been developed to analyze the existence of spatial correlation in a panel data approach. As such, this paper tries to utilize the available diagnostic test which is based on the cross-sectional approach.

Table 3.4
Diagnostic test on spatial correlation on the debt-growth model

	Rejection the null of no spatial correlation
Moran's I test	1995,2001,2004
LR test	1974,1976,1977,1979,1985,1986,1991,1993,1998,1999,2001,2004
Wald test	1970,1973,1974,1976,1977,1979,1980,1982,1985,1986,1988,1991,1993, 1995,1996,1998,1999,2001,2004,2005
LM error test (SAR)	1970,1971,1974,1975,1976,1977,1979,1980,1985,1986,1988,1991,1992, 1993,1994,1997,1998,1999,2000,2004,2005
LM error test (SEM)	1976

The results are summarized in Table in 3.4.[19] The first test is Moran's I test statistics for spatial correlation in residuals which is based on the least-squares residuals that correspond to a standard normal distribution. The Moran's I statistics are positive and could reject the null of no spatial correlation for 1995 (at 10 percent significance level) and 2001 as well as 2004 (at 5 percent significance level), indicating the existence of the spatial correlation in the model estimated by the least-squares. The positives and significant values for Moran's I indicates that countries have levels of location establishment similar to neighbouring countries and a high value in the country of interest may be surrounded by high value in nearby countries. However, the Moran's I statistics reveal the general presumption of spatial dependence and do not allow us to discriminate between spatial error model and spatial lag model (Anselin and Rey, 1991). In addition, the results implies that the debt-growth model for the hypothesis of independent observation which underlies OLS estimation is not valid.

The results of the likelihood ratio test are formulated based on the difference between the log likelihood from the SEM model and the log likelihood from a least-squares regression. The test statistics reject the null hypothesis of no spatial correlation for the years 1974, 1976, 1977, 1979, 1985, 1986, 1991, 1992, 1993, 1999 and 2004 (at 5 percent significance level), and 1997 and 2001 (at 10 percent significance level), implying the existence of spatial correlation in the growth model through that period. The Wald test statistics for testing the residual spatial autocorrelation presented in row

[19] Details on the results of diagnostic test are presented in the Appendix 3.5.

three show strong evidence of spatial correlation for most of the period. This provides strong evidence of the existence of spatial correlation in the cross-sectional sample.

The Lagrange multiplier (LM) is used to test for a specific form of spatial dependence and to check whether spatial lag model or spatial error model is best for robust estimation (Anselin, Florax and Ray, 1991). If both tests for spatial error and spatial lag are significant, the larger of the test statistics implies the better model.

The Lagrange multiplier (LM) test is an asymptotic test which follows chi square distribution with one degree of freedom and test for error dependence. Meanwhile, the LM lag test, which is based on the least-squares involving the spatial weight matrix W in column four, provides evidence of rejection of the null at 5 percent significance level for most of the period as compared to the error model which is significant (at 10 percent significance level) only for the year 1976. Furthermore, the coefficient provided by the LM test for lag model is higher than in the error model, implying that the role spatial correlation is strong in the lag model rather than in the error model. The LM lag test confirms a highly significant context, so that its modelling is not only possible but necessary (Anselin, 2001). Thus, the result suggests that the spatial autoregressive specification (spatially lagged endogenous variable) best matches the data generating process for the estimated model. Thus, the next analysis will focus on estimating the lag model for the debt growth model.

In the presence of a spatially lagged dependent variable, simultaneity will result in OLS estimates which are both biased and inefficient. According to Anselin (1988), the spatial lag model (SAR) faces a simultaneity and endogeneity problem which could lead to bias and inconsistent estimation. This problem could be solved through instrumentation (IV and GMM). Meanwhile, Kukenova and Jose-Antonio (2008) show that the system-GMM can estimate consistently the spatial lag coefficient which takes into account the endogeneity and simultaneity problem. Table 3.5 shows the results of the growth model, estimated by system-GMM with a spatial lagged dependent variable.

The results found that the external debt variable is statistically negative and significant at 5 percent significance level. The coefficient of -4.906 indicates that an

increase (1 percent) in the external debt stock led to a decline in economic growth by 0.05 percent. Thus, this evidence supports the negative relationship of external debt and economic growth, which is in line with the results estimated by system-GMM with the absence of spatial interaction. Furthermore, the debt service payment is found to have a negatively significant effect (at 10 percent significance level) on economic growth. In addition, the gross investment and fiscal balance as well as the trade openness (at 5 percent significance level) were found to have a positive and significant impact on economic growth. However, the inclusion of spatial lagged dependent variable to the standard model does not considerably change the effect of other determinants (independent variables). In other words, the addition of spatial lagged dependent variable does not significantly affect the estimation of the rate for the economies to move towards their steady-state. Even though it does not change the results significantly, this has contributed to found one important omitted variable in the debt-growth model.

The lagged spatial autoregressive coefficient shows positively and is significant at 5 percent significance level in the debt growth model. Thus confirmed that the spatial autoregressive specification model is the best represents the data as been suggested by the LM specification test that had been obtained earlier. The spatial coefficient represents growth spillover between countries where the spatial lagged dependent variable is estimated to be 0.15 and is statistically different from zero with at least 95 percent level of confidence. This parameter may also be interpreted directly as elasticity. The spatial lag parameter can be interpreted as a 1 percent increase in the GDP per capita growth rate of surrounding countries, and will result in 0.15 percent increase in growth rate of GDP per capita in the home country.

Table 3.5
Impact of external debt on growth

	System- GMM with spatial lagged
Growth model	
Initial income$_{(t-1)}$	4.459
	(16.52)
External debt	-4.906
	(2.043)*
Debt Service	-0.059
	(0.003)**
Secondary education	0.129
	(0.110)
Gross investment	0.417
	(0.105)*
Fiscal balance	0.075
	(0.036)*
Openness	0.102
	(0.043)*
Term of trade	-0.000
	(0.000)*
Population growth	1.241
	(0.314)*
W*dependent variable	0.154
	(0.032)*
Sargan test	0.99
Instrument for first difference	L(2/.)initial income
Instrument for level	DL. initial income

Notes: * and ** denotes significant at 5 and 10 percent significance levels respectively. Numbers in brackets represent the robust standard error. The value reported for Sargan test is the p-value for the null hypothesis, valid specification. The initial income and external debt are expressed in natural logarithms. Data are for five-year intervals

In other words a country whose are growing is better positioned to enjoy growth spillover and other externalities generated by surrounding countries than those countries which are isolated. In contrast, if a country whose neighbouring countries experience a recession or economic downturn, proximity can have the effect of suppressing home country activity. In addition, Sargan test statistics with a p-value of 0.996 suggest that the estimators use a valid instrument and the additional instruments of the system-GMM are correct.

3.7 Conclusion

The aim of this chapter is to analyze the debt-growth nexus, particularly the debt-growth and the debt-investment relationship with reference to 31 developing countries in the sample. This chapter also employed the recent technique of spatial econometrics to incorporate the 'neighbour' effect in the debt-growth model. Five main points may be summarized from the analysis. First, the accumulation of external debt is associated with a slowdown in the economies of the developing countries. Apart from this, we find evidence that the debt service ratio does not crowd out the investment rate in developing countries. Thus, there are convincing results to support the negative effect of external debt on economic growth but there is no evidence that debt service payment squeezes the investment rate. This could imply that the likelihood of a country being able to service its repayment (principal and interest payment) through investment is still high. In other words, the negative effect could be interpreted as a signal of the symptom of the debt-overhang problem. Third, and correspondingly, the insignificant effect of external debt on investment rate could raise the issue of whether the external borrowing has been efficiently allocated to investment. However, this issue should be analyzed in further detail and with due caution since this is important for policy formulation mainly on the debt management issues. Despite the above findings, fiscal balance, government revenue, openness, and domestic credits are found to have a positive effect on investment and, to a lesser extent, economic growth. Fourth, the analysis also shows that the role of spatial correlation is important and should be considered for any analysis in growth models. Although with the inclusion of spatial autocorrelation does not significantly change the estimated coefficient for other variables, this findings has highlight the important omission variable in the debt-growth model thus increase the accuracy if the estimated results. In addition there is evidence to support the existence of spillover growth among the neighbourhood countries where the spillover effect could potentially through the international trade and foreign direct investment. Fifth, there is no evidence that the debt-Laffer curve relationship exists in the debt growth model, which reflects that the negative relationship of debt with economic growth is robust.

The results have important implications for policy-makers who inspire to generate economic growth particularly for most of the developing countries. It is a major challenge for governments to formulate a prudent debt management policy to control

and maintain the level of indebtedness of their countries at a manageable level before it becomes too late and a country becomes involved in a debt overhang or, to a lesser extent, in default. As external debt is important as a source of capital, the government could play an important role in utilizing the public debt to improve and provide an environment conducive to investment incentive. In return, a climate of investment growth will benefit a country through aggregate national growth. In other words, a well-built infrastructure for investment could help boost domestic investment as well as attract more foreign direct investment into the country. In addition, policy that could generate earnings, especially in foreign revenue, should be formulated wisely. Policies such as an export-led growth strategy could benefit a country, since countries use their foreign earnings to service the external debt. Besides that, a manageable debt level is important since this could affect a country's sovereign ratings and source of funding.

Chapter 4

Is an accumulation of international reserves good for the developing countries?

4.1 Introduction

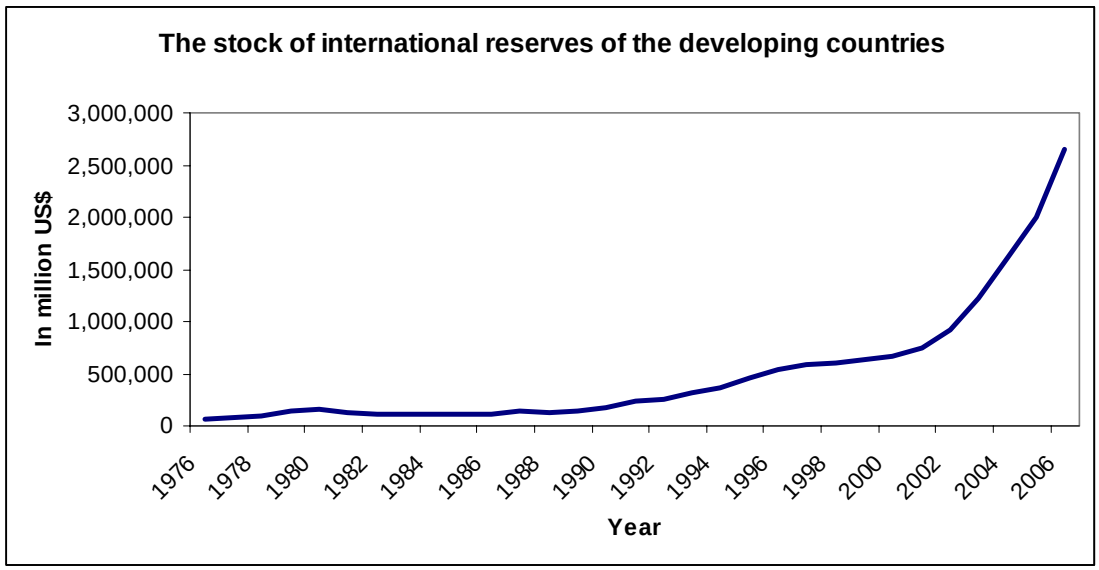
The unprecedented increase of international reserves held by most of the developing countries and emerging economies has raised a debate among the academicians and policy-makers. The central debates are related to the motives of countries holding the bulk of international reserves. [20]

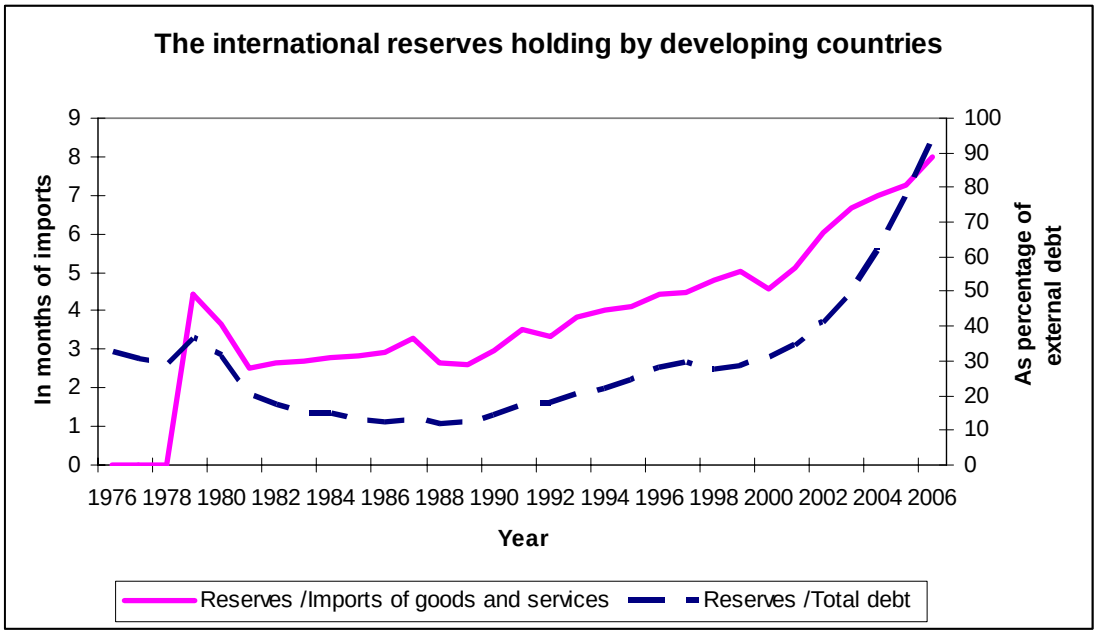
It is notable that the stock of international reserves has been increasing consistently from the period after 1990 (Figure 4.1). The upper panel of the graph shows the increasing pattern of the stock of international reserves over the last three decades for all developing countries in US dollars (millions). In addition, the increasing pattern seems consistent even with different indicators (proxy) of international reserves which are international reserves as a percentage of total debt as well as a month of imports. Besides that, starting from the year 2002, the growth in accumulation of international reserves has increased dramatically and is higher than the previous recorded years (the curve is steeper than the period before 2002). As such, this phenomenon could be explained by the self-protection motive against sudden shock by some of the East Asia and Latin American (crisis-hit) countries which had suffered during the financial crisis in the late 90s. In the era of financial globalization, where financial markets are integrated, countries are faced with the high probability of being more exposed to international financial market vulnerability. In other words, the substantial increase of international reserves in some developing countries has been interpreted as a form of

[20] International reserves consisting of external assets are readily available to control by monetary authorities for direct financing of payment imbalance, directly regulating the magnitude of such imbalances through intervention in exchange rate market to affect the currency exchange rate or other purposes (IMF,1993).

self-insurance against anticipated shocks with regard to financial and economic instability. Thus, a country could possibly be holding more reserves to better withstand adverse external shock.

Figure 4.1
The international reserves of the developing countries





Source: Global Development Financial (GDF) indicator, World Bank

Despite holding the international reserves for a self-protection motive, the hoarding of international reserves could also be related to government intervention in the foreign exchange rate market to maintain a pegged rate. Besides that, an increase in international reserves-holding could also be interpreted as a mercantilist policy, where a country accumulates international reserves to keep its currency low and to enjoy competitive prices in exports, leading to a trade surplus position. In addition, a rise in the volatility of external transactions also increased the holding in stock of international reserves (Aizenman and Lee, 2005). As such, the importance of international reserves primarily stems from the adjustment, liquidity, and confidence problems of countries in the payment mechanism of the international monetary system (Choudhry and Hasan, 2008).

On the other hand, countries simultaneously borrowed from abroad to get external sources of capital to boost their domestic economies. With an increase in the stock of international reserves this could reduce the ability of a country to repay its sovereign debt. As such, countries are associated with a lower probability of repaying their sovereign debt, which could lead to a higher probability of being in default on their sovereign debt. As a consequence, once in default on its sovereign debt, a country will face the probability of being excluded from the international capital market and losing access to future borrowings. Although countries could reduce their debt-sustainable level with regard to accumulation of international reserves, the international reserves-holding is associated with the consumption-smoothing it would allow if the country default.

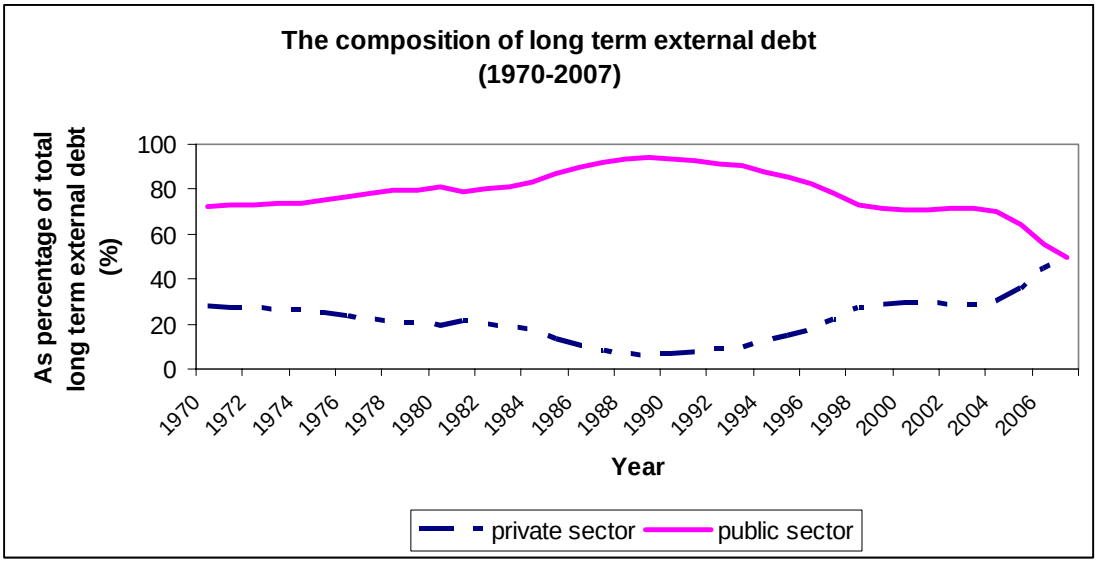
Sovereign debt could be defined as the long-term external debt owed by the public sector to the non-resident. The main objectives of government in borrowing abroad are to finance domestic expenditure, particularly for development purposes. In addition, governments play an important role particularly in borrowing decisions where the composition of public long-term external debt has been approximately more than 50 percent of total long-term external debt since the year 1970 (Figure 4.2).[21]

In order to maintain the economy with a sound and prudent reserves and debt level policy, governments need to make wise decisions on policy formulation regarding

[21] The total long-term debt represents more than almost 85 percent of the total stock of external debt.

jointly-held reserves and sovereign debt-holding. However, reserve holdings and lower outstanding debt are not perfect substitutes even though reserves-holding reduces the amount of sustainable debt, or increases debt-servicing for a given level of debt (Alfaro and Kanczuk, 2008). Thus, with a stockpile cushion of international reserves and liability on sovereign indebtedness, governments need to formulate a strategy on the joint decision of holding international reserves and sovereign indebtedness, since sovereign debt also plays an income-smoothing role in the economy. Maintaining a good reputation to secure new borrowing in the future is important for developing countries. Thus, raises the issue of the cost of holding reserves that also incorporates the stock of indebtedness. In other words, is the holding of international reserves costly with regard to the level of sovereign indebtedness? What is the optimal or best policy on the jointly-held reserves and debt? In addition, the adequate level of international reserves holdings with a level of sovereign debt could also be raised.

Figure 4.2
The long-term external debt of the developing countries



Source: Global Development Financial (GDF) indicator, World Bank

These issues are important for policy formulation since international reserve and debt management are related to a country's access to the credit market in the future. However, by accumulating international reserves and external debt, a country could potentially default (with a high level of indebtedness). On the other hand, by delaying the default, a country with a high level of debt is reducing welfare levels and, to a lesser extent, its sustainable debt position (Grossman and Han, 1997). As such, issues

on international reserves-holding and solvency indebtedness are very important and need to gain more attention for governments to formulate an effective external sector policy.

The aim of this chapter is to analyze the cost of the joint decision of holding international reserves and sovereign indebtedness for developing countries. Precisely, this chapter tries to estimate the cost of holding reserves and sovereign debt with respect to a country's credit risk. Furthermore, this has led the chapter to examine the optimal level of reserves-holding with respect to a country's stock of sovereign indebtedness. Recent developments show that most of the developing countries have simultaneously increased their stocks of international reserves (assets) and external indebtedness (liabilities), which make them perfect candidates to be analyzed. This chapter contributes to the small but growing body of empirical literature on the joint decision analysis of reserves and debt-holding. This chapter focuses on the cost of holding reserves and sovereign debt with respect to credit risk. In addition the study fills a gap in the literature by examining the adequate level of international reserves-holding with all potential reserves indicators by exploiting the recent methodology of threshold estimation. On the other hand, this chapter could provide information about whether countries are saving enough of their international reserves assets with regard to the stock of sovereign debt liability. This chapter proceeds as follows. Section 4.2 reviews the theoretical models and empirical literature while section 4.3 discusses the model specification. The estimation procedure and the data used in this chapter are explained in sections 4.4 and 4.5 respectively. The empirical results are presented in section 4.5 and section 4.6 concludes the paper.

4.2 Review of the literature

The issues around international reserves-holding have gained the attention and scrutiny of researchers since the 1960s. The earlier literature begins with work by Heller (1966), Pagan (1968) and Frenkel (1981), who have contributed to a theoretical framework of the factors that contributed to countries' demand for international reserves. [22] Heller (1966) used an optimizing approach to analyze the demand for international reserves based on cost and benefits analysis. He found that the

[22] For a comprehensive review of literature, please refer to Bahmani-Oskooee and Brown (2002).

propensity to import, the opportunity cost of holding international reserves and the stability of a country's balance of payment account are associated with a country's decision to hold international reserves. An increase in the propensity to import and the cost of holding international reserves would decrease the level of optimal reserves, while the imbalances the in balance of payment position would tend to increase the international reserves-holding. Furthermore, the optimal level of international reserves-holding is given by the amount which minimizes the total cost of adjusting and for financing the external imbalances. Meanwhile, Pagan (1968) reformulated the model proposed by Heller (1966) by adapting an inventory theory. However, the two approaches are sufficiently similar to yield an optimal reserves formula, even though the actual reserves level calculation by Pagan's (1968) formula yields a slightly lower optimal reserves level (Heller, 1968). Frenkel (1981) developed a stochastic model for determining the optimal stock of international reserves. The model emphasises the important role of stochastic characteristics of external transaction and the forgone earnings with regard to holding reserves.

Even though Heller (1966) and Durdu, Terrones, and Mendoza (2007) have developed a model to analyze the opportunity cost of holding international reserves, the theoretical literature on the joint decision in holding reserves and debt are still limited (Gonzalez-Rozada and Yeyati, 2005; and Kanczuk, 2008). Most of the formal models developed have set aside the joint decision of holding external debt and reserves and treated it as given. This has motivated Alfaro and Kanczuk (2008) to construct a stochastic dynamic equilibrium model of a small open economy to analyze the implications of the joint decision of holding external debt and reserves. They found that the current reserve holding does not seem to correspond to the optimal behaviour of a country that can both choose the levels of debt and hold reserves. Furthermore, they claim that the optimal policy is not to hold reserves at all and the developed model is robust to consider an interest rate shocks, sudden stops, contingent reserves and reserves-dependent output costs.

Meanwhile, there is a vast body of empirical literature that analyzes the determinants of demand for reserves, including Frenkel (1974), Aizenman and Marion (2004), Aizenman (2008), Chowdhury and Hassan (2008), Aizenman and Lee (2005), Aizenman, Lee and Rhee (2007), Ramachandran (2004), and Iyoha (1976).

Choudhry and Hasan (2008) found that there is a long-term stationary relationship between level of imports and the average propensity and variability of imports even with fixed and floating exchange rates. Aizenman (2008) suggests that greater financial integration increased the demand for international reserves. In addition, the precautionary demands for international reserves are driven by the attempt to reduce the incidence of costly output decline, induced by sudden reversal of short-term capital flows. Aizenman and Lee (2005) also found that trade openness and exposure to financial crisis are important in explaining the variation in reserves-holding. A study conducted for 29 LDC countries found that expected exports receipts, an instability in the export receipt index, degree of openness, return on reserves, and two lagged values of reserves explained over 93 percent of systematic variations in the reserves-holding behaviour (Iyoha, 1976). In addition, Ramachandran and Srinivasan (2007) suggest that volatility of external transactions has a moderate impact on reserves demand in India.

Despites the growing interest in analyzing the determinants of demand for reserves, researchers are also interested in investigating the opportunity cost of holding reserves (Iyoha 1976; Hipple 1979; Ben-Bassat and Gottlieb 1992; Ramachandran 2004). The opportunity cost of holding reserves also plays a role in models of optimal demand for foreign exchange. However, most studies failed to find a significant opportunity cost effect. Iyoha (1976) estimated a cross-sectional of 29 LDC countries in 1970 and found that a 10 percent increase in the opportunity cost of holding reserves will trigger a 9 percent reduction in the level of reserves held. However, Hipple (1979) argued that the definition and proxy used by Iyoha (1976) is not suitable for representing the opportunity cost and suggests yield rates in United States or London. In addition, Ben-Bassat and Gottlieb (1992) found a significant effect of opportunity cost of the demand for reserves by using the return on capital and reserves as a proxy. Ramachandran (2004) found that the opportunity costs predominantly determine the reserve demand rather than the reserve volatilities. On the other hand, there is still a lack of empirical evidence analyzing the joint cost of holding reserves. A recent study by Yeyati (2008) suggests that self-insurance is costly and should be considered as a second best solution in a context of an imperfect international financial market.

4.3 Model Specification

The recent development in the literatures has established the role of international reserves accumulation as a self-insurance motive against sudden shock. With the jointly decision policy of holding reserves and debt implemented by government, these decision are been proved to have an impact to country's sovereign ratings. Previous studies have provided support for the basic premise that sovereign ratings are significantly linked with the selected economic fundamentals. Cantor and Parker (1996) have suggested the first quantitative assessment of the determinants of sovereign ratings. Despites being as a measurement of country's ability to meet its debt obligation, countries with good credit ratings are potentially easier in getting external fund from abroad to finance their domestic investments. As predicted by the theory, holding more reserves could contribute to improve the sovereign ratings while holding debt downgraded the sovereign ratings. However, holding too much reserves and too little debt might not an optimal policy to be implemented by the government. Thus, to provide suggestion whether a country should increase the international reserves or debt holding with respect to sovereign credit risk, this chapter begins with the analysis of the impacts of the jointly holding reserves and debt to country's credit risk. To analyze the impact of the jointly-held decision of holding international reserves and sovereign debt on credit risk, we first estimate equation (4.1) which is

$$SOVRA_{it} = \alpha_0 + \alpha_1 IR_{it} + \alpha_2 SOVDE_{it} + \alpha_3 X_{3,it} + \alpha_4 X_{4,it} + ... + \alpha_n X_{n,it} + \varepsilon_{it} \qquad (4.1)$$

where (for country i, at time t), $SOVRA_{it}$ is sovereign credit rating (which has been transferred into numerical value) as a proxy of the country credit risk, IR_{it} is international reserves (in million USD) , $SOVDE_{it}$ is sovereign debt (in million USD), $X_3,....X_4,.....X_{n,}$ are represent other explanatory variables which is STD is short-term debt (in million USD), TOT is term of trade, $REER$ is real exchange rate (CPI based), CEX is changes in nominal exchange rate. The sovereign ratings, international reserves, sovereign debt, short-term debt are expressed in natural logarithms.

However, in analyzing the impact of holding reserves and sovereign debt to credit risk, sovereign credit ratings and spread variables could be employed. Sovereign

credit rating could be explained as an assessment on the probability of country to default on their debt obligations. In addition, probability of default could also be interpreted as the country's credit risk. High probability of default is associated with the high credit risk, since a defaulter could face the probability of being excluded from the credit market. As such, to analyze the effect of holding reserves and sovereign debt on credit risk, the sovereign credit ratings are potentially the best indicator.

In addition, spread could also be used to analyze in a more general issue point of view. Spread represents the opportunity cost of holding reserves and debt. In other words, the cost (opportunity cost) of holding reserves and sovereign debt could be measured by using spread as a dependent variable.

In conjunction with the motive of holding reserves as a self- insurance, an adequate or optimal level of reserves is one of the important aspect that need to gain additional attention. Too much stockpile of international reserves are not necessary good for the country which highlighted the issue on the opportunity cost of holding reserves and the methods to measure it. From a broad perspective, the opportunity cost of reserves could be explained as the difference between cost and benefits incurred or yield by the government. In particular, it has been defined by Yeyati (2006) as the return that the government has to pay in excess of the return on the liquid foreign assets to finance the purchase of reserves. Meanwhile, Rodrik (2006), and Jeanne and Ranciere (2008) define the opportunity cost of reserves as the different between the interest rate paid on the country's liabilities and the lower return received on the reserves. Meanwhile an increase in international reserves reduces the probability of costly crises in the case of default and also reduces the spread paid on the stock of sovereign debt which tends to reduce the marginal cost of reserves accumulation.

The opportunity cost for self insurance could also relate to a risk premium rate, while the risk premium is also explaining the probability of country to default. Therefore, Jeanne and Ranciere (2008) suggest the cost of self-insurance should be measured by the pure risk premium (interest rate spread) rather than incorporating the default risk

premium in the model since by adding both risks could overestimates the true opportunities cost of reserves.[23]

To analyze it empirically, this chapter has been inspired by the work of Yeyati (2008) which builds the model based on the Gonzalez-Rozada (2006). To estimate the optimal level of international reserves with respect of its opportunity cost, the model of emerging market spread is proxied by the emerging market bond index (EMBI global) with the stock of international reserves and sovereign debt as the independent variables are included in the estimated model. The estimated model is

$$EMBI_{it} = \alpha_0 + \alpha_1 IR_{it} + \alpha_2 SOVDE_{it} + \varepsilon_{it} \quad (4.2)$$

where EMBI is the emerging market bond index which measures the opportunity cost of holding reserves for the emerging market.

4.4 Estimation procedure

It has been a rule of thumb (convention) to investigate the long-run parameter as reflecting cointegration relationship among a set of I(1) variables. In this paper, a panel unit root test has been applied to determine the stationarity status of all variables to determine the order of integration. In addition, this paper employs a panel unit root test proposed by Im et al. (2003) for a dynamic heterogeneous panel. After confirming the stationary status of each variable, this paper proceeds to estimate the impact of holding international reserves and sovereign debt on credit risk. In addition, this paper also exploits the method on the threshold estimation by Hansen (2000) to analyze the existence of threshold effect in the estimated model. If there is evidence of a threshold effect in the estimated model, further analysis of the optimal level will be examined.

[23] For an extensive review, please refer Jeanne and Ranciere (2008).

4.4.1 Panel Unit Root

This chapter employs panel tests proposed by Im et al. (2003) where the t-bar test statistic is based on the Augmented Dickey Fuller (ADF) statistics that averages across individuals or cross-section. In addition, Im et al. (2003) tests allow for individual unit root process with the

$$\Delta y_{it} = \beta_i y_{i,t-1} + \sum_{j=1}^{pi} \gamma_{ij} \Delta y_{it-j} + x'_{it}\delta_i + \varepsilon_{it} \tag{4.3}$$

where $i = 1,2,3,...N$ the cross-sectional unit and $t = 1,2,3,...T$ time period. In other words, β_i may vary across cross-section. The null hypothesis (unit root) is $H_o : \beta_i = 0$, for all i, against the alternatives that the series are stationary process $H_1 : \beta_i < 0$ for all i. The null hypothesis is tested with standardized *t*-bar statistics proposed by Im et al. (2003)

$$\psi_{\bar{t}} = \frac{\sqrt{N}\{\bar{t}_{NT} - (1/N)\sum_{i=1}^{N} E[t_{i,T}(p_i,0) \mid \beta_i = 0]\}}{\sqrt{(1/N)\sum_{i=1}^{N} Var[t_{i,T}(p_i,0) \mid \beta_i = 0]}} \tag{4.4}$$

where

$$\bar{t}_{NT} = \left(\sum_{i=1}^{N} t_{i,T}(p_i, \beta_i) \right) / N \tag{4.5}$$

and $t_{i,T}(p_i, \beta_i)$ is the individual *t*-statistics for testing $\beta_i = 0$ for all *i*. $E[t_{i,T}(p_i,0) \mid \beta_i = 0]$ and $Var[t_{i,T}(p_i,0]$ are reported in table 2 of Im et al. (2003). $E[t_{i,T}(p_i,0) \mid \beta_i = 0]$ and $Var[t_{i,T}(p_i,0]$ vary as the lag length in the ADF regression varies. Under the null hypothesis, the standard *t*-bar statistic $\psi_{\bar{t}}$ is asymptotically distributed as a standard normal distribution. A Monte Carlo simulation of Im et al. (2003) demonstrates that the t-bar statistic achieves more accurate size and higher

power relative to the Levin et al.(1993) test, when one allows for heterogeneity across groups and serial correlation in errors across groups.

4.4.2 Panel cointegration

The Pooled Mean Group (PMG) estimation technique for dynamic heterogeneous panel introduced by Pesaran et al. (1999) is applied in this paper. The maximum likelihood estimation of the parameter represents an intermediate case between the Mean Group (MG) and the traditional pooled estimation technique (fixed and random effects). The MG estimation averages coefficients to obtain means of the parameter estimates. The traditional pooled estimator such as fixed and random effect estimator allowed only the intercept to differ across group while all other coefficients and error variance are constrained to be the same (homogeneity).

PMG estimation, which involves pooling and averaging, constrained the long-run coefficient to be the same across countries. Besides that, the intercept, short-run coefficient as well as error variances are allowed to differ. One advantage of the PMG estimators over the traditional Dynamic Fixed Effect (DFE thereafter) model is that they can allow the short-run dynamic specification to differ from one country to another. Based on the basic ARDL (p, q_1, q_2,…q_n) model:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} x_{i,t-j} + \mu_i + \varepsilon_{it} \tag{4.6}$$

where x_{it} (k x 1) is the vector of explanatory variables for group i, μ_i represent the fixed effects, the coefficient of the lagged dependent variables, λ_{ij} are scalars, and δ_{ij} are (k x 1) coefficient vectors. Written in error correction form, the specification for the PMG estimator is as follows:

$$\Delta y_{it} = -\Phi_i (y_{i,t-1} - \beta_i x_{it} - \theta_{0i}) + \sum_{j=0}^{q-1} \lambda'_{ij} \Delta x_{i,t-j} + \varepsilon_{it} \tag{4.7}$$

where β_i is the long-run parameter, Φ_i is the error correction parameter and $\theta_{0i} = \frac{\mu_i}{1-\lambda_i}$ .The PMG estimators adopted a maximum likelihood approach to estimate the model using a Newton Raphson algorithm. One advantage of the PMG estimator is that the estimated models are not dependent whether the variables are I(1) or I(0). In addition, Pesaran and Shin (1998) present evidence through the Monte Carlo simulation that the ARDL approach that is based on the delta method can reliably be used in small samples and to test the hypothesis on the long-run relationship in cases of whether there is a mix of I(1) and I(0) regressors.

4.4.3 Sample splitting and threshold estimation

Meanwhile, this paper also tries to examine the existence of threshold effect which made it possible to estimate the optimal amount of international holding with the stock of sovereign indebtedness. Thus, the test proposed by Hansen (2000) to assess the null hypothesis of a linear regression against a threshold regression analysis has been employed. In the form of the thresholds model,

$$y_i = \beta_1^{'} x_i + \mu_i \quad q_i \leq \gamma$$
$$y_i = \beta_2^{'} x_i + \mu_i \quad q_i > \gamma \tag{4.8}$$

where q_i is the threshold variable, which is international reserves IR ; it is used to split the sample into two groups or regimes and could be part of the regressors. Meanwhile y_i is SPREAD measured by EMBI global index. The IR is the observation of the independent variable and also the threshold variable. x_i is *px1* vector of independent variables. The random variable μ_i is a regression error. The model allows the regression parameters to differ depending on the value of IR. Equation (4.8) allows all the regression parameters to differ between the two regimes. The null hypothesis of linearity against a threshold specification can be expressed as:

$$H_0 : \beta_1 = \beta_2 \tag{4.9}$$

Hansen (2000) has developed a threshold model estimator which considered the least squares estimations. In addition, by providing an asymptotic simulation test of the null of linearity against the alternative of a threshold, this method also computed a confidence interval by inverting the likelihood ratio statistics. Besides that, Hansen (2000) also proposes an F-test bootstrap (heterocedasticty-consistent) procedure to test the null of linearity. Since the threshold value γ is not identified under the null, the p-values are computed by a fixed bootstrap method. The independent variables are supposed to be fixed and the dependent variable is generated by a bootstrap from distribution $N(0,\hat{\mu})_i$, where $\hat{\mu}_i$ is the OLS residual from the estimated thresholds model. In other words, it is estimated by fixing the regressors at the right-hand side and generating the bootstrap dependent variable from the dependent variable. Hansen (2000) shows that this procedure yields asymptotically correct p-values. If the null hypothesis of linearity (4.9) is rejected, one can split up the original sample according to the estimated thresholds value and then perform the same analysis on each sub-sample.

The method is employed for this analysis to examine the optimal level of reserves that a country should hold. It could give some indication whether a country hold too much, optimal or too little reserves for self-insurance motive. In addition, with a continous variables such spread and international reserves use in this analysis, this had make method developed by Hansen (2000), the most relevant to be used in this study. The distribution of the threshold estimator is non standard while it only allows one threshold relationship and one threshold variables. Since the threshold γ is not identified under the null hypothesis of no thresholds effect, the p-value is computed using fixed bootstrap (analog) by fixing the regressors from the right-hand side and generate the bootstrap dependent variable from the distribution $N(0,\hat{\mu})_i$ where $\hat{\mu}_i$ is the OLS residual from the estimated thresholds model. Hansen (2000) shows that this procedure yields asymptotically correct p-values. If the null hypothesis of linearity (4.9) is rejected, one can split up the original sample according to the estimated thresholds value and perform the same analysis on each sub-sample. Equation 4.8 allows the regression parameter to switch between the regimes. The results generalize the case where only a subset of the parameter switches between the regimes and the case where some regressors only enter in one of the two regimes.

Intuitively, this estimator can endogenously determine the threshold level of reserves (confidence interval) at which the relation between reserve and sovereign debt with spread changes. In particular, these threshold levels will provide information about the optimal level of reserves where the cost of holding reserves and sovereign debt could be minimized.

4.5 Data set

To examine the cost of jointly holding international reserves and sovereign debt policy to credit risk, we use annual data from various sources: World Development Indicator (WDI) and Global Development Financial (GDF) indicator from World Bank (WB) database, Standard and Poor's, International Financial Statistics (IMF/IFS) by International Monetary Fund (IMF) and Datastream by Thomson. The sovereign credit ratings provided by Standard and Poor's proxy for countries' credit risk, International reserves variables measured as a percentages of a month of imports, external debt, GDP and short-term debt are gathered from IMF/IFS and GDF database. In addition, the US treasury rate measured for long-term interest rate is taken from IMF/IFS database. The real effective exchange rate (REER) which is CPI based, and nominal exchange rates are gathered from Datastream as proxies of other external factors in the estimated model. In addition data on spread represented by Global Emerging Market Bond Index (EMBI) are taken from Datastream as a proxy of opportunity cost. Data on sovereign debt as percentage of GDP that represents the sovereign debt, and term of trade representing the role of shocks are gathered from GDF/World Bank database. The details on countries included in the sample are listed in the Appendix 4.1.

4.6 Empirical results

To test the order of integration for each variable, this chapter employs panel unit root tests by Im et al. (2003). This section then presents the results of the costs of holding reserves and sovereign debt with respect to credit risk. Finally, the optimal level of international reserves with regard to sovereign debt liability has been revealed.

4.6.1 Integration

Table 4.1 presents results of the stationarity test for all eight variables in this analysis. The reported results show that the test statistics of Im et al. (2003) could not reject the null (at level form) for sovereign credit ratings, international reserves, sovereign debt, term of trade and short-term debt variables. Meanwhile, the results of the unit root test reveal a rejection of the null at level for US treasury, international reserves, REER and changes in the nominal exchange rates implies that the variables are integrated at order zero, I(0). Meanwhile, the sovereign ratings, sovereign debt, term of trade and short-term debt variables are rejecting the null at first difference form, indicating that the variables are integrated at order one, I(1). However, the PMG cointegration method developed by Pesaran and Shin (1998) present evidence through the Monte Carlo simulation that the method can reliably be used to test the hypothesis on the long-run relationship in cases whether there is a mix of I(1) and I(0) regressors. Thus the paper proceeds with the PMG estimator to estimate the long-run relationship for the series variables.

Table 4.1
Panel unit root test

	Im, Pesaran and Shin	
Variables	Level	1st difference
Ratings	-1.022	-6.464*
US treasury (10yr)	-4.456*	-19.67*
International Reserves	3.835*	-6.217*
Sovereign debt	0.649	-7.453*
Term of trade	-0.121	-2.219*
REER	-1.682*	-5.258*
Short-term debt	-0.540	-2.769*
Changes in exchange rates	-17.43*	-25.67*

Notes:* and ** denotes significance at 5 and 10 percent significance level.

4.6.2 Cost of holding reserves on credit risk

By employing the PMG estimation technique, this chapter estimates the cointegration relationship between international reserves and sovereign debt holdings with respect to sovereign credit ratings. On the other hand, this relationship could be defined as the elasticity of holding international reserves and sovereign debt to credit risk. Furthermore, the results could also be interpreted as the cost of holding international reserves and sovereign debt. The results are shown in Tables 4.2 and 4.3[24] .

In Table 4.2, the result shows that reserves-holding is consistently positive and significant at 5 percent significance level, which implies that accumulation of reserves is associated with the upgrading in sovereign credit ratings, or reduces the credit risk. Meanwhile, the sovereign debt is negatively significant at 5 percent significance level with respect to the movement of sovereign ratings. In other words, an increase in sovereign debt is associated with the downgrade in ratings (increasing the credit risk).

By following the general-to-specific methodology, column 1 to 6 show that the international reserves, sovereign debt and the short-term variables are significant with the movement in sovereign ratings at 5 percent significance level. In contrast, the term of trade variables are found to be insignificant in the estimated model. In particular, column 1 illustrated the results of the estimated cost and benefit model of sovereign credit risk that also incorporated the shock factors (short-term debt and term of trade).

These results could be interpreted in two ways: an increase in international reserves (assets) and sovereign debt (liabilities) as well as a decrease in international reserves (assets) and sovereign debt (liabilities). In column 1, a 1 percent increase in the stock of international reserves is associated with an upgrading of the sovereign credit ratings by 1.13 percent. While additional of 1 percent of sovereign debt is found to have a negative impact with the sovereign credit rating, downgraded by 1.46 percent. As such, with the increase in international reserves and sovereign debt-holding, the cost of holding sovereign debt with respect to the credit risk is higher than the benefits to countries of holding the international reserves, and has resulted in a net negative

[24] This endogeneity problem potentially occurs through the simultaneity and measurement error problem. However, by using numbers of lag for dependent and independent variables in the ARDL model of PMG estimator, this could potentially reduce the endogeneity problem.

effect on the sovereign ratings. This indicates that repaying (reducing) sovereign debt liabilities is a better decision than increasing the international reserves assets with respect to credit risk. This could be supported by the work of Yeyati (2008) who suggests that self-insurance is costly and should be considered as a second best solution in the context of an imperfect international financial market.

Table 4.2
The elasticity of holding reserves and debt on sovereign credit ratings

Ratings		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Reserves		1.127 (0.081)*	1.125 (0.177)*	0.179 (0.032)*	0.247 (0.047)*	0.231 (0.040)*	
Sovereign debt		-1.452 (0.064)*	-1.201 (0.165)*	-0.586 (0.036)*			-0.459 (0.053)*
Short-term debt		-0.343 (0.038)*	-0.451 (0.085)*		-0.052 (0.036)		
Term of trade		0.001 (0.002)					
ECT term		-0.143 (0.058)*	-0.137 (0.049)*	-0.250 (0.072)*	-0.306 (0.067)*	-0.307 (0.066)*	-0.231 (0.071)*
Restricted Likelihood	Log	74.82	255.99	236.90	220.17	213.20	205.68
Unrestricted Likelihood	Log	428.38	331.184	297.04	256.96	223.22	236.28
LR statistics[#]		307.13*	150.24*	120.28*	73.57*	20.03**	61.19*

Notes: * and ** denotes significance at 5 percent and 10 percent level. The null hypothesis is no cointegration. All variables are expressed in natural logarithms. Numbers in parenthesis denote the standard error. [#] represents the LR test statistics testing for equal long-run parameters.

On the other hand, a decrease in international reserves-holding has downgraded the sovereign ratings by 1.13 percent, while a decline in the stock of sovereign debt will improve the sovereign ratings by 1.46 percent. It has resulted in a net positive effect on sovereign ratings. This suggest that repaying the sovereign debt is a better decision than increasing the international reserves stock in order to improve the countries' credit risk.

The short-term debt and the term of trade variables represent the shock factor that could potentially affect the sovereign credit ratings. In addition, the short-term debt is found to have negative and significant effect with the sovereign credit risk where associated with a downgraded of the sovereign credit risk. In addition, liquidity can be achieved not just by building up foreign reserves, but also by reducing the short-term

liability (Rodrik, 2006). As predicted by the theory, the short-term debt is statistically negative and significant at 5 percent significance level.

In summary, the findings show that a 1 percent increase in short-term debt has downgraded the sovereign credit rating by 0.34 percent (Column 1), while an increase in international reserves of 1 percent, improve ratings by 1.13 percent and downgraded of the sovereign credit rating by 1.45 percent that is associated with an increase of 1 percent of sovereign debt holding. In this case, the cost of short-term debt-holding and sovereign debt has been crowded out by the effect (benefit) of holding reserves resulting in a net negative effect on sovereign ratings suggesting that holding sovereign debt and short-term debt is costly. The net negative effect on sovereign credit rating is consistent with the exclusion of the term of trade variable in column 2.

Meanwhile, in column 3, by excluding the short-term debt variable, the benefits of holding international reserves is been crowding-out with the cost of holding sovereign debt, resulted in a net negative effect on sovereign credit rating or country's credit risk. This finding is consistent with the estimated model in column 1 which suggests that countries need to reduce their sovereign debt holding in order to improve their sovereign credit rating or credit risk.

On the other hand, in the case of international reserves with short-term debt holding (in column 4), an increase of 1 percent of short-term debt downgraded ratings by 0.05 percent. Meanwhile, an increase in the international reserves stock improves the sovereign rating by 0.25 percent. As such, this will result in a net positive effect on sovereign ratings. Central banks should make a decision whether to increase the assets or decrease the liability based on the net effect. This implies that an increase in international holding reserves gives more benefits to a country with a certain level of short-term debt-holding. Intuitively, in an environment where a country also holds such a highly risky capital stock of short-term debt, increasing the holding of international reserves gives a better position for the country's credit risk. Furthermore, by holding more international reserves, a country could protect its economy or absorb any sudden or reversal shock from the international market.

Results on the bivariate analysis of international reserves and sovereign debt-holding with the credit risk are presented in columns 5 and 6 respectively. It shows that a 1 percent increase in the stock of international reserves improves the sovereign credit rating by 0.23 percent which reduces the credit risk. Meanwhile, the sovereign debt movement is found to have negative effect with the movement in sovereign credit rating. In particular, an increase in 1 percent of stock of sovereign indebtedness reduces the sovereign credit ratings by 0.46 percent, suggesting that an increase in sovereign debt-holding is followed by an increase in the credit risk.

The error correction term is statistically negative at 5 percent significance level, suggesting the existence of a long-run relationship for the model estimated. The adjustment coefficient shows a slow phase of speed of convergence to equilibrium with values ranging from 13.5 percent to 31 percent. This could indicate that a country takes about a 13.5 to 31 percent speed of adjustment to converge to equilibrium if there is a shock. The likelihood ratio test statistics reveal a rejection of null of no equal long-run parameters across countries suggesting that the long-run coefficients do not differ across countries and implies that there is long-run homogeneity among the countries in the sample. The restricted log likelihood and the unrestricted log likelihood show that the model in column 1 and column 2 respectively, is the best for explaining the variation of the sovereign credit ratings as credit risk.[25]

For a robustness check, this paper also tries to include other explanatory variables which could represent the role of other external factors in the estimated model. The results are shown in Table 4.3. By including US Treasury bond yield, real effective exchange rate, and changes in nominal exchange rates, the results are in line with the results obtained earlier. In other words, the inclusion of the term of trade, real exchange and nominal exchange rate in the model does not change the direction (net effect) or sign regarding the cost-benefits of holding international reserves and sovereign debt for sovereign credit ratings. The results reveal a consistency of positive and significant (at 5 percent significance level) effect of international

[25] This chapter also tries to exclude China from the sample, since the stockpile of international reserves held by China could potentially lead to a bias result. However, the results does not vary sensible and is attached at Appendix 4.3.

reserves-holding on sovereign credit ratings while there is a negative effect of sovereign debt on sovereign credit ratings.

The results are consistent with the previous estimated results where, in the case of international reserves with sovereign debt liabilities, decreasing or repaying the sovereign debt improves a country's credit risk level. These findings are more convincing since Yeyati (2008) could not provide strong evidence of which decision - either increasing the stock of assets or reducing the liability of sovereign debt - is the better decision with respect to sovereign ratings or credit risk. However, in the case of international reserves with short-term debt, increasing the stock of international reserves is better for providing a net positive effect in order to improve the country's credit risk.

With the inclusion of additional variables, the elasticity of international reserves and sovereign debt increases, ranging from 0.14 to 0.65 and 0.49 to 0.80 respectively. In addition the term of trade is found have a negative and significant effects on sovereign credit ratings in columns 4, 8, 9 and 10 at 5 percent significance level. This implies that the term of trade variable which represent shocks is found to have a negative effect on the movement in sovereign credit ratings. An increase in the movement of real exchange rate is found to be positively significant (at 5 percent significance level) with the movement in sovereign credit ratings indicating that depreciation in the real exchange rate has downgraded the sovereign risk. Changes in nominal exchange rate are found to have a negative effect on sovereign credit ratings implying that a positive change (depreciation) has a downgrading impact on sovereign ratings. These two variables should be seen as complementary, whereas the real exchange rate is expected to reflect low frequency real shocks, and the nominal depreciation is more likely to react to high frequency speculative moments (Yeyati, 2008).

Table 4.3
The elasticity of holding reserves and debt on sovereign credit ratings with external factor

Ratings	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
US treasury (10yr)	1.376 (0.275)*	1.717 (0.254)*		1.651 (0.212)*	1.305 [6.152]*						2.628 (0.382)*
Reserves	0.659 (0.064)*	0.451 0.045)*	0.212 (0.037)*	0.433 (0.047)*	0.421 (0.037)*	0.249 (0.045)*	0.149 (0.033)*	0.185 (0.025)]*	0.224 (0.043)]*	0.107 (0.023)]*	0.699 (0.108)*
Sovereign debt	-0.798 (0.174)*	-0.753 (0.119)*		-0.838 (0.117)*	-0.877 (0.104)*	-0.636 (0.037)*	-0.493 (0.041)*	-0.509 (0.035)*	-0.692 (0.070)*	-0.512 (0.046)*	
Short-term debt			-0.017 (0.019)								0.061 (0.062)
Term of trade	-0.002 (0.005)	-0.003 (0.005)	-0.001 (0.000)*			-0.001 (0.000)	-0.001 (0.000)*	-0.003 (0.000)*	-0.005 (0.002)*		0.007 (0.003)*
REER			-0.121 (0.072)		0.123 (0.155)		0.146 (0.049)*	0.285 (0.070)*		0.173 (0.075)*	
Changes in exchange rates		-1.249 (0.208)*		-1.190 (0.192)*	-0.958 (0.187)*			-0.303 (0.136)*	-0.813 (0.207)*	-0.208 (0.097)*	
ECT term	-0.175 (0.063)*	-0.137 (0.054)*	-0.292 (0.088)*	-0.148 (0.053)*	-0.143 (0.058)*	-0.257 (0.072)*	-0.227 (0.083)*	-0.219 (0.071)*	-0.177 (0.049)*	-0.246 (0.072)*	-0.144 (0.060)*
Restricted Log Likelihood	257.36	306.03	282.216	288.28	305.55	248.11	290.08	317.19	288.24	285.39	251.9290
Unrestricted Log Likelihood	397.14	675.53	406.275	433.95	611.20	335.97	458.19	634.27	423.66	463.80	382.8273
LR statistics[#]	279.56	738.99	248.118	291.35	611.30	175.72	336.23	634.15	270.84	356.82	261.7967

Notes:* and ** denotes the significance at 5 and 10 percent significance level. All variables are expressed in logs, except changes in exchange rates. Numbers in parentheses represent the standard error. [#] represents the LR test statistic testing for equal long-run parameters

4.6.3 Optimal level of international reserves

The first part of the analysis had answered the question on the cost of the joint holding decision of holding reserves and sovereign debt to credit risk which shows that the cost of holding sovereign debt is expensive with respect to credit risk. In other words, a country should reduce the stock of sovereign indebtedness to maintain a good credit risk level. Besides that, it also raised the issue of the adequate level of international reserves-holding with the stock of sovereign debt with respect to its opportunity cost. To solve this problem, it is useful to analyze the adequate level of international reserves with respect to its opportunity cost as measured by the spread. By employing the threshold method of Hansen (2000), this paper tries to analyze any potential threshold effect in the estimated model (4.2). This uses two independent variables which are international reserves (measured by month of imports (R/M), external debt (R/ED), GDP (R/GDP), short-term debt (R/STD)) and sovereign debt.

By using 1000 bootstrap replications, the results on F-statistics and the p-value for the threshold model are reported in Table 4.4. The F-statistics and the bootstrap p-value suggest a rejection of the null of no thresholds effect at 5 percent significance level for the R/ED (reserves to external debt) and R/GDP(reserves to GDP), and 10 percent significance level for R/M (reserves to a month of imports), over the period 1994-2006. This implies that there is evidence of threshold effect for the estimated model with respect to different proxies of international reserves, which are R/M, R/ED and R/GDP.

Table 4.4
Thresholds effect of spread-reserves and sovereign debt relationship

Threshold variable	R/M	R/ED	R/GDP	R/STD
F- test	17.58**	28.35*	27.03*	17.85
Bootstrap p-value	0.091	0.014	0.0110	0.113

Notes: * and * denotes significance at 5 and 10 percent respectively. The null hypothesis is no threshold relationship. R/M, R/ED, R/GDP,R/STD represents reserves to imports, reserves to external debt, reserves to GDP and reserves to short-term debt respectively.

The detailed results for the model that have been found to have a threshold effect are presented in Table 4.5. The results show that the threshold estimate of R/M is at 3.66 months of imports, implying that a country had to save at least 3.66 months of imports in order to protect itself from any sudden shock. In addition, the results also reveal

that an increase of R/M below the 3.66 months of imports is associated with a reduction in spread of about 23.6 bps and, to a lesser extent, lower opportunity cost. As the stock of R/M increases, it is associated with a reduction in opportunity cost, up to the threshold level. However, above the threshold level, any increase in R/M is associated with the increase in spread, which suggests an increase in the cost of holding reserves. Even though the increase in R/M is associated with a lower opportunity cost (in the first regime), countries have not achieved the optimal level where the opportunity costs are at the lowest level. Furthermore, less saving of R/M below its adequate level might increase the difficulties for the country in facing any sudden shock.

Table 4.5
Elasticity of cost of holding reserves and sovereign debt (1994-2006)

SPREAD[#]	**R/M**	**R/ED**	**R/GDP**
Threshold estimates (γ)	3.656	31.12	16.808
Reserves $(q_i \leq \gamma)$	-23.60	-2.83865	-3.70988
	(23.52)	(3.1622)	(3.73137)
Sovereign debt	-0.773	-1.2282	-0.6954
	(0.477)	(0.5451)*	(0.4976)
Observations	15	17	19
Reserves $(q_i > \gamma)$	4.867	-0.2233	-1.6575
	(8.648)	(0.4177)	(1.2607)
Sovereign debt	3.844	4.78245	4.64013
	(0.961)*	(0.5243)*	(0.5524)*
Observations	16	14	12

Notes: * and * denotes significance at 5 and 10 percent respectively. The null hypothesis is no threshold relationship. Numbers in bracket represent a robust standard error. R/M, R/ED, R/GDP,R/STD represents reserves to imports, reserves to external debt, reserves to GDP and reserves to short-term debt respectively.[#] Spreads are calculated based on EMBI global.

In other words, the table shows that countries are not at the optimal position to accumulate R/M if the increase in R/M is still below (first regime) the thresholds level. As such, continuously increasing the stock of international reserves above the adequate level is associated with increased opportunity cost. In this case, there is less advantage to the country if it continues to accumulate the R/M, since it is associated with higher opportunity cost. In addition, by continuing to increase its R/M in the second regime, the country lowers its ability to repay its sovereign debt which also increases the probability of the country being in default. On the other hand, holding sovereign debt in the first regime is associated with a reduction in its opportunity cost, at -0.77 bps in its spread. In other words, an increase in sovereign debt in the first regime is associated with a decline in its opportunity cost by 0.77. However,

accumulating sovereign debt is costly in the second regime (reserves at 3.65 months of imports) since it is associated with an increase in opportunity cost of 3.88 bps (in spread).

Thus, increasing the R/M and sovereign debt in the first regime are associated with a decline in their opportunity cost whilst, above the threshold level, an increase in the R/M and sovereign debt is associated with an increase in the opportunity cost, and countries are faced with 'double' cost in the second regime. First, the increase in the cost of increasing international reserves itself where it could be invested in other investment instrument, portfolio, direct investment and other investment (bonds). Second, holding international reserves in the second regime, lower the probability of a country repaying debt and thus increases the likelihood to default on its sovereign debt.

Intuitively, countries in the first regime are faced with the probability of 'not enough' saving to protect the country from any sudden stop. In addition, countries in the second regime are found to save too much, which is associated with an increase in the opportunity cost. Countries that fall into the second regime are Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Egypt, Indonesia, Malaysia, Nigeria, Peru, Poland, Russia, Thailand, Turkey, Uruguay and Venezuela. Countries in the first regime, including Cote D'Ivoire, Dominican republic, Ecuador, El Salvador, Ghana, Mexico, Panama, Pakistan, Philippines, Serbia, South Africa, Tunisia, Ukraine, and Vietnam had 'not enough' stock of international reserves and sovereign debt which could help the country in the event of any sudden shock and help to boost domestic investment respectively. Neither the first, nor the second regime is preferable for policy decisions, thus suggesting it is best to be at the optimal level.

In addition, the results found that the optimal levels of international reserves-holding are estimated at 31.12 and 16.8 for R/ED and R/GDP respectively. Below the threshold estimated (in the first regime), it is found that an increase in R/ED and R/GDP is associated with a decline in spread of about 2.84bps and 3.71bps respectively. Meanwhile an increase in R/ED and R/GDP above the threshold estimate still reduces the spread, albeit at a lower rate of 0.22bps for R/ED and 1.66bps for the R/GDP. Above the estimated thresholds, countries still incurred a

reduction in the opportunity cost, albeit at a lower rate. With a given of low opportunity cost, this could indicate that, with respect to R/ED and R/GDP as a dependent and the thresholds variable, countries in the sample are still on the right track where an increase in reserves to external debt and GDP does not increase the opportunity cost. However, it is suggested that countries should position their economies up to threshold-estimated levels since they could benefit from optimal opportunity cost. In addition, above the optimal level (second regime), an accumulation of international reserves is associated with a lower reduction in opportunity when compared with the first regime.

On the other hand, the accumulation of sovereign debt in the first regime is associated with decreasing in opportunity cost at 1.23bps. However, above the estimation of R/ED with 31.12, the cost increases substantially from -1.23bps in the first regime to 4.78bps in the second regime. In other words, beyond the international reserves threshold there is evidence that an increase of sovereign debt is associated with an increase in opportunity cost of holding debt. In addition, an increase of the sovereign debt in the second regime (for R/GDP variable) is also associated with high opportunity cost.

As such, in the second regime, there could be an indication that an increase in R/ED or R/GDP and sovereign debt is associated with a net effect of increase in high opportunity cost, implying that a country is faced with high opportunity costs if it continuously increases the stock of R/ED, R/GDP and sovereign debt above the optimal level. Therefore, countries that are in the second regime are Bulgaria, Chile, Colombia, Croatia, Egypt, El Salvador, Malaysia, Nigeria, Peru, Poland, Russia, South Africa, Thailand and Venezuela for the R/ED, while, for the R/GDP, Bulgaria, Chile, Croatia, Egypt, Ghana, Malaysia, Morocco, Nigeria, Peru, Philippines, Russia, Serbia and Thailand would be advised to lower their reserves-holding in order to keep the opportunity cost at the optimal level.

It has been noted some of the developing countries have experienced crises in the 1990s. To provide an additional insight into the joint decision of holding debt and reserves, this paper also estimates the model for the period 2000-2006 since this could

represent the post-crisis era for most of the developing countries. Results on the elasticity of cost of holding reserves for the period 2000 to 2006 are in Table 4.6.

With p-value of 0.002 and 0.058, the null of no threshold relationship could be rejected at 5 and 10 percent significance respectively for R/ED and R/STD (for the period 2000-2006). Although the threshold effect is found for R/M, R/ED and R/GDP for the period 1994 to 2006, the threshold effect still holds for the R/ED and R/STD for the analysis within the period 2000 to 2006. The estimated threshold level is at 39.7 and 2.28 for R/ED and R/STD respectively.[26]

Table 4.6
Elasticity of cost of holding reserves and sovereign debt (2000-2006)

SPREAD[#]	**R/ED**	**R/STD**
Threshold estimates (γ)	39.716	2.283124
Reserves $(q_i \leq \gamma)$	-3.7878 (3.2742)	56.885 (53.348)
Sovereign debt	-1.6578 (0.8010)*	-1.5828 (0.5990)*
Observations	22	15
Reserves $(q_i > \gamma)$	-1.4670 (0.7732)**	-4.1136 (2.8339)*
Sovereign debt	8.3487 (1.6262)*	6.1980 (1.7111)*
Observations	10	17
F- test	26.25*	20.27**
Bootstrap p-value	0.021	0.058

Notes: * and * denotes significance at 5 and 10 percent respectively. The null hypothesis is no threshold relationship. Numbers in bracket represent a robust standard error.[#] Spreads are calculated based on EMBI global. R/M, R/ED, R/GDP,R/STD represents reserves to imports, reserves to external debt, reserves to GDP and reserves to short-term debt respectively.

In line with the results for the period 1994 to 2006, the negative effect reported in both regimes could be interpreted as an increase in R/ED, and is associated with a decline in spread. In particular, the significance of the R/ED (at 10 percent significance level) in the second regime indicates that countries that fall into this regime should take precautionary action since, with an increase in R/ED, the elasticity is lower at 1.47 as compared to 3.79 in the first regime, implying a decline in the opportunity cost, but at a lower rate, while the elasticity of sovereign debt is found to reduce the spread in the first regime and increase it in the second regime. In summary,

[26] The thresholds estimate of R/ED for the period 2000 to 2006 is slightly higher than estimated for the period 1994 to 2006. This result is reasonable since, due to the recovery period for some emerging economies from financial crisis the opportunity cost are high. As such countries opt to accumulate higher international reserves to absorb any sudden future shock.

the second regime could indicate that an increase in R/ED and sovereign debt is associated with a net effect of increase in high opportunity costs, implying that countries are faced with high opportunity costs if they continuously increase the stock R/ED and sovereign debt above the optimal level.

Meanwhile, the results show that the threshold estimates of R/STD are at 2.28 which are higher than the Guidotti rule. [27] An increase in the R/STD is associated with a positive of the opportunity cost for the first regime, and negative of the opportunity cost (significant at 5 percent significance level) for the second regime. This could explain that the R/STD need to be sufficiently high in order to find a significant effect in terms reduced the cost. Meanwhile, an increase in sovereign debt is consistently associated with negative (low) effect in the first regime and positive effect in the second regime, implying that, beyond the reserves thresholds level, an increase in sovereign debt also increased the opportunity cost. In summary, in both the first and second regimes an increase in R/STD and sovereign debt is associated with net positive (increase) in the opportunity cost. Thus it is optimal for the country to stock its R/STD up to 2.28. However, countries in the first regime are highly at risk since the net opportunity costs are higher than in the second regime. This implies that if a country holds R/STD lower then the optimal level, it is facing a very high cost, and is highly at risk through not saving enough reserves for any uncertain position.

[27] The Greenspan-Guidotti rule suggests a full coverage of total short-term external debt where countries would have enough reserves to resist a massive withdrawal of short-term foreign capital.

4.7 Conclusions

The main analytical contribution of this paper is to investigate the impact of holding international reserves and sovereign debt with regard to credit risk which has been measured by the sovereign credit ratings. This chapter also analyzes the cost of jointly holding reserves and sovereign debt decision and, to a lesser extent, the optimal level of reserves-holding. These issues are important for policy formulation since international reserve and debt management policy could affect a country's access to international credit markets in the future.

A good credit risk position increases the likelihood of the country obtaining external sources of funding from abroad in the future. Indirectly, this could provide information on the solvency and the ability of the countries to absorb uncertainty and sudden shock. The important findings on these issues are that international reserves-holding is associated with good sovereign credit ratings as well as a reduced credit risk while sovereign debt-holding leads to a lower sovereign credit ratings and high credit risk. This suggests that reducing (repaying) their sovereign debts is the best decision for countries to acquire and maintain a good credit risk reputation. Despite the cost-benefits of holding international reserves and sovereign debt, the accumulation of international reserves, which were intended to improve sovereign credit ratings, have been crowded out by the effect of accumulation of sovereign debt which worsened sovereign ratings and resulted in a net negative effect on sovereign ratings.

In contrast, the benefit of holding reserves has been crowed out the cost of holding short-term debt, resulting in a net positive effect on sovereign ratings. Thus, this implies that countries should hold more reserves with regard to the level of short-term debt, which is a highly vulnerable liability for a country.

These findings have inspired an analysis of the adequate level of international reserves with regard to sovereign debt-holding. The results reveal that the adequate level of international reserves in a month of imports is slightly higher at 3.67 (months of imports) than the conventional rule which is 3 (months of imports). The best decision is to hold international reserves assets at an optimal level when the opportunity costs are at a minimal level. Holding lower reserves might expose a

country to a high risk of uncertainty and sudden shock. However, too high a level of savings is associated with a high cost as well as a reduction in the probability of a country repaying its sovereign debt.

In addition, this paper also revealed that the threshold estimates of reserves to short-term debt are higher that the Guidotti rule. The effect of reserves on short-term debt is found to be positively significant for the first regime and negatively significant for the second regime which could explain that the reserves to short-term debt-holding need to be sufficiently high to find a significant effect in terms of reducing the cost. Furthermore, there is evidence in favour of the elasticity of sovereign debt consistently having a thresholds effect which is a negative effect in the first regime and a positive effect in the second regime. This implies that, beyond the reserves thresholds level, an increase in sovereign debt also increased the opportunity cost.

The implications of our findings for policy formulation is profound, since this paper established the optimal level of international reserves-holding with respect to sovereign debt-holding with different measurements and different period coverage.

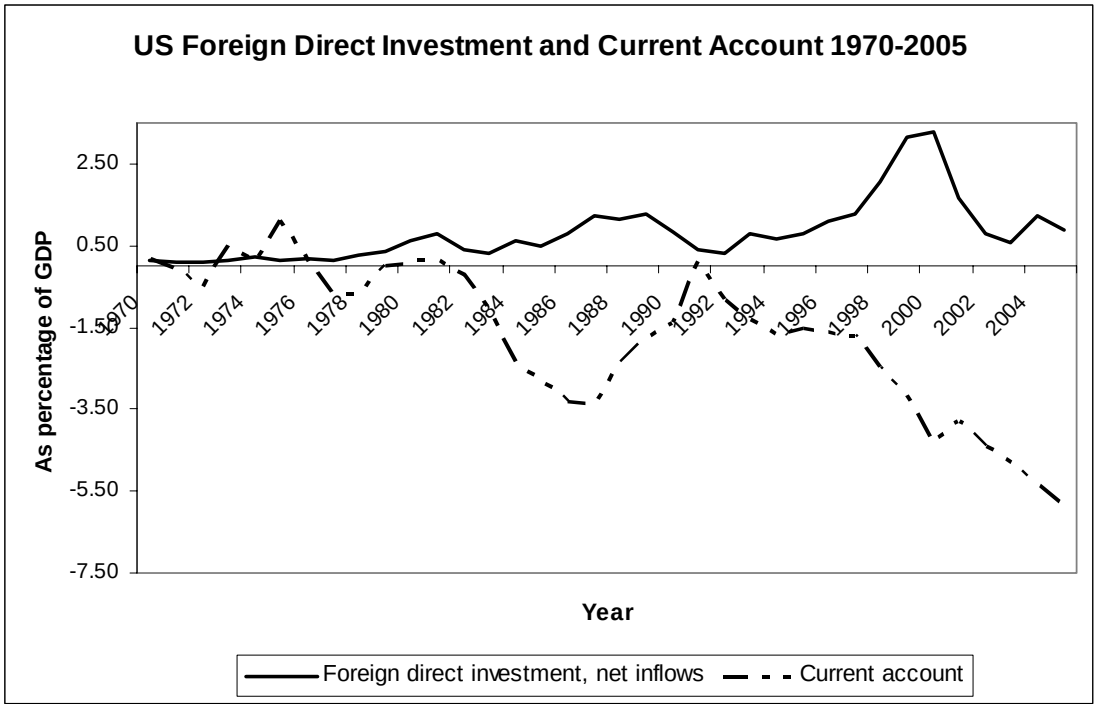
5.1 Conclusion

As Herb Stein once said, "If something's unsustainable, it tends to stop" which refers to the persistence of current account deficit experienced by the United States. However, these imbalances in the current account deficits have increased continuously since 1982 from about -0.2 percent of GDP (USD -5.54 billion) to a record of about -5.9 percent of GDP (USD-728.99 billion) in 2005 for the United States. However, the gaps between the current account deficits and the net foreign investment became wider between the periods 1982 to 1991 and 1992 to 2005 (Figure 5.1). The growth in current account deficit is found to be higher than the growth in the foreign direct investment which then raised the issues of how long the country could survive with a long period of persistence. Furthermore, according to Holman (2001), a large current account deficit may cause a shift in investor confidence and a reversal of international capital flows as investors fear loans will not be repaid. Even though Hubbard (2006) suggested that the United States increase its saving, while high-saving emerging market economies need to undertake steady reform of their financial system in order to make the capital market and financial intermediation more efficient, these suggested policies could only be implemented if the true condition of the sustainability is examined and revealed, thus indirectly highlighting the importance of the analysis of the sustainability position in chapter 2.

With the objective of re-examining the sustainability position of developing and developed countries in their intertemporal budget constraint by using a panel study approach, Chapter 2 investigates two major aspects of sustainability: current account and fiscal policy position. In addition, analysis of fiscal sustainability using the model proposed by Bohn (1998) will examine from different points of view on sustainability. Thus, by analyzing every aspect of the sustainability position, current account and fiscal policy, this chapter provides an extensive picture of countries' real position. On the other hand, by employing a panel cointegration method of PMG estimators proposed by Pesaran et al. (1999), these findings provide evidence of the size of error correction term estimated that is related to the adjustment speed of the current account position if there is sudden shock in the economy.

After identifying various possibilities for models of sustainable position, it is found that the high-income countries are in a sustainable position for current account, indicating that the intertemporal budget constraints are holding. In addition, Canada, Japan, Australia, New Zealand, Denmark, France, Germany, Netherlands and Spain are found to have a current account sustainability position for the period 1978-2005. In contrast, the middle- and low-income countries are found to be classified in an unsustainable position of current account throughout the period. In addition, this chapter also found that all groups of countries have a slow phase speed of convergence towards equilibrium which suggests that they are exposed to a high degree of vulnerability to any sudden shock or stop in the economy. As a consequence, governments need to formulate policy that could increase savings (domestic and international) to correct the imbalances and protect a country from any sudden stop or shock. This phenomenon indirectly highlights the role of international reserves to protect country from any external shock. Furthermore, this raises the issue of the optimal level international reserves that should be hold by country which is been discussed later (chapter 5).

Figure 5.1
The Foreign direct investment and current account position



Sources: OECD and World Bank

Conclusive evidence on the sustainability of fiscal policy position is only found for the high-income and middle-income countries. There is evidence that governments of the high-income and middle-income countries obey their intertemporal budget constraints and take some corrective action to improve and maintain the government's financial position. In addition, government policy formulations are subject to their intertemporal budget constraints and they take corrective action to improve budget surplus with regard to the increasing level of public debt. These findings could provide evidence of the sustainability of fiscal policy. This implies that, with an increasing debt level, governments in the high-and middle-income countries are capable of repaying their public debts with an effective fiscal policy implemented. This may also give a positive signal to the creditors that their financing is profitable and repayable.

Even though the persistence of external balances may cause the same effect, the solution and policy of adjusting the imbalances should be treated differently for developed and developing countries (Yan, 2007). According to Freund (2000), the current account adjustments of developed countries are closely related to the business cycle. Furthermore, during recession, demand for foreign goods declines and current account improves. In contrast, based on the experience of some emerging market economies' currency crisis in the 90s, postponing the current account adjustment will result in a high stock of foreign indebtedness and increase the probability of being in default.

Meanwhile, the tremendous increases in the stock of external debt by the developing countries are recorded at about US$ 70, 067 million in 1970 to US$ 3,186,567 million in 2007 (about 44 percent growth). This development indicates that the idea of the importance (role) of external debt in helping boost domestic economic growth has been accepted worldwide, especially in the developing countries. However, despite the increase in external indebtedness that is aimed at boosting domestic investment, most of the developing countries are still experiencing difficulties with the unsustainable debt that is associated with a low rate of economic growth and a high level of poverty. In addition, the initiatives of the debt relief program conducted by the World Bank, known as HIPC initiatives (with the objective of helping the poorest and most heavily indebted countries escape from unsustainable debt burden), has

brought out the issue of whether external debt is playing a role in improving a country's economic growth. By analyzing the effect and relationship between external debt and economic growth, this provides some intuition as to whether countries have benefited from external borrowing over the past 20 years. In contrast, this could also give a signal about the effectiveness of the debt management policies of the developing countries. In other words, with regard to the findings of this chapter, governments could formulate policies that could prevent countries for being in default or in a debt-overhang situation. This raised the issue of whether external borrowing helps to boost domestic investment and capital accumulation as well as economic growth or whether it could become a burden that has to be paid for by future generations.

Motivated by its key role in boosting investment as well as economic growth, the aim of Chapter 3 is to analyze the debt-growth nexus, particularly the debt-growth and the debt-investment relationship, with 31 developing countries in the sample. Furthermore, in the era of globalization the interdependence relationship among countries could not be denied. Relationships through trade and knowledge spillover have highlighted the importance of analyzing the 'neighbouring' effect in the debt growth model.

Besides that, it is important to investigate whether a country's indebtedness is associated with a symptom of the debt-overhang position. The debt-overhang is a situation in which countries have a very high level of indebtedness which leads to a high debt service burden. As such, this resulted in the position where the stock of external debt is larger than the country's ability to repay its debt in the future. On the other hand, the high level of debt service would crowd out investment and lead to lower economic growth. The longer a country remains in the debt-overhang situation, the higher the probability of the country being in default.

Chapter 3 is distinct from other research in several aspects. Firstly, the chapter contributes to the small but growing body of empirical literature on the debt-growth nexus. Furthermore, the chapter provides more detailed analysis to examine whether the relationship between debt and growth is robust for all the developing countries in the sample. Secondly, this is the first attempt to analyze the relationship of the debt-

growth nexus by using a spatial correlation approach. Moreover, no empirical study has been carried out to determine whether location matters for the debt-growth model. An analysis of the contribution of external debt to economic growth from a panel spatial econometric approach rather than a cross-sectional or time series (country-specific) analysis could provide a valuable addition to existing empirical studies. Thus, this chapter attempts to fill this gap in the literature.

This analysis in this chapter is important since any results found from the linkages between the external borrowing and economic growth would be useful for policy formulation. In this case, debt could boost or impede economic growth; there is either a positive or negative relationship between external debt and economic growth. Besides that, this study could give an indirect signal to creditors regarding a country's ability to service its debt in the future.

The findings reveal that the accumulation of external debt is associated with a slowdown in the economies of the developing countries. Besides this, we find evidence that the debt service ratio does not crowd out the investment rate in developing countries. Thus, there are convincing results to support the negative effect of external debt on economic growth but there is no evidence that debt service payments squeeze the investment rate. This could imply that the likelihood of a country being able to service its repayment (principal and interest payment) through investment is moderate. Even though the negative effect could be interpreted as a signal of the symptom of the debt-overhang problem, this situation has not yet been reached. As such, governments should take the opportunity to correct any misallocation of the external borrowing. In addition, the correspondingly insignificant effect of external debt on the investment rate could raise issues of whether the external borrowing has been efficiently allocated to investment. However, these issues should be analyzed in further detail and with due caution, since this is important for policy formulation mainly on the debt management issues. Despite the above findings, fiscal balance, government revenue, openness, and domestic credits are found to have a positive effect on investment and, to a lesser extent, economic growth. It also shows that the role of spatial correlation is important and should be considered for any analysis of the growth model. Furthermore, there is evidence to support the existence of spillover growth among the neighbourhood countries. There

is no evidence that the debt-Laffer curve relationship exists in the debt growth model which suggests that the negative relationship of debt with economic growth is robust.

The results have important implications for policy-makers who are inspired to generate economic growth, particularly for most of the developing countries. It is a major challenge for governments to formulate a prudent debt management policy, controlling and maintaining the level of indebtedness of countries at a manageable level before it becomes too late and a country could be involved with a debt-overhang situation or, to a lesser extent, is in default. As external debt is important as a source of capital, governments could play an important role in utilizing the public debt to improve and provide an environment conducive for investment incentive. In return, a growth in investment climate will benefit countries through aggregate national growth. In other words, a well-built infrastructure for investment could help boost domestic investment as well as attracting more foreign direct investment into the country. In addition, a policy that could generate earning, especially in foreign revenue, should be formulated wisely. Such policies of export-led growth strategy could benefit a country, since it could use its foreign earnings to service the external debt. Besides that, a manageable debt level is important since this could affect a country's sovereign ratings and source of funding.

Since the effects of capital mobility on developed and developing countries are different, the policy formulation should be treated differently. For the emerging market economies that do not have a sophisticated and sound financial system, governments need to channel funds to the proper location; they should exercise caution and not abruptly remove their restrictions on capital mobility (Yan (2007).

The unprecedented increase in international reserves acquired by most of the developing countries and emerging economies has raised a debate among academics and policy-makers about the main motives of a country for holding a bulk of international reserves. The idea behind the increasing stock of international reserves has been interpreted as having a self-insurance motive. In contrast, a country might also accumulate reserves to keep its currency low and enjoy competitive prices in exports, leading to a trade surplus, which is defined as a mercantilist motive.

On the other hand, countries simultaneously borrowed from abroad to get external sources of capital to boost their domestic economies. With an accumulation of international reserves this reduces the probability of a country repaying its sovereign debt and is highly associated with the likelihood of being default. As a consequence, this may lead to the country being excluded from the international capital market and losing access to future borrowings with other opportunity costs of being in default. Even though reserves-accumulation may reduce the sustainable debt level, international reserves-holding is associated with the consumption-smoothing it allows in case the country defaults. However, reserve holdings and less outstanding debt are not perfect substitutes even though reserves-holding reduces the amount of sustainable debt, or increases debt services for a given level of debt (Alfaro and Kanczuk, 2008). Thus, with a stockpile cushion of international reserves and liability on sovereign indebtedness, governments need to formulate strategies on the joint decision of holding international reserves and sovereign indebtedness since sovereign debt also plays an income-smoothing role in the economy. This raises issues about the cost of holding reserves which also incorporated the stock of indebtedness.

Chapter 4 aims to examine the cost of the joint decision of holding international reserves and sovereign indebtedness for developing countries. Precisely, the chapter tries to estimate the cost of holding reserves and sovereign debt with respect to credit risk. Furthermore, this has led to an examination of the optimal level of reserves-holding with respect to sovereign indebtedness.

These issues are important for policy formulation since international reserves and debt management policy could affect a country's access to credit markets in the future. By accumulating international reserves and external debt, a country could potentially default (with a high level of indebtedness). Even by delaying default, a country which has a high level of debt as well as highly volatile to any fluctuation in economy, are reducing welfare level, to a lesser extent, sustainable debt position (Grossman and Han1997). As such, issues about international reserves-holding and solvency indebtedness are very important and need to gain more attention from academics for governments to formulate an effective external sector policy. By contributing to the small but growing body of empirical literature on the joint decision analysis of reserves and debt-holding, Chapter 4 focuses on the cost of holding reserves and

sovereign debt with respect to credit risk. In addition the study fills a gap by examining the adequate level of international reserves-holding with all potential reserves indicators by exploiting the recent methodology of threshold estimation.

The important findings on this issue are that the international reserves-holding is associated with good sovereign credit ratings as well as a lower credit risk while the sovereign debt-holding leads to a lower sovereign credit rating and a high credit risk. This implies that repaying their sovereign debts is the best decision for countries to keep and maintain a good credit risk reputation.

Despite the cost-benefits of holding international reserves and sovereign debt, the accumulation of international reserves which were intended to improve the sovereign credit ratings have been crowded out by the effect of accumulation of sovereign debt which worsens sovereign ratings and results in a net negative effect on sovereign ratings. In contrast, the benefit of holding reserves has crowded out the cost of holding short-term debt, resulting in a net positive effect on sovereign ratings. This could imply that a country should hold more reserves with regard to the level of short-term debt, which is a highly vulnerable liability for a country.

These findings have inspired an analysis of the adequate level of international reserves with regard to sovereign debt-holding. The results reveal that the adequate level of international reserves in a month of imports is slightly higher with 3.67 (months of import) than the conventional rule which is 3 (months of imports). The best decision is to hold international reserves assets at their optimal level when the opportunity costs are at minimal level. Holding fewer reserves might expose a country to a high risk of uncertainty and sudden shock. However, too high a level of savings is associated with a high cost as well as a reduction in the likelihood of a country repaying its sovereign debt.

In addition, the chapter also reveals that the threshold estimate of reserves to short-term debt is higher that the Guidotti rule. The effect of reserves on short-term debt is found to be positively significant for the first regime and negatively significant for the second regime which could explain that the reserves to short-term debt-holding need to be sufficiently high to find a significant effect in terms to reduce the cost.

Furthermore, there is evidence in favour of the elasticity of sovereign debt consistently having a thresholds effect which is a negative effect in the first regime and a positive effect in the second regime. This implies that, beyond the reserves thresholds level, an increase in sovereign debt also increased the opportunity cost.

The implications of our findings for policy formulation is profound, since this chapter established the optimal level of international reserves-holding with respect to sovereign debt-holding with different measurements and different period coverage. Governments should avoid asset and liability structures that are likely to trigger default and it should avoid debt and asset structures that prolong and intensify the decline in economic activity that follows default (Dooley, 2000).

In summary, the developing countries, which include middle-and low-income countries, are found to have an unsustainable current account position which indicates that these conditions are contributing to the probability of the country being in default. An unsustainable current account position indicates that countries are not obeying their intertemporal budget constraints in the long-run which makes them use their savings to finance the deficits. A reduction in savings would affect a country's investment and, finally, its economic growth. On the other hand, countries are facing the probability of finding it difficult to repay their debts (particularly the external debts) in the future with a lower holding of foreign saving. It was also found that developing countries are highly vulnerable to any sudden shock in the economy, and it is suggested that they hold international reserves as a self-insurance motive. The sustainability fiscal policy also holds for the high- and middle-income countries. Despite the unsustainable current account position, the middle-income countries are in a satisfactory, sustainable fiscal policy position together with the high-income countries, implying that governments have been successful with their fiscal policy formulation in their allocation of revenue and expenditure in order to maintain their countries' economic growth.

On the other hand, the role of external debt (which includes public and private long-term external debt) in economic growth has been questioned since there has been a high incidence of default, and low economic growth and high levels of poverty are associated with high stocks of external debt. Furthermore, the worries about whether

countries are already trapped in the debt-overhang situation have underlined the urgency of analyzing this area. It is found that external debt has a negative effect on economic growth which raises the issue of whether external debt has been allocated efficiently to domestic investment or whether it has been used for any other purposes such as financing the current account deficit, or spending on military supplies which is related to the issue of corruption and waste. However, this analysis should be considered carefully with full attention before jumping to alarming conclusions. Even though external debt is found to have a negative effect on economic growth, the debt-overhang hypothesis could not be supported for the developing countries in the sample, implying that it is not too late for a country to re-formulate a prudent and sound debt management policy. Furthermore, the debt-growth policy should be formulated with consideration for the interdependence among the developing countries, since the results found the effects of spillover growth among the sample.

However, with the joint decision of holding international reserves and sovereign debt applied in real life, it is important to examine the costs and benefits of holding both instruments. As such, it is found that the net negative effect of holding reserves and sovereign debt, where the sovereign debt-holding is found to increase a country's credit risk, cost more than the benefits of holding international reserves. As such, it is suggested that countries reduce their sovereign debt in order to keep and maintain a good credit risk position. However, in the case of international reserves with short-term debt-holding, it is suggested that countries should hold more reserves with regard to the level of short-term debt since short-term debt-holding is highly risky. In addition, it is found that the adequate level of international reserves-holding in the case of holding sovereign debts is higher then the conventional level. A position neither below nor above the adequate international reserves level is suggested for a country wishing to protect itself from any sudden shock.

Besides that, Chapters 3 and 4 have answer on the issues of the debt sustainability position of developing countries (the increasing levels of public debt are associated with in increase in the growth of public debt in the next period which has been addressed in Chapter 2). Since the public debt represents more than 50 percent of long-term external debt for the developing countries (short-term debt for only 15 percent of total external debt), the negative effect of external debt on economic

growth could also indicate that the government debt position of the middle-income countries is unsustainable. Furthermore, with the cost of holding sovereign debt found to be expensive with regard to the impact on credit risk, a preliminary conclusion on the debt sustainability position of the middle-income countries could be made, which is that they are in an unsustainable debt position. Thus, governments are recommended to re-examine their decision to increase their borrowing from the rest of the world since the increases are associated with a negative impact and risk.

Based on the findings in this thesis, we have highlighted the role and importance of the external sector to the economy. As such, the external sector position should also be considered in policy formulation in order to promote and embrace sustainable long-term economic development.

Appendices

Appendix 2.1
Country list

a) Current account sustainability analysis

High-income countries: United Kingdom, Canada, United States, Israel, Japan, Singapore, Australia, Austria, New Zealand, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway Portugal, Spain, Sweden, Switzerland, Antigua, Trinidad.

Middle-income countries: Philippines, Thailand, Bolivia, Colombia, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Nicaragua, Paraguay, Peru, Suriname, Egypt, Jordan, Morocco, Syria, Tunisia, Sri Lanka, Lesotho, Swaziland, Malaysia, Turkey, Brazil, Chile, Costa Rica, Dominica, Grenada, Panama, St. Vincent, Venezuela, Oman, Botswana, Seychelles, South Africa.

Low-income countries: Papua New Guinea, Haiti, Bangladesh, Nepal, Pakistan, Benin, Congo Republic, Cote D' Ivoire, Ghana, Kenya, Madagascar, Mali, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Togo.

b) Fiscal policy sustainability analysis

High-income countries: Australia, Austria, Canada, Finland, France, Germany, Italy, Netherlands, Portugal, Switzerland, United Kingdom, United States, Korean Republic, Belgium, Norway, Singapore, Cyprus.

Middle-income countries: Bolivia, China, Colombia, El Salvador, Fiji, Guatemala, Guyana, Honduras, Indonesia, Iran, Jordan, Nicaragua, Paraguay, Peru, Philippines, Swaziland, Thailand, Dominican Republic, Ecuador, Morocco.

Low-income countries: Burundi, Chad, Haiti, Kenya, Malawi, Nepal, Papua New Guinea, Rwanda, Sierra Leone, Tanzania, Zambia.

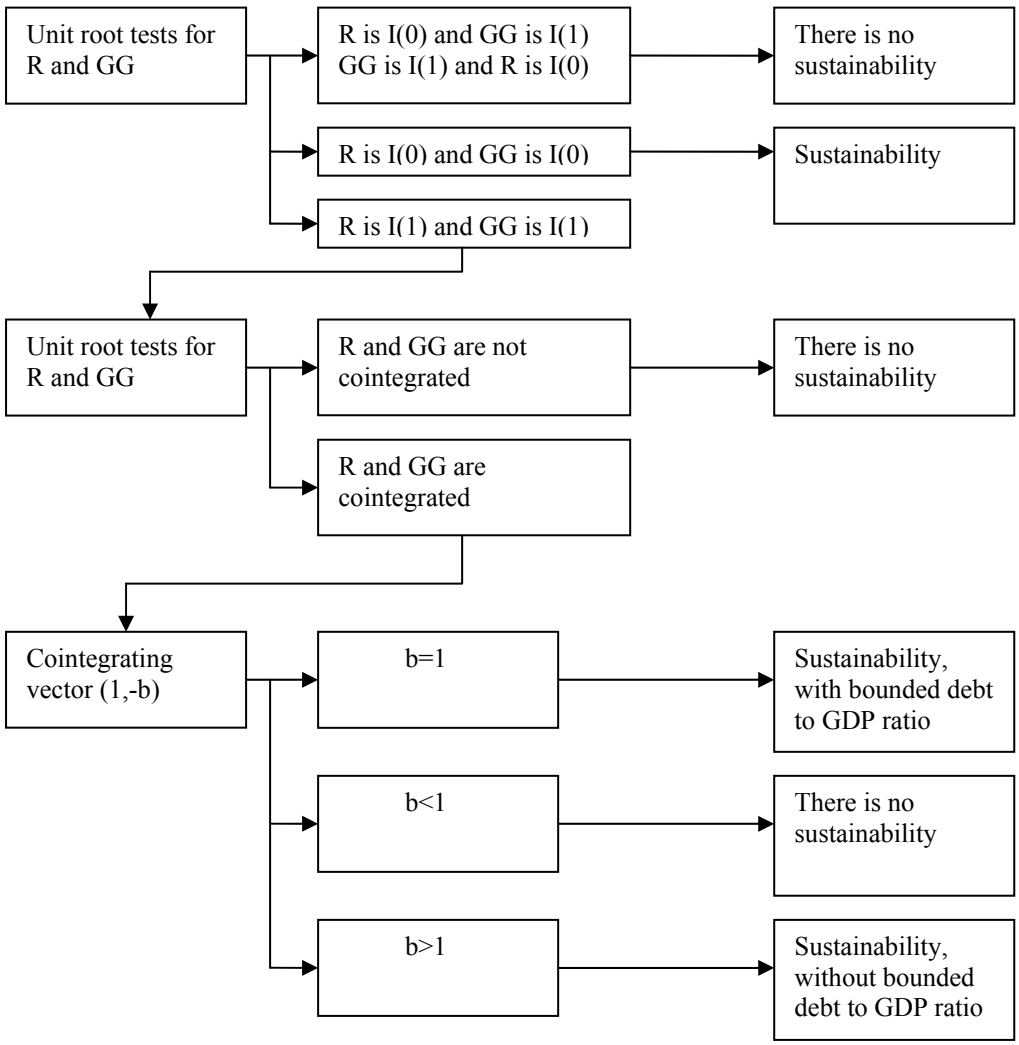
c) Debt position sustainability analysis

High-income countries: Australia, Austria, Canada, Germany, Italy, Netherlands, Portugal, Switzerland, United Kingdom, United States, Korean Republic, Belgium, Norway, Finland.

Middle-income countries: China, Colombia, El Salvador, Fiji, Guatemala, Guyana, Iran, Jordan, Philippines, Swaziland, Thailand, Ecuador, Morocco, Costa Rica, Malaysia, Uruguay.

Low-income countries: Burundi, Chad, Haiti, Kenya, Nepal, Papua NG, Rwanda, Sierra Leone, Tanzania.

Appendix 2.2
Sustainability, unit root and cointegration tests



Notes: Source from Afonso (2004). This procedure is also applicable for the fiscal policy sustainability analysis.

Appendix 2.3
Cointegration test on current account sustainability position by SBC criterion selection

	High income countries	Middle income countries	Low income countries
		Pooled Mean Group estimator	
MM	-1.149 (0.015)*	-0.835 (0.014)*	-0.590 (0.026)*
ϕ_i	-0.214 (0.050)*	-0.287 (0.054)*	-0.371 (0.092)*
No of observations	26	36	19
LR statistic	62.38*	154.80*	37.76*

Notes: * and ** indicates significance at 5 and 10 percent respectively. Numbers in brackets represent the standard error. ϕ_i denotes speed of the adjustment (error correction term). The null hypothesis is no cointegration. The LR statistics test for equal long-run parameters.

Appendix 2.4
Country-specific estimates for the current account sustainability analysis

High income countries	ϕ_i	$\chi^2 SC$	$\chi^2 NO$	$\chi^2 HE$	$\bar{R}^2$
United Kingdom	-0.024	1.25	0.04	0.11	0.78
	(0.066)				
Canada	-0.276	0.66	1.81	0.04	0.70
	(0.113)*				
United States	0.010	1.42	1.27	1.09	0.59
	(0.037)				
Israel	-0.165	0.01	0.61	0.17	0.42
	(0.133)				
Japan	-0.301	0.09	0.60	1.15	0.69
	(0.115)*				
Singapore	-0.121	0.10	8.18	0.10	0.95
	(0.143)				
Australia	-0.828	0.92	11.44	0.62	0.71
	(0.176)*				
New Zealand	-0.631	3.42	0.57	0.05	0.66
	(0.098)*				
Austria	-0.080	0.41	8.37	0.00	0.95
	(0.074)				
Cyprus	-0.201	1.75	0.76	0.01	0.70
	(0.137)				
Denmark	-0.207	0.13	0.22	0.20	0.83
	(0.111)*				
Finland	-0.092	2.91	0.77	5.93	0.83
	(0.065)				
France	-0.233	0.73	0.99	0.21	0.92
	(0.122)*				
Germany	-0.200	0.01	1.08	0.01	0.86
	(0.119)*				
Greece	-0.053	0.30	2.94	0.13	0.95
	(0.055)				
Iceland	0.007	0.01	0.41	0.81	0.38
	(0.096)				
Ireland	-0.319	1.60	0.41	3.22	0.19
	(0.106)*				
Italy	-0.214	3.72	0.83	0.00	0.75
	(0.112)**				
Netherlands	-0.398	7.28	2.00	1.61	0.94
	(0.164)*				
Norway	-0.154	1.28	1.31	0.01	0.23
	(0.126)				
Portugal	-0.005	2.10	1.36	0.36	0.65
	(0.059)				
Spain	-0.131	2.16	1.48	0.04	0.84
	(0.064)*				
Sweden	-0.147	0.06	0.27	0.02	0.93
	(0.095)				
Switzerland	0.073	0.02	2.12	1.09	0.85
	(0.117)				
Antigua	-0.448	1.25	1.99	10.77	0.28
	(0.124)				
Trinidad	-0.137	0.09	0.09	0.05	0.16
	(0.164)				

Notes: *and ** indicates significance at 5 and 10 percent respectively. Numbers in the brackets represent the standard error. ϕ_i denotes speed of the adjustment (error correction term). The null hypothesis is no cointegration. $\chi^2 SC$, $\chi^2 NO$ and $\chi^2 HE$ denoted the chi-square statistics of the serial correlation, normality and heterocedasticty respectively. While $\bar{R}^2$ is the adjusted R-Squared from the estimated model.

Appendix 2.5

Alternatives pooled estimates on the current account sustainability ARDL (1,1)

	High income countries		Middle income countries		Low income countries	
	MM	ϕ_i	MM	ϕ_i	MM	ϕ_i
SFE	-1.128 (0.012)*	-	-0.688 (0.073)*	-	-0.504 0.067)*	-
DFE	-1.161 (0.052)*	-0.200 (0.044)*	-0.634 (0.106)*	-0.140 (0.058)*	-0.459 (0.069)*	-0.269 (0.074)*
MG	-1.067 (0.103)*	-0.217 (0.022)*	-0.623 (0.148)*	-0.290 (0.043)*	-1.215 (1.063)	-0.359 (0.072)*
No of observations	26		36		19	

Notes: SFE is static fixed effect, DFE is dynamic fixed effect, MG is mean group estimation, PMG is pooled mean group estimation. *, ** indicates significance at 5 and 10 percent respectively. # indicates robust standard error. Numbers in the brackets represent the standard error. ϕ_i denotes speed of the adjustment (error correction term). The null hypothesis is no cointegration.

Appendix 2.6
Panel cointegration with multiple structural breaks

Country	Estimated break points
High income countries	
United Kingdom	1978,1989
Canada	1978,1989
Finland	1980,1988,1994,1999
France	1979,1994,1999
Greece	1979,1992,1999
Iceland	1979,1993,1999
Ireland	1979,1994,1999
Italy	1978,1999
Norway	1979,1983,1993
Portugal	1978,1999
Middle Income countries	
Malaysia	1978,2000
Turkey	1978,2000
Brazil	1978,2000
Chile	1978,2000
Grenada	1982,1983,1986,1996,2000
Botswana	1978,1983
Seychelles	1978,1983
South Africa	1978,1983
Thailand	1978,1983
Bolivia	1979,1984,1996
Low income countries	
Congo	1979,1984,1989
Mali	1979,1995
Rwanda	1978,1998
Sierra Leone	1980,1985,1993,1997

Notes: The estimated break points are based on the case of structural break with constant term only (Case 2 in Westerlund, 2006).

Appendix 2.7
Bohn's function with random effect

Variables	Government surplus function			Debt reaction function		
	High income countries	Middle income countries	Low income countries	High income countries	Middle income countries	Low income countries
Intercept	-0.031	-0.034	-0.027	0.031	0.026	0.013
	(0.013)*	(0.008)*	(0.004)*	(0.013)*	(0.013)*	(0.010)
Debt /GDP	0.022	-0.017	0.010	-0.035	-0.048	0.009
	(0.010)*	(0.010)**	(0.005)*	(0.025)	(0.046)	(0.031)
GVAR	-1.253	-0.032	-0.882	-0.119	-0.092	0.295
	(0.191)*	(0.023)	(0.219)*	(0.493)	(0.055)**	(0.417)
YVAR	-1.284	0.186	-0.486	0.550	0.026	0.714
	(0.380)*	(0.083)*	(0.236)*	(0.695)	(0.195)	(0.857)

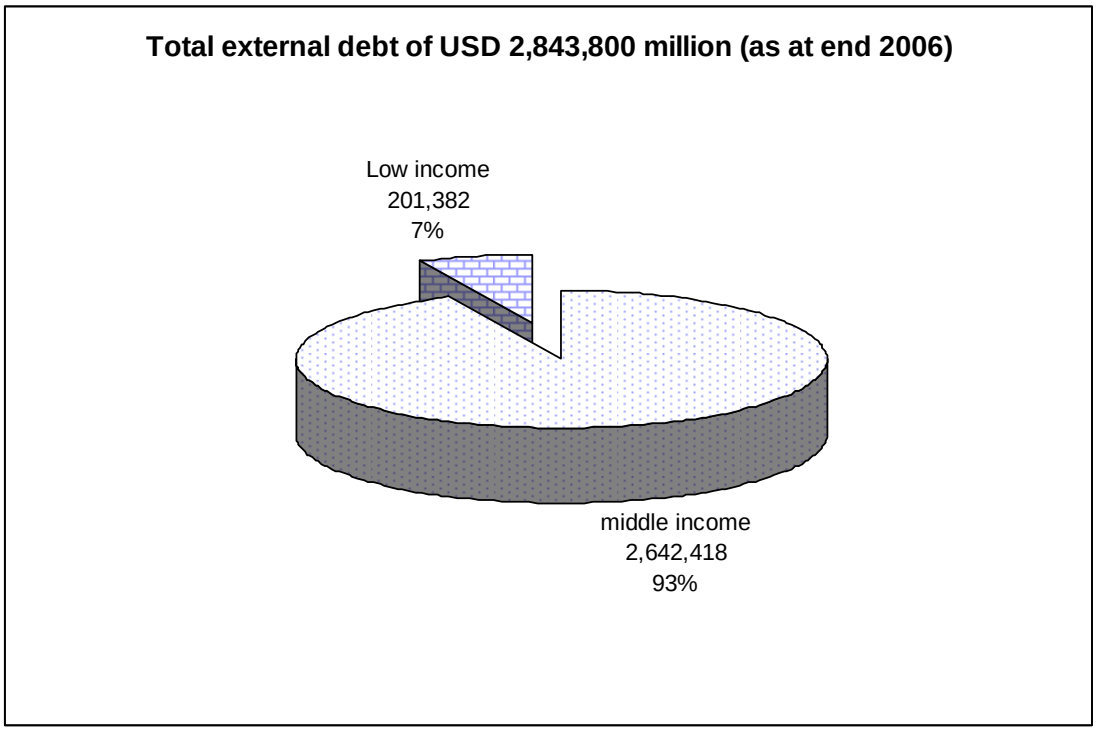
Notes: * and ** denotes significance at 5 and 10 percent respectively. Numbers in brackets indicate the robust standard error.

Appendix 3.1
Country List

Region/ countries	Level of indebtedness	Level of income
A) East Asia and Pacific		
1)Indonesia	Severe indebtedness	Lower middle income
2)Malaysia	Moderate indebtedness	Upper middle income
3)Papua New Guinea	Moderate indebtedness	Low income
4)Philippines	Moderate indebtedness	Lower middle income
5)Thailand	Less indebtedness	Lower middle income
B) Latin America and Caribbean		
1)Bolivia	Moderate indebtedness	Lower middle income
2)Brazil	Severe indebtedness	Lower middle income
3)Colombia	Moderate indebtedness	Lower middle income
4)Costa Rica	Less indebtedness	Upper middle income
5)Dominican republic	Less indebtedness	Lower middle income
6)Ecuador	Severe indebtedness	Lower middle income
7)Guatemala	Less indebtedness	Lower middle income
8)Guyana	Severe indebtedness	Lower middle income
9)Honduras	Moderate indebtedness	Lower middle income
10)Paraguay	Moderate indebtedness	Lower middle income
11)Peru	Severe indebtedness	Lower middle income
12)Mexico	Less indebtedness	Upper middle income
13)Uruguay	Severe indebtedness	Upper middle income
C) Middle East and North Africa		
1)Egypt	Less indebtedness	Lower middle income
2)Morocco	Less indebtedness	Lower middle income
3)Syria	Severe indebtedness	Lower middle income
4)Tunisia	Moderate indebtedness	Lower middle income
D) Sub Saharan Africa		
1)Cameroon	Moderate indebtedness	Low income
2)Kenya	Moderate indebtedness	Low income
3)Lesotho	Less indebtedness	Low income
4)Malawi	Severe indebtedness	Low income
5)Mali	Less indebtedness	Low income
6)Rwanda	Severe indebtedness	Lower middle income
7)Swaziland	Less indebtedness	Low income
8)Togo	Severe indebtedness	Low income
9)Zambia	Severe indebtedness	Low income

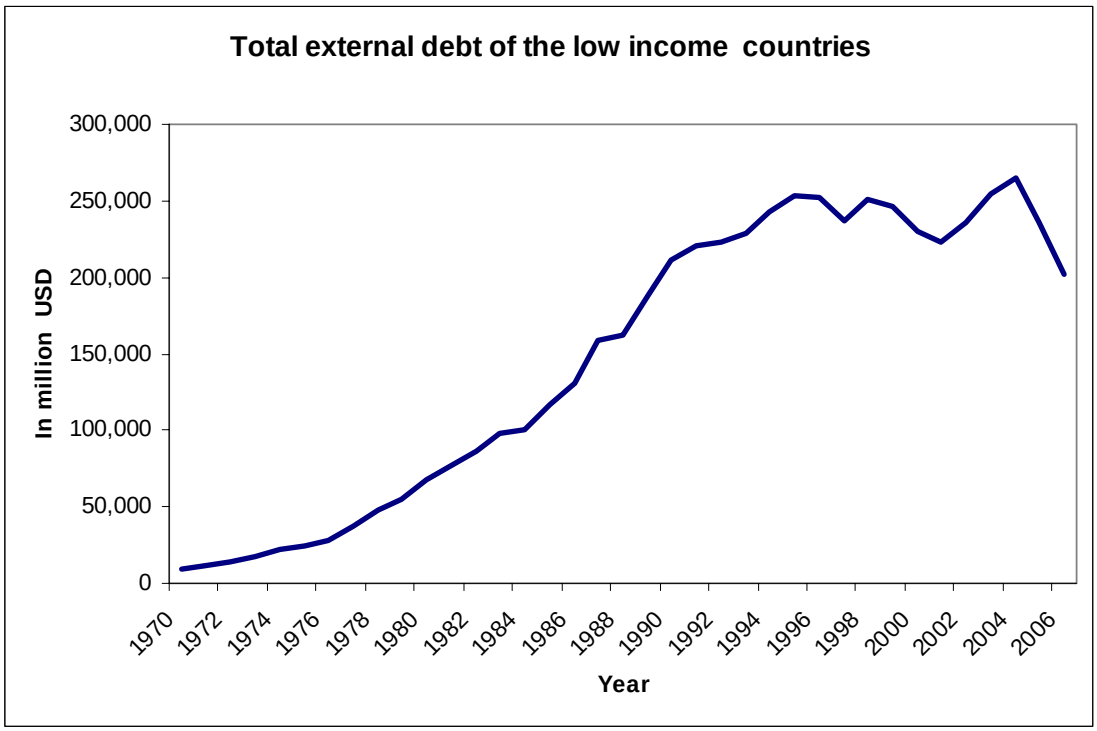
Notes: The income and level of indebtedness is based on World Bank classification.
Source:http://csirwebistad.org/pdf/classi.pdf

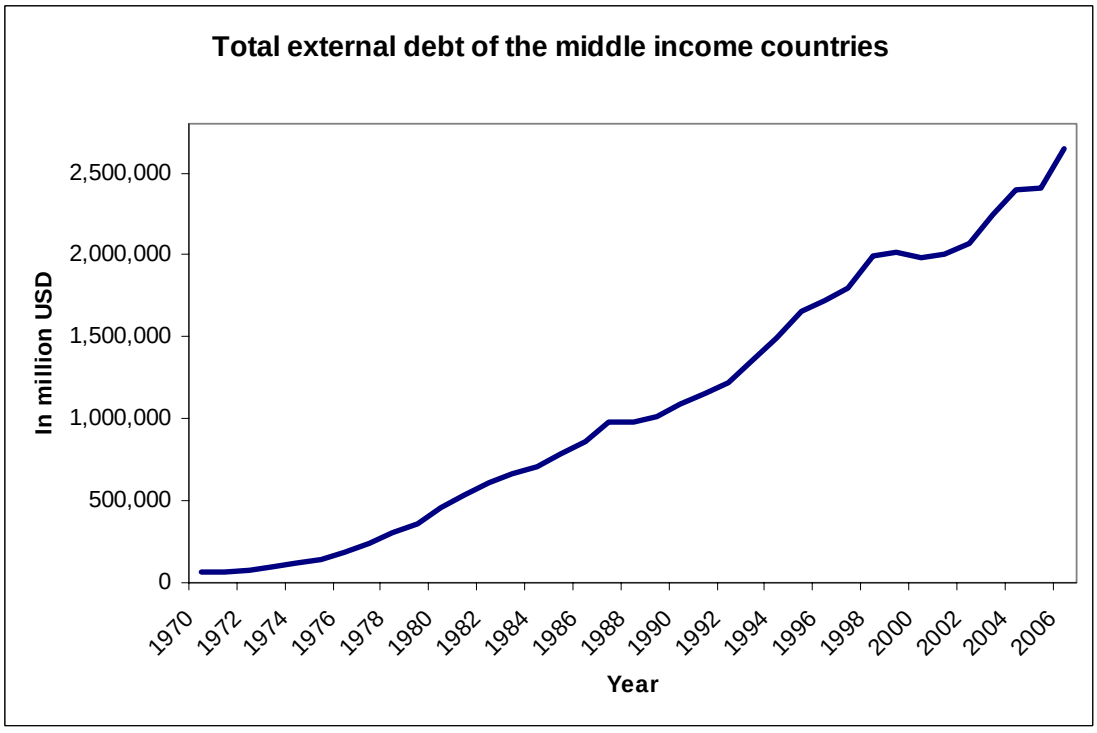
Appendix 3.2
The composition of external indebtedness by developing countries



Sources: World development Indicator (WDI), World Bank.

Appendix 3.3
The stock of external indebtedness by low and middle income countries





Sources: World development Indicator (WDI), World Bank.

Appendix 3.4
Spatial error model and spatial autoregressive model with fixed effect

To provide additional evidence of the robustness negative effect of external debt to economic growth, this paper also tries to investigate the debt-growth model in the spatial panel growth model with consideration of cross-sectional fixed effect. Figure3.2 illustrates the estimation of growth model with spatial error model (SEM) and spatial autoregressive model (SAR) with cross-sectional fixed effect. Besides that, author is aware of the possibility of the presence of endogeneity (measurement error, variable omission, simultaneous relationship between the dependent) in the debt-growth model.

Figure 3.2
Impact of external debt on per capita income growth

Growth rate of GDP per capita	**Overall sample**	
	SEM with fixed effect[#]	SAR with fixed effect[#]
A)Growth Model		
Initial income	-6.719	-6.824
	(0.818)*	(0.825)*
External debt	-0.841	-0.916
	(0.238)*	(0.224)]*
Debt Service	-0.040	-0.040
	(0.030)	(0.030)
Secondary education	0.094	0.113
	[(0.037)*	(0.037)*
Gross investment	0.186	0.194
	[(0.025)*	(0.025)*
Fiscal balance	0.138	0.151
	(0.028)]*	(0.028)*
Openness	0.014	0.016
	(0.009)	(0.009)**
Term of trade	-0.000	-0.000
	(0.000)	(0.000)
Population growth	-0.084	-0.095
	(0.165)	(0.165)
Spatial autocorrelation	0.176	-
	(0.044)*	
W*dependent variable	-	0.014
		(0.046)
R-squared	0.215	0.202
Log likelihood	-3235.67	-3241.71

Notes: * and ** denotes significant at 5 and 10 percent significance level respectively. Numbers in parentheses represent the t-statistics. The fixed effect model represents the cross-sectional fixed effect. [#] The demeaned model no longer contains a constant term where it may be incompatible with assumptions made by standard spatial econometrics software (Anselin, et al.2008).

The results in figure3.2 show the estimates of the growth model with SEM and SAR and with cross-sectional fixed effect (to capture for unobserved heterogeneity effect). The spatial autocorrelation variable shows as positive and significant at 5 percent significance level,

suggesting an existence of spatial correlation in the disturbance error in the growth model. Despite strong evidence of spatial correlation in SEM model, there is less evidence to support the spatial dependence role in the growth model. The lagged spatial autoregressive coefficient is positive for both cases with and without fixed effect but insignificant, thus no conclusive evidence could be found to confirm the positive spillover effect among the 31 developing countries in the sample. The results also show a similar pattern when it was estimated with the SAR model. Besides that, the external debt to GDP variable is found to have a negative and significant (at 5 percent significance level) effect on economic growth for both models, SEM and SAR, implying that the negative effects are robust to other alternative estimators. This might suggest that external debt does not contribute in boosting economic growth.

Appendix 3.5
Diagnostic test on spatial correlation on the debt-growth model

Year	Test statistics				
	Moran's I test (SEM)	**LR test (SEM)**	**Wald test (SEM)**	**LM error test (SEM)**	**LM error test (SAR)**
1970	-0.2256	0.9105	2.6722**	0.3757	13.5534*
1971	-0.0195	0.6355	1.1256	0.2897	6.5060**
1972	0.8365	0.0543	0.0391	0.0319	0.3569
1973	-0.1474	1.8789	24.4983*	0.4320	1.3618
1974	-0.8706	3.9358*	23.378*	1.6722	48.049*
1975	1.0340	1.1633	1.9394	0.2752	4.080*
1976	-1.6167	9.1416*	45.1658*	3.4339**	42.521*
1977	-0.6085	4.4811*	43.2106*	1.0568	9.2199*
1978	1.0567	0.4401	0.6480	0.1466	1.840
1979	-0.8810	5.1183*	39.1875*	1.5088	10.633*
1980	-0.5587	1.7727	5.9878*	0.7890	6.1310*
1981	0.4452	0.0189	0.0391	0.0055	0.082
1982	-0.0479	1.2594	10.131*	0.1880	0.5802
1983	1.1341	0.2877	0.2167	0.1778	0.8795
1984	0.9429	0.2756	0.3809	0.0905	0.1493
1985	-0.9980	11.3607*	45.3294*	1.7667	34.824*
1986	-0.8836	5.5712*	43.210*	1.1495	32.386*
1987	0.7093	0.1506	0.1042	0.0929	1.1791
1988	-0.3453	1.3202	12.421*	0.3053	4.6574*
1989	0.3429	-0.000	0.001	0.0001	0.0045
1990	-0.0054	0.3057	1.3589	0.0709	0.2493
1991	-0.9328	7.4362*	45.004*	1.2107	7.0568*
1992	-0.2567	0.6945	1.4520	0.2824	7.5386*
1993	-0.6561	5.7103*	44.6737*	0.7277	2.7081**
1994	0.0681	0.1046	0.1684	0.0358	0.0086
1995	1.6232**	2.2421	2.6306**	1.4356	6.5276*
1996	0.0480	0.5008	3.8588*	0.0366	0.0296
1997	1.4328	1.4873	1.1619	0.9468	37.5405*
1998	1.5176	2.5799**	3.8052*	1.3419	8.1870*
1999	-1.0931	6.2627*	45.1688*	1.3474	22.141*
2000	0.7465	0.9251	1.4117	0.2418	2.050
2001	2.2424*	3.0475**	2.8880**	2.3446	25.1732*
2002	0.0781	0.1087	0.1213	0.0549	0.2497
2003	0.6564	0.1633	0.1813	0.0581	0.6419
2004	2.2971*	3.6943*	3.7824*	2.4454	5.3048*
2005	-0.3639	1.7879	10.836*	0.4978	12.435*

Notes: * and ** denotes significant at 5 and 10 percent significance level respectively.

Appendix 3.6
Impact of external debt on growth (1996-2005)

	Bias-Corrected LSDV	
Growth model	Non-HIPC	Overall
Initial income$_{(t-1)}$	-28.228	-24.41
	(4.892)*	(4.632)*
External debt	-4.206	-5.840
	(1.767)*	(1.786)*
Debt Service	-0.265	-0.088
	(0.142)**	(0.098)
Secondary education	0.418	0.423
	(0.263)	(0.224)*
Gross investment	0.177	0.117
	(0.089)**	(0.139)
Fiscal balance	0.070	0.422
	(0.080)	(0.223)**
Openness	0.029	0.020
	(0.030)	(0.270)
Term of trade	-0.000	-0.000
	(0.000)	(0.000)
Population growth	-3.674	-0.594
	(1.326)*	(0.303)**
Observations	22	31
Investment model		
Investment rate $_{(t-1)}$	0.733	0.713
	(0.041)*	(0.048)*
Debt service	0.039	0.016
	(0.105)	(0.094)
External debt	-1.937	-1.958
	(1.107)**	(1.224)
GDP growth rate	0.417	0.305
	(0.057)*	(0.048)*
Aid	-0.182	0.095
	(0.357)	(0.066)
Secondary education	-0.187	-0.049
	(0.180)	(0.182)
Domestic credit	0.015	-0.000
	(0.021)	(0.000)
Openness	0.005	0.006
	(0.025)	(0.022)
Government revenue	0.002	0.001
	(0.004)	(0.004)
Observations	22	18

Notes: * and ** denotes significant at 5 and 10 percent significance level respectively. Numbers in parenthesis represent the t-statistics. The initial income, investment rate and external debt are expressed in natural logarithm. The standard errors are computed based on the bootstrap variance-covariance matrix.

Appendix 4.1
Country list

First analysis: The impact of joint holding decision on credit risk
Argentina, Brazil, Chile, Chile, Colombia, Indonesia, Malaysia, Mexico, Philippines, South Africa, Thailand, Turkey, Uruguay, and Venezuela.

Second analysis: The optimal level of international reserves-holding
Argentina, Brazil, Bulgaria, Chile, Colombia, Cote D'Ivoire, Croatia, Dominican Republic , Ecuador, El Salvador, Egypt, Ghana, Indonesia, Malaysia, Mexico, Nigeria, Panama, Pakistan, Peru, Philippines, Poland, Russia ,Serbia, South Africa ,Thailand, Turkey, Tunisia, Ukraine, Uruguay, Venezuela and Vietnam.

Appendix 4.2
Alternatives of panel unit root test

	Levin, Lin and Chu	ADF-Fisher	Levin, Lin and Chu	ADF-Fisher
Variables	Level		1st difference	
Ratings	-2.875*	33.515	-9.6979*	88.758*
US treasury (10yr)	-8.352*	63.961*	-24.363*	240.802*
Reserves	1.753	20.983	-7.566*	90.002*
Sovereign debt	-0.979	19.148	-9.4027*	103.250*
Term of trade	-2.683*	15.850	-5.199*	35.456*
REER	-4.038*	39.001*	-7.677*	74.919*
Short-term debt	-5.250*	48.17*	-9.045*	80.92*
Changes in exchange rates	-35.072*	114.284*	-47.369*	179.910*

Notes:* and ** denotes the significance at 5 and 10 percent significance level.

Appendices 4.3
The elasticity of holding reserves and debt on sovereign credit ratings (excluding China)

Ratings	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Reserves	0.384	0.266		0.307	0.419	0.330		0.265
	(0.064)*	(0.033)*		(0.044)*	(0.065)*	(0.057)*		(0.039)*
Sovereign debt	-0.506		-0.117		-0.497		0.196	
	(0.123)*		(0.019)*		(0.089)*		(0.066)*	
Short term debt				-0.020		-0.023		
				(0.011)**		(0.013)**		
Term of trade					-0.004	0.000	-0.002	0.001
					(0.001)*	(0.001)	(0.001)	(0.001)
ECT term	-0.266	-0.370	-0.285	-0.336	-0.283	-0.323	-0.262	-0.352
	(0.070)*	(0.074)*	(0.065)*	(0.079)*	(0.084)*	(0.076)*	(0.064)*	(0.077)*
Restricted Log Likelihood	195.92	188.76	185.65	198.95	213.87	212.27	200.11	202.71
Unrestricted Log Likelihood	255.45	195.78	209.14	215.97	299.02	252.49	246.71	223.96
LR statistics[#]	119.06*	14.05	46.98*	34.03**	170.29*	80.43*	93.19*	42.50*

Notes: * and ** denotes the significance at 5 percent and 10 percent level. The null hypothesis is no cointegration. All variables are expressed in natural logarithmic. Number in parenthesis denotes the standard error. [#] represents the LR test statistics testing for equal long-run parameters.

Appendix 4.4
Thresholds effect of spread-reserves and debt relationship

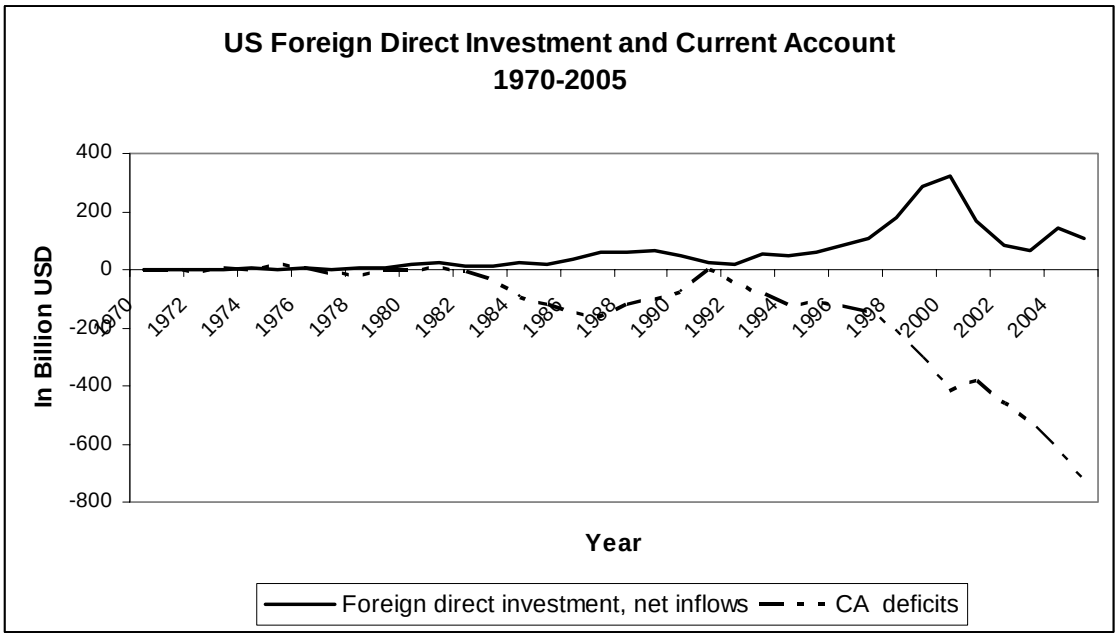
SPREAD[#]	**R/M**	**R/ED**	**R/GDP**	**R/STD**
Threshold estimates (γ)	3.294	40.597	11.31	3.342
Reserves $(q_i \leq \gamma)$	-9.620	0.013	0.574	0.931
	(1.662)*	(0.149)	(0.374)	(2.622)
Observations	12	21	13	16
Reserves $(q_i > \gamma)$	1.563	0.035	0.071	0.0884
	(0.886)**	(0.004)*	(0.026)*	(0.022)
Observations	15	6	14	11
F-test for no threshold	16.486*	5.655	4.703	11.30
Bootstrap p-value	0.053	0.675	0.752	0.191

Notes: * and * denotes significance at 5 and 10 percent respectively. The null hypothesis is no threshold relationship. Number in brackets represent a robust standard error.[#] spreads are calculated based on the difference between long-term government bond yield and the federal reserves fund rate (short-term rate), Jeanne and Ranciere(2009).

Appendix 4.5
Results on countries sample splitting

Reserves variable	Regime	Countries
R/M	First regime	Cote D'Ivoire, Dominican Republic, Ecuador, El Salvador, Ghana, Mexico, Panama, Pakistan, Philippines, Russia, Serbia, South Africa, Tunisia, Ukraine, and Vietnam.
	Second regime	Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Egypt, Indonesia, Malaysia, Nigeria, Peru, Poland, Thailand, Turkey, Uruguay, and Venezuela
R/ED	First regime	Argentina, Brazil, Cote D'Ivoire, Dominican Republic, Ecuador, Ghana, Indonesia, Mexico, Pakistan, Panama, Philippines, Serbia, Tunisia, Turkey, Ukraine, Uruguay, and Vietnam.
	Second regime	Bulgaria, Chile, Colombia, Croatia, Egypt, El Salvador, Malaysia, Nigeria, Peru, Poland, Russia, South Africa, Thailand, and Venezuela.
R/GDP	First regime	Argentina, Brazil, Colombia, Cote D'Ivoire, Dominican Republic, Ecuador, El Salvador, Indonesia, Mexico, Pakistan, Panama, Poland, South Africa, Tunisia, Turkey, Ukraine, Uruguay, and Vietnam.
	Second regime	Bulgaria, Chile, Croatia, Egypt, Ghana, Malaysia, Nigeria, Peru, Philippines, Poland, Russia, and Thailand.

Appendix 4.6
The foreign direct investment and current account position



Sources: OECD and World Bank

Appendix 4.7
Standard & Poor's long-term issuer sovereign credit rating scale

Rating category	Definition
AAA	An obligor rated AAA has extremely strong capacity to meet its financial commitment. AAA is the highest Issuer Credit Rating assigned by S & P's.
AA	An obligor rated AA has very strong capacity to meet its financial commitment. It differs from the highest rated obligors only in small degree.
A	An obligor rated A has strong capacity to meet its financial commitment but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.
BBB	An obligor rated BBB has adequate capacity to meet its financial commitment. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitment.
BB	An obligor rated BB is less vulnerable in the near term than other lower-rated obligors. However, it faces major ongoing uncertainties and exposure to adverse business, financial or economic conditions which could lead to the obligor's inadequate capacity to meet its financial commitments.
B	An obligor rated B is more vulnerable than the obligors rated BB, but the obligor currently has the capacity to meet its financial commitment. Adverse business, financial, or economic conditions will likely impair the obligor's capacity or willingness to meet its financial commitments.
CCC	An obligor rated CCC is currently vulnerable, and is dependent upon favourable business, financial and economic conditions to meet its financial commitments.
CC	An obligor rated CC is currently highly vulnerable.
SD	An obligor rated SD is in selective default

Sources: Standard & Poor's (2000)

Appendix 4.8
Transformation of S& P's and Moody's rating scales into numerical scale

S&P	**Moody's**	**Scale**
Investment-grade ratings		
AAA	Aaa	20
AA+	Aa1	19
AA	Aa2	18
AA-	Aa3	17
A+	A1	16
A	A2	15
A-	A3	14
BBB+	Baa1	13
BBB	Baa2	12
BBB-	Baa3	11
Speculative-grade ratings		
BB+	Ba1	10
BB	Ba2	9
BB-	Ba3	8
B+	B1	7
B	B2	6
B-	B3	5
CCC+	Caa1	4
CCC	Caa2	3
CCC-	Caa3	2
CC	Ca	1
D	C	0

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