ESSAYS ON SOVEREIGN DEBT

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ABSTRACT

This thesis analyzes various issues of sovereign debt from both theoretical and empirical perspectives. The first chapter investigates how global and country-specific factors like US interest rates, global risk aversion and the country-specific macroeconomic climate drive the dynamics of sovereign spreads in emerging countries. I develop a theoretical framework that pinpoints the determination of the equilibrium debt level, probability of default and sovereign spread, and test empirical implications derived from the predictions of the model. The chapter then employs a Structural Vector Autoregression (SVAR) model to show empirically how the spread of sovereign debt is influenced over time by the factors given above. The empirical results show that most of the variations in sovereign spreads are caused by global shocks such as the term structure of US interest rates and the global risk aversion. The findings also indicate that shocks from the US have a direct effect on sovereign spread and an indirect effect via country-specific macroeconomic fundamentals. Finally, the evidence produced validates the presence of some response patterns of sovereign spread to the global shocks.

The second chapter deals with debt restructuring strategy from private initiatives when multiple players are involved. I show that when the old creditor is unable to extend new loans due to liquidity crunch and austerity, and incentive issues of the borrowing country worsen sovereign debt repayment problems, a debt equity swap where an old creditor swaps a part of the debt for an equivalent amount of equity is Pareto improving and benefits all stakeholders. The exchange of old debt into equity makes the new debt automatically more senior as the extra equity (swapped) is by

definition junior to all other debt. The enhanced priority of the new debt increases the pay-off of new lenders in the bad state and makes this debt relatively safer and allows lenders to charge lower interest rates. This fall in the face value of new loans (payments in the good state) leaves an increased surplus to the borrowing country, which is then incentivized to make an extra effort to make risky project successful, which further lowers the probability of second time default, making everyone's gains ex ante. Thus, unlike previous work on debt equity swap models which show ambiguous increments in welfare, my work shows the opposite when such swaps are designed in the debt restructuring process. My model further discusses why such swaps are most effective in the current European debt crisis. Finally, my model shows that debt exchange, where the old creditor exchanges its existing debt into a new junior debt, is Pareto improving.

The third chapter empirically analyses the effect of participating in an IMF program on sovereign debt rescheduling. By applying simultaneous equation estimation for 115 countries from 1970 to 2012, I found that participating in a non-concessional IMF program increases the probability of subsequent debt rescheduling, but the probability and the quantity of debt rescheduling are negatively correlated with the amount of non-concessional IMF disbursed loans in the short term. The participation effect of IMF programs on sovereign debt rescheduling is larger for countries with a lower income. Furthermore, compliance with IMF conditionality could increase the probability and quantity of subsequent debt rescheduling, especially for low income countries. The results may indicate that participation in a non-concessional IMF program could signal a country's willingness to reform and that the recipient country is rewarded with subsequent debt rescheduling. The effectiveness of signaling is negatively linked to the country's level of income and compliance with IMF conditionality could enhance such signaling effects.

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DECLARATION

Part of chapter 2 has been published: Banerji, S., Ventouri, A., Wang, Z., 2014. The sovereign spread in Asian emerging economies: The significance of external versus internal factors. Economic Modelling 36 566-576. This chapter is my original research work, it was done under the guidance of Professor Sanjay Banerji.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF: Augmented Dickey Fuller test

AIC: Akaike Information Criterion

BAA: The credit rating grade of BAA which is issued by Standard and Poor

CAD: Canadian dollar

CBS: Corporate Bond Spread

CDS: Credit Default Swap

CHF: Swiss franc

EMBI: Emerging Market Bond Index

EME: Emerging Market Economy

EUR: Euro

FRB: Federal Reserve Board

G7: Group of 7

GBP: British Pound

GDP: Gross Domestic Product

GNI: Gross National Income

GNP: Gross National Product

HQIC: Hannan-Quinn Information Criterion

IMF: International Monetary Fund

JPY: Japanese Yen

KPSS: Kwiatkowski, Phillips, Schmidt and Shin test

LTCM: Long-Term Capital Management

OLS: Ordinary Least Squares

PMG: Pool Mean Group

RAI: Risk Appetite Index

SEK: Swedish Krona

SUR: Seemingly Unrelated Regression

SVAR: Structural Vector Autoregression

UN: United Nations

US: United States

VAR: Vector Autoregression

VIX: Chicago Board Options Exchange volatility index

VRP: Variance Risk Premium

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1 INTRODUCTION

The problems of sovereign debt has multiple dimensions, where numerous players, institutions and countries are engaged in its various parts. The issues involve economic as well as political considerations and their impacts are often far reaching and go beyond the boundaries of the nations involved in the process; hence there are no unifying theories or empirical conclusions connecting all the disparate themes. Sovereign bond is the key source of funds for the governments in all countries, in particular for emerging markets. The confidence placed by the investors worldwide upon a Government is often reflected by the interest rate of sovereign bonds. The return on emerging market issues of sovereign bond is generally expressed in terms of their spread rather than their absolute interest rate. The spreads of the US Dollar denominated bond are defined as the difference in yield between the bond and a benchmark US Treasury Bond of a similar maturity. In recent times, capital flight and sovereign bond spread have attracted huge attention. Because of the Federal Reserve Board's (FRB)

tapering of Quantitative easing policies (or bond buying programmes) and the market expectation of lifting interest rates in the US, flows to emerging markets have weakened considerably. This in turn has led to greater volatility in the financial markets and higher risk aversion globally. If the current trend continues, then the emerging market economies are expected to suffer a net capital outflow for the first time since 1980s[1]. Aizenman *et al*. (2014) show that the FRB's decisions to taper 'bond buyback programmes' triggered capital outflows from emerging markets, and lead to a fall in the performances of the equity market, depreciations of exchange rates, and an increase in Credit Default Swap (CDS) spreads (reflecting a greater uncertainty and risk in sovereign bond markets).

Chapter 2 deals with the determinants of sovereign bond spreads in emerging markets; in particular, the interaction between global factors (the expectations of US interest rates, risk aversion and the Dollar Index), country-specific factors and sovereign bond spreads. I found that the variation in sovereign spreads are mainly driven by global shocks, with the term structure of US interest rates and the global risk aversion of international investors having the most important roles. In order to capture the dynamic interaction between global factors, country-specific factors and sovereign bond spreads I use Structural Vector Autoregression (SVAR) to test my hypotheses on

[1] See "Capital flight darkens economic prospects for emerging markets" in Financial Times, October 1, 2015.

15 emerging countries. The hypotheses are drawn from my theoretical model which establishes interdependence among sovereign bond spreads, country-specific and global factors. By assuming that global investors are risk averse and the sovereign countries' citizens are subject to moral hazard in effort, the model shows how global shocks such as US interest rates and global risk aversion affect capital mobility and sovereign bond spread.

When the markets perceive a government as less likely to repay the debt in the future, this can increase the borrowing cost of a country, which may cause sovereign default (Trebesch *et al*., 2012). In fact, Pescatori and Sy (2007) suggest that bond spreads exceeding 1,000 basis points should be categorized as episodes of severe debt distress. Thus an increase in sovereign bond spreads is typically seen as a key predictor of default and a need for the restructuring of the terms and conditions of the original debt. Debt crisis can indeed be self-fulfilling and caused by contagion and investors' adverse sentiments (Cole and Kehoe, 1996; Cole and Kehoe, 2000; Chamon, 2007). Duffie *et al*. (2003) point out that rather than defaulting outright, a sovereign debt issuer usually pursues a restructuring or renegotiation of its debt. Relatedly, sovereign bond spreads can play a crucial role for debtor's policies in distress. For example, governments may react to an increase in sovereign bond spread by pursuing additional fiscal tightening and debt restructuring. Debt restructuring may benefit both creditor and debtor (Krugman, 1988), but under different circumstances some restructuring

strategies might be more effective. Hence, it is customary for countries experiencing sovereign debt crisis to engage in the process of debt restructuring.

The Chapter 3 deals with debt restructuring strategies by private initiatives (e.g. banks) when multiple players are involved. This chapter analyzes the financial aspects of different debt restructuring strategies when the debtor faces repayment problems, in particular, to what extent financial engineering could resolve the issue. The theme of this chapter involves three parties: old creditors, new creditors and the borrowing country. Whenever the old creditor is unable to provide new loans and the incentive issues of the borrowing country worsen the sovereign debt repayment problem, I find that a debt equity swap where an old creditor swaps a part of the debt for an equivalent amount of equity is Pareto improving and benefits all stakeholders.

Debt restructuring can be a Pareto improving strategy, but in reality, it could also be delayed over so many years and fail due to low creditor participation. This might be due to the conflict of interest between multiple players, for example, the problem of creditor holdouts is one of the main reasons for delayed and inefficient debt restructuring. Typically, a creditor tends to refuse to participate in a restructuring offer, so as to enforce better terms later on. Debt restructuring in Argentina (2005) and Dominica (2004) are the two most recent cases which were unsuccessful because they suffered from a large share of holdout creditors (Trebesch *et al*., 2012). Looking back at debt crises that have happened since 2005, the International Monetary Fund (IMF) acknowledges the failure of recent debt restructuring and finds that debt restructuring

is often "too little too late" and fails to achieve sustainable results[2]. In addition to the holdout problem, it is well known that lack of transparency and insufficient communication with creditors can contribute to failed or delayed restructuring processes. Evidence suggests that information sharing and close consultation with banks and bondholders can lead to quick and successful restructuring (Andrizky, 2006; Enderlein *et al*., 2012; Roubini and Setser, 2004; Sturzenegger and Zettelmeyer, 2006). Thus, a co-ordination body such as the IMF could play an important role in resolving debt holdout and information asymmetry problems, hence facilitating debt restructuring.

Chapter 4 analyzes the effect of participating in an IMF program on subsequent sovereign debt rescheduling. In order to control for the potential endogeneity issues with IMF participation, a simultaneous equation model is employed. Using data from 115 developing countries, I found that participating in a non-concessional IMF program increases the probability of subsequent debt rescheduling. Such participation effects are larger for countries with lower income. Furthermore, compliance with IMF conditionality could increase the probability and quantity of subsequent debt rescheduling, especially for low income countries.

[2] See "IMF acknowledges failure of recent debt restructurings, proposes new reforms" in Eurodad, May 30, 2013.

2 THE SOVEREIGN SPREADS IN EMERGING ECONOMIES: THE RELATIVE IMPORTANCE OF GLOBAL VERSUS COUNTRY-SPECIFIC FACTORS[3]

2.1 Introduction

With the rapid growth in the amount of outstanding debt[4], sovereign bonds form an important class of portfolio for investors and a key source of funds for Governments in emerging markets. There exists a powerful view that understanding the factors behind the magnitude of the spread and its volatility, and identifying how the spread is influenced over time is important not only for the purpose of inclusion in a well-

[3] Part of this chapter has been published: Banerji, S., Ventouri, A., Wang, Z., 2014. The sovereign spread in Asian emerging economies: The significance of external versus internal factors. Economic Modelling 36 566-576

[4] Since the 1990s, there has been a significant increase in the amount of outstanding debt. By 2010, the world had over 77 trillion dollars aggregate outstanding in sovereign bonds according to BIS.

diversified portfolio, but also for grasping its efficacy as a financial instrument of the governments in emerging economies. Typically, the sovereign spreads of the US Dollar denominated bond are defined as the difference in yield between the bond and a benchmark US Treasury bond of a similar maturity, and they are normally expressed in basis points. The return on emerging market issues of such bonds is generally expressed in terms of their spread rather than their absolute yield.

The role of sovereign bond spreads in emerging economies has generated a lot of interest among economists for the past century. Using Ordinary Least Squares (OLS) and panel regressions, extensive empirical evidence has been produced on the role of country-specific and global factors on the variation of sovereign bond spread. Some studies focus on the country-specific factors (e.g. Edwards, 1984; Baldacci *et al*., 2008; Hilscher and Nosbusch, 2010), whereas others focus on the global factors (e.g. Arora and Cerisola, 2001; Weigel and Gemmill, 2006; Hartelius, Kashiwas and Kodres, 2008). Another tranche of studies have turned their attention to the endogeneity of sovereign spread (e.g. Uribe and Yue, 2006) and endogeneity of risk aversion (e.g. Blanchard, 2005; Garcia-Herrero and Ortiz, 2006; Fracasso, 2007).

This chapter constitutes the first attempt, to my knowledge, to explicitly assess the relative importance of both country-specific and global factors in influencing the variations of spread of the sovereign bonds issued by emerging countries over time. In order to resolve endogeneity problems stemming from the dynamic interdependence between these variables I employ a Structural Vector Autoregression (SVAR) model.

In addition, instead of following the traditional approach relying on an exchange rate, I use the US Dollar Index[5] as a proxy for the currency risk that affects the probability of default of sovereign bonds and their spread.

This chapter advances the previous literature in the following directions: Firstly, I develop a model which establishes interdependence among sovereign bond spread, country-specific and global factors and shows the mechanism of how global shocks such as US interest rates and global risk aversions affect sovereign bond spread. Secondly, I explicitly take into account currency risk by bringing the US Dollar exchange rate into the analysis. The bulk of empirical evidence on capturing currency risk tends to use the exchange rate between domestic currency and the US Dollar (treated as a country-specific factor); however, currency risk can be seen as a purely global factor, which implies that the Dollar Index is a more appropriate proxy because exchange rates can be affected by country-specific factors, such as high debt level; but, previous studies on this issue have already included these country-specific factors in their models, which implies that after controlling for domestic macroeconomic fundamentals, exchange risk can be seen as a purely global factor. Thirdly, while the majority of prior literature tends to focus on the spot US interest rate because their

[5]The Dollar Index is a trade-weighted average of six foreign currencies against the dollar. Currently, the index includes the Euro (EUR), Japanese Yen (JPY), British Pound (GBP), Canadian Dollar (CAD), Swedish Krona (SEK) and Swiss Franc (CHF).

models are static, I investigate the dynamic role of the term structure of US interest rates on the domestic economy of the emerging markets and sovereign spread. An increase in the expected future short term US interest rate might cause a higher cost of borrowing in emerging countries, but it also signals a recovery in a world economy.

My results indicate that global factors cause variations of both country-specific variables (trade balance to GDP ratio and debt to GDP ratio) and sovereign spreads. Moreover, there is also evidence which suggests that global factors not only directly affect sovereign spread, but indirectly cause fluctuations of sovereign spread via their impact on the country-specific macroeconomic fundamentals.

The remainder of the chapter is organized as follows: Section 2.2 reviews the literature. Section 2.3 develops the theoretical model to show how sovereign spread and the level of debt are interdependent, and that they respond to the variations of global factors. Section 2.4 explains the empirical strategy. Section 2.5 discusses the empirical results for the variance decomposition and impulse response functions. Section 2.6 concludes.

2.2 Literature Review

The existing literature on sovereign bond spread has mainly focused on identifying the main determinants of sovereign bond spread; in particular, the role of country-specific economic factors and global factors in explaining the variation in sovereign bond spread.

2.2.1 The role of country-specific economic factors

Many papers have emphasized the importance of country-specific economic factors; in particular, the role of solvency condition, liquidity condition, macroeconomic fundamentals, fiscal position and political factors. Edwards (1984) provides a simple valuation framework for the determination of sovereign risk premium. This framework is derived under the assumption that the emerging market economy (EME) is a small borrower, investors are risk neutral and the financial market is competitive. Under such assumptions, a country's fair risk premium is a function of the probability of default on its external obligation. In turn, this probability depends on a set of macroeconomic variables and external shocks. Using this framework, Edwards estimates the determinants of primary yields[6] on bank lending to EMEs. Based on a sample of 19 developing countries from 1976-1980 and random effect estimation, he provides evidence suggesting that the sovereign risk premium is determined by the reserves-to-GNP, debt-to-GDP and Debt-service ratios, as well as by the propensity to invest. Edwards (1986) extends the study by running separate estimates of default risk premium in international bank lending and the bond market. Researchers have pointed out that the international bank loan market and bond market are significantly different both from economic and institutional points of view, hence international bank loans and bonds should be priced differently (Eaton and Gersovitz, 1981; Saches and Cohen,

[6] The yield in the primary market.

1982; Sachs, 1982; Sachs, 1984; Mckinnon, 1984; Folkerts-Landar, 1985). This is supported by the empirical finding in Edwards (1986), which finds that bond spread is more sensitive to an increase in the debt output ratio and less sensitive to the changes in investment ratio when compared with bank loan spread. Thus, bond lending is more risky than bank loan lending.

Min (1998) adopted the framework of Edwards (1984) to estimate the determinants of primary yield spreads on sovereign bonds issued during the 1991-1995 period for 11 countries. He found that the bond spread was determined by a set of solvency, liquidity and macroeconomic fundamental variables, specifically debt to GDP ratio, international reserve to GDP ratio, debt service ratio, export growth rates, import growth rates, export growth rates, domestic inflation rate, net foreign assets, and the terms of trade and real exchange rates. However, external shocks such as real oil price and the international interest rate were found to be non-significant as the determinants of bond spreads. These results suggest that in order to lower the borrowing cost in the international bond market, the country should improve its macroeconomic fundamental and financial positions, in particular, solvency and liquidity conditions. Instead of using a set of country-specific factors as independent variables, Kamin and Kleist (1999) use credit ratings issued by the major rating agencies. By controlling for instrument characteristics, they found that EME bond spreads had strong relationships with credit rating, which is high correlated with a set of macroeconomic fundamentals.

A common feature of the above studies is the use of primary yields as a measure of a country's default risk, but the choice of the bond used in those studies could be selection biased. Eichengreen and Mody (1998) show that under poor market conditions, when secondary spreads rise, primary spreads do not rise proportionately, and in some cases they actually fall. When emerging market debts become more risky, which is reflected by raising secondary market spreads, riskier borrowers are rationed out of the market, leaving only risky and lower spread borrowers to issue new bonds. One way to correct this selection bias is to use secondary market bond spreads.

Ferrucci (2003) investigated the determinants of sovereign bond spread by using secondary market bond spreads. In particular, he aimed to explain the long-run determinants of EME bond spread, together with short-run dynamic behavior. A dynamic error correction model called ‘pool mean group’ (PMG) technique was employed because it allowed cross-sectional coefficients to vary in the short run, but be homogeneous in the long run. The purpose of using PMG is that it allows assess whether sovereign bond is overprice or underpriced during different periods. The main results suggest that both debtor country's fundamentals and global liquidity conditions are significant determinants of EME bond spreads. Rather than choosing a specific bond for each country, this study uses the J.P. Morgan Emerging Market Bond Index (EMBI) Global as a proxy of sovereign spread for different countries. The EMBI Global is a weighted average of the spreads of US Dollar-denominated individual bonds issued by a particular emerging market country. The EMBI Global index controls for floating

coupons, principal collateral, rolling interest guarantees, and other unusual features of the bonds. Most of the studies on secondary market bond spreads use the J.P. Morgan EMBI Global. Other papers have found that country specific factors are important by using secondary market bond spreads, but they mainly focus on the role of global factors (e.g. Arora and Cerisola., 2001; Beak *et al*., 2005; Hartelius *et al*., 2008), I will discuss this in greater detail in section 2.2.2.

Hilscher and Nosbusch (2010) extend on previous literature by considering the volatility of macroeconomic fundamentals in addition to their levels. Their results suggests that the volatility of terms of trade has a statistically and economically significant effect on sovereign bond spread.

Focusing on the fiscal and political factors, Akitoby and Stratmann (2007) examine the effects of fiscal policy on sovereign bond spread and whether the effect of fiscal variables on spreads differs by political institution. They separated fiscal adjustment into two types: spending based adjustment, which reduce the current expenditures and Revenue based adjustment, which reduce public investment and increase tax. By using a panel regression with data from 32 emerging countries, they found that revenue based adjustments lower spreads more than spending based adjustments. The effect of fiscal adjustment on sovereign bond spread differs by political institutions and increase in spreads induced by spending based fiscal expansion is lower under proportional elections than under majoritarian elections.

Baldacci *et al*. (2008) examined the effect of fiscal and political factors on sovereign bond spreads. Using a panel of 30 emerging countries from 1997 to 2007, their results suggest that while political risk factors play a significant role in raising sovereign bond spreads, fiscal variables are more important and have a larger impact on spreads. The impact of fiscal factors on sovereign bond spreads was also found to be larger when the country has experienced previous default.

2.2.2 The role of global factors

Most recent studies focus on investigating the effect of global factors on EME bond spreads. The common global factors which have been found across these studies are US interest rate and investors' risk appetite. Arora and Cerisola (2001) investigated the impact of changes in the US monetary policy on country risk and economic growth in several developing countries in Latin America, Asia, and Eastern Europe over the period 1994-1999. By employing panel regression, the results indicated that the level of US interest rates has a direct positive effect on sovereign bond spreads. The findings also document that country risk (proxied by sovereign bond spreads) is influenced by the US monetary policy, country-specific fundamentals, and the conditions of the global capital markets.

Beak et al. (2005) examined the determinants of Brady bond[7] yield spread. Their results showed that while economic fundamentals of a country significantly affect the bond yield spread, the market's attitude towards risk is also an important determinant and has a relatively large impact on the Brady bond yield spread. The market's attitude towards risk was measured by a risk appetite index (RAI) which was constructed by the authors, based on the stock markets from 47 developed and emerging countries. The results explained why there was contagion in the Brady bond market, and why countries found their bond yield spreads changing while their economic fundamental were unchanged.

McGuire and Schrijvers (2003) investigated the extent to which EME bond spreads reacted to forces that are common across markets. By using factor analysis, they found that a single common factor accounts for, on average, one third of the total variation in daily sovereign bond spread changes. This common factor is highly correlated with changes in investors' tolerance for risk. Ciarlone *et al*. (2009) extend the work of McGuire and Schrijvers (2003) in two directions. Firstly, they estimated a long-term relationship between the common factor and internal financial market conditions. Secondly, they used the common factor as a determinant of EME bond spreads. Their

[7] Brady bonds are dollar-denominated bonds, issued mostly by Latin American countries in the late 1980s. The bonds were name after U.S. treasury Secretary Nicholas Brady, who proposed a novel debt reduction agreement for developing countries. (see "The Brady Plan", Emerging Markets Traders Association)

results suggested that the single common factor is a significant determinate of EME bond spreads and that the common factor is determined by the volatility of the US stock market and investors' degree of risk aversion.

Weigel and Gemmill (2006) used end-of-month market prices of Par Brady bonds to investigate the impact of global, regional and country-specific factors on the creditworthiness of four emerging economies from April 1994 to October 2001. By using panel regression, the results indicated that credit risk (as measured by the estimated distance-to-default) was mainly driven by systematic global and regional factors, implying that credit risk should be treated as non-diversifiable. Thus, their results tend to suggest that credit ratings for emerging markets should be based more on global and regional economic factors than on local factors. One notable result which relates to this chapter was that they used the term structure of the US interest rate as an explanatory variable because it has significant positive effects on the distance-to-default, except that when the on period lag of the term structure of the US interest rate was taken into account, the effects disappeared in Brazil and Mexico.

Gonzales-Rosada and Yeyati (2006) examined the effect of risk appetite and the interest rate in developed countries on EME bond spreads. In contrast to previous studies, they used financial variables with a high frequency of data (daily). By estimating panel error-correction models and controlling for country-specific factors by using credit ratings, the results indicated that global liquidity and market sentiment could explain a large part of the volatility of EME bond spreads.

Dailami *et al*. (2008) considered the non-linearity of the effect of US interest rate policy on EME bond spreads. Using PMG estimation which was similar to Ferricci (2003), their results showed that the impact of US interest rates on EME bond spreads is small when the debtor's debt level is low, whereas the impact is much larger when the debtor is close to the borderline of default.

Hartelius *et al*. (2008) attempted to empirically distinguish the role of economic fundamentals and global liquidity in determining EME bond spreads. In contrast to previous studies, they used forward looking variables as determinants. Credit rating outlook, the Fed Funds 3-months ahead futures rate and the volatility of the Fed Funds futures rate were employed to measure economic fundamentals and global liquidity. One of the motivations of using such forward looking variables was that markets react foremost to expectations rather the actual event when it occurs. By using panel regression, the results showed that both US interest rate variables and economic fundamentals are important determinants of EME bond spreads. Siklos (2011) employed other forward looking global factors such as the Chicago Board Options Exchange volatility index (VIX) because this index can be used as a proxy for investor risk aversion. His results showed that the VIX is an important determinant of EME bond spreads.

2.2.3 Application of Structural Vector Autoregression model

The above studies relied on OLS and panel regressions to investigate the relationship between sovereign bond spreads, country-specific factors and global factors. Recently, there are studies which have emphasized the necessity of using a Structural Vector Autoregression model (SVAR) instead, because it has several advantages when compared with other regression techniques. Firstly, SVAR allows for dynamic interactions between variables; for example, sovereign bond spread is affected by macroeconomic fundamentals, but at the same time it affects macroeconomic fundamentals. Secondly, SVAR can address the endogeneity problem of independent variables; for example, there is potential endogeneity problem with investors' risk appetite. Finally, SVAR provides a framework for identifying the relative importance of various factors in determine sovereign bond spread.

Uribe and Yue (2006) examined the interaction of sovereign spreads, the world interest rate, and business conditions in emerging markets. Based on data from 7 emerging economies from 1994 to 2001 and using a panel Vector Autoregression (VAR) model, the authors found that sovereign spreads affect aggregate activity, but interestingly, at the same time respond to domestic macroeconomic conditions. Even more importantly, their findings highlighted the issue of sovereign spreads being dependent on domestic fundamentals and the world interest rate appearing to be of great interest in understanding business cycles in emerging countries. However, this analysis did not take into account the role of global risk aversion, which may also affect

sovereign spreads, especially in an open emerging market economy (Ciarlone *et al*., 2009; Siklos, 2011).

Garcia-Herrero and Ortiz (2006) analyzed the role of global risk aversion of international investors on the variation of sovereign bond spread in Latin America. In order to control the potential endogeneity problem with global risk aversion, a four variable SVAR model was employed. Of the four variables, all except sovereign bond spreads, were global factors. Using data from 9 Latin American countries from 1994 to 2003, their findings suggest that US growth and interest rate have a direct effect on sovereign spread and an indirect effect on global risk aversion, but country-specific factors were not explicitly captured by this model. In a more recent study, Fracasso (2007) attempted to fill this gap in the literature by considering both the endogeneity of the credit spreads and global risk aversion of international investors, as well as take domestic and international macroeconomic factors into account.[8] The analysis was based on a VAR system encompassing six domestic and three foreign variables[9] capturing global factors in Brazil during 1999-2004. The findings broadly support the

[8]The focus of this study is to examine the impact of foreign global shocks on the behaviour of domestic macroeconomic variables (in particular external debt and EMBI spread) in Brazil.

[9] The author uses the industrial cycle; primary deficit; real depreciation; inflation; external debt; and EMBI spread as domestic variables while the US industrial cycle; US Federal fund rate; US-BAA corporate high yield spread are used as foreign variables.

view that foreign factors, in particular global appetite for risk and global risk aversion, are important determinants of the development of the domestic variables.

Dungey *et al*. (2004) claim that global risk aversion could be separated into three components: liquidity risk, credit risk and volatility risk. They used SVAR to explore the role of different component of investor's risk aversion during three financial crisis periods (Russian crisis, Long-Term Capital Management (LTCM) crisis and Brazilian crisis). During the Russian and LTCM crises, investor's risk aversion was mainly caused by credit risk and country risk, whereas during the Brazilian crisis period, the increase in sovereign spread was driven by credit, liquidity and volatility risk.

Overall, understanding these relationships has important policy implications because researchers should take into account both country-specific and global factors, as well as the role of global risk aversion when investigating emerging economies. Although several studies have investigated sovereign spread in emerging markets, none of them offer explicit consideration of foreign and domestic factors in determining the shapes of the spread over time. Appendix 2.C presents a summary of the previous studies on sovereign spread, along with their main findings. On balance, the existing literature indicates that foreign and domestic factors can significantly influence sovereign spread.

2.3 Theoretical model

Here I develop a model that combines the capital inflow model in the presence of the probability of default of Blanchard (2005) with the framework of debt overhang originally proposed by Krugman (1988) and illustrated by Obstfeld and Rogoff (1996), among others. This new model establishes interdependence between sovereign debt spreads of bonds and probability of default, and shows how they respond to global shocks such US interest rates and global risk aversions. I then take the data from predictions derived from this model and empirically analyze it in subsequent sections.

I consider a one-period model with two different risk averse representative investors: 1) an emerging market investor whom I call the Malaysian investor, and 2) an international investor. There are three assets in the model: 1) a risk free one-period Malaysian bond denominated in domestic currency with rate of return r; 2) a one-period Malaysian government bond[10] denominated in US dollars with rate of return r^{MA} with a probability of default q; and 3) a risk free one-period US government bond denominated in US dollars with rate of return r^{US}. There are capital flow controls or restrictions on both types of investor that a representative government in emerging markets imposes on both domestic and international investors. Throughout, I assume that the Malaysian (i.e. emerging country) investors can buy Malaysian risk free bonds

[10] For convenience, we will be using the term 'Malaysian Government bond 'and emerging markets sovereign bond synonymously.

and Malaysian government bonds denominated in US dollars, but are not allowed to buy bonds issued by foreign (US) Governments. For simplicity, I also assume that the International investor buys only US government bonds and Malaysian government sovereign bonds expressed in US dollars.

Given the restricted pattern of capital inflow, the equilibrium no-arbitrage condition for the Malaysian investor would satisfy:[11]

$$(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) = (1+r) + Aq \qquad (2.1)$$

Where A is the degree of absolute risk aversion of the Malaysia investor, γ is the exchange rate expressed as Malaysian currency per US dollar and γ' is the expected exchange rate in the next period. The condition states that for the Malaysian investor to hold the risky government bond, the expected return on the Malaysian Government sovereign bond should be equal to the rate of return of a risk free domestic bond plus a premium, measured by qA.

The next step is to look at the determination of international capital flow to emerging markets. Since international investors choose between Malaysian government US dollar denominated bonds and US government bonds, the capital flow

[11] The equation is derived in Appendix 2.A. See Blanchard (2005) for its application in a different context.

will depend on the difference between relative return of the two bonds adjusted by the risk premium of the international investor, measured by qA^*.

Hence, capital flows to Malaysia are given by:

$$CF = C\{(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) - \frac{\gamma'}{\gamma}(1+r^{US}) - A^*q\} \quad C' > 0$$

Where, A^* is the degree of risk aversion of international investor. The first two terms are the expected rate of return on Malaysia US dollar bonds and US government bonds respectively, both expressed in terms of Malaysian currency.

By using equation (2.1), capital flow equation can be expressed as:

$$CF = C\{1 + r - \frac{\gamma'}{\gamma}(1+r^{US}) + (A - A^*)q\}$$

If the risk aversion of the Malaysian investor and the international investor are the same, then the increase in the probability of default q would not generate capital flow in either direction. However, if international investors have a home bias and the Malaysian investors have restricted participation in the international capital market, then the probability of default will trigger the capital outflows captured by the above equation. If I assume that the international investors are more risk averse than the Malaysian investors with respect to the inclusion of the Malaysian assets in their portfolio, then $A^* > A$.

For the sake of simplicity, I further assume that:

$$A = \mu A^*, \quad \mu \leq 1$$

Then, the resulting expression for capital flow is given by:

$$CF = C\{1 + r - \frac{\gamma'}{\gamma}(1 + r^{US}) - (1 - \mu)A^*q\}$$

Since this is a one-period model, I assume, following Blanchard (2005) that the future expected exchange rate depends on the current rate via the relationship:[12]

$$\gamma' = \gamma^{\eta}, \quad 0 \leq \eta \leq 1$$

Using the above relation in the expression of *CF*, I get:

$$C\{1 + r - \gamma^{\eta-1}(1 + r^{US}) - (1 - \mu)A^*q\}$$

The above expression also stipulates that the capital inflow to Malaysia will depend inversely on the increased risk aversion of the foreign investors and exchange rate depreciation of Malaysian currency vis-à-vis the US dollar and the probability of default on the Malaysian sovereign bond.

The sum of the capital inflow must be matched by net trades between the countries so that in equilibrium, capital inflow (outflow) must equal to net exports (imports); stated as:

$$C\{1 + r - \gamma^{\eta-1}(1 + r^{US}) - (1 - \mu)A^*q\} + N(\gamma) = 0 \qquad (2.2)$$

Where $N(\gamma)$ is the net export that is a function of the current exchange rate and $N' > 0$.

[12]If η is very close to 1, then the future exchange rate moves in prefect tandem with the current exchange rate.

Note that equation (2.2) determines the exchange rate $\gamma = \gamma(q, A^*, r^{US})$ as a function of A^*, r^{US} and q. For example, an increase in the probability of default will trigger capital outflow from Malaysia. Since the sum of the capital flows must balance the net exports, the equilibrating mechanism requires an increase in net exports via depreciation of the exchange rate.

Due to the increased probability of default, and the consequent rise in the exchange rate when in equilibrium, the Malaysian Government will accumulate further debt in the next period, denominated in US dollars, as given by:

$$D' = (1 + r^{MA})D^{\$}\gamma(q) - R$$

Where, R is the primary surplus and $D^{\$}$ is the debt inherited by the Malaysian Government. D' and R are measured in Malaysian currency.

The use of the no-arbitrage condition from equation (2.1), $A = \mu A^*$ and the equilibrium condition $\gamma = \gamma(q)$ from equation (2.2) in the above equation gives a relationship between q (the probability of default) and D' (future accumulation of debt) that preserves the capital market equilibrium and is shown as:

$$D' = \left(\frac{1+r}{1-q} + \frac{\mu A^* q}{1-q}\right) D^{\$}\gamma(q) - R \equiv D'(q) \qquad (2.3)$$

That is, equation (2.3) captures the relationship between the future accumulation of stock of debt and the probability of default implied by the capital market equilibrium. The curve DD in Figure 2.1 depicts this relationship.

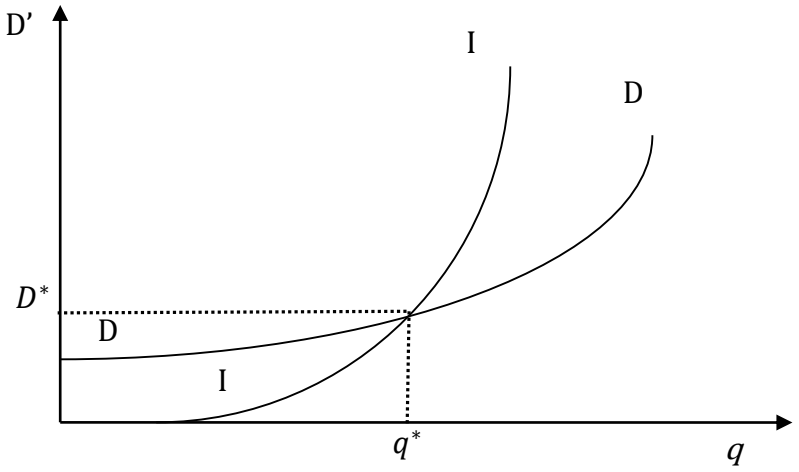


Figure 2.1 Sovereign debt and the probability of default

The probability of default, on the other hand, is not exogenous: it depends on the effort put in by the residents of a country. An accumulated debt is known to cause a 'debt overhang' problem that reduces the incentive for residents to work harder because much of the GDP would then be used to service debt, which in turn increases the probability of default.

Let $EU = (1-q)U(Y_G - D') + qU(Y_B) - 0.5m(1-q)^2$ be the expected utility function where $(1-q)$ is the probability of success (no default) that stands for the effort exerted by the residents of the emerging market and the last term capture costs incurred by the residents for exercising that effort. The underlying idea borrowed from the incentives literature is that when an individual in an economy works harder, it

reduces the probability of default by the emerging market, but the agents incurs costs associated with their effort. The representative agents in Malaysia take the next period debt D' to be given while making the optimal choice of the effort level. The first-order condition is:

$$U(Y_G - D') + U(Y_B) = (1 - q)m \tag{2.4}$$

The right hand side represents the incremental cost of working harder and the left hand side captures the extra pay-off resulting from it. Equation (2.4) sketches a positive relationship between D' and q because an increased debt in the next period dampens the incentive to exert effort, and thus increases the probability of default. This is because the existence of past debt reduces the residual pay-off available to the citizens of the debtor country. This in turn reduces the incentive to exert effort and increases the probability of default. Appendix 2.B derives the relationship between D' and q which is labeled as *II* in Figure 2.1.

Equations (2.3) and (2.4) jointly determine the equilibrium probability of default (q^*) and the future debt level (D^*) via the intersection of curves *DD* and *II* as functions of global risk aversion (A^*) and US interest rate (r^{US}), among other variables. The equilibrium determination of D^* and q^* also determines some of the key macroeconomic indicators such as debt to GDP ratio, trade balance to GDP ratio and sovereign spread which can be expressed as:

$$S = r^{MA} - r^{US} = \frac{1 + r + \mu A^* q}{(1 - q)\gamma(q)^{\eta - 1}} - 1 - r^{US} \tag{2.5}$$

Next, I generate comparative statistics to uncover the impact of the key exogenous factors (from the perspective of the Malaysian Government) on those key indicators that will form the basis of the hypotheses to be tested in the empirical section (Section 2.3). I report some key results below that will be tested with the aid of an SVAR model:

Result I: The probability of default on Malaysian US dollar sovereign bonds will increase with an increase in the US interest rate and global risk aversion.

Result II: The spread of sovereign bonds issued by the Malaysian Government will increase with global risk aversion and the US interest rate.

The hypotheses are derived in Appendix 2.B and intuitively plausible. For example, an increased global risk aversion will cause capital to rapidly leave the emerging country, leading to a depreciation of the currency (the capital market effect) and would also increase the total amount of debt serviced in US dollars, that will in turn reduce the incentive to exert effort (incentive effects), leading to an increased probability of default and a higher spread in the emerging market's dollar denominated bonds.

The following comments regarding the link between this theoretical model and empirical strategies. The empirical model tests the relationship between sovereign spread and the domestic and international elements, and attempts to assess to what extent they contribute to variations in spread.

The model guides the empirical section by firstly formulating how the spread is affected by both global and country-specific factors. Secondly, in my model, both

domestic and international factors exogenous to Malaysia determine the exchange rate vis-à-vis US dollar (equation (2.2)); that in turn also affects the equilibrium debt and probability of default, and sovereign spread via equations (2.3) and (2.4). That is, these exogenous elements affect both debt and spread directly as well as indirectly via their impact on the exchange rate. This structure also determines the order of estimation used in the SVAR model. This link is explained in detail below.

2.4 Empirical model

2.4.1 Data and variables

This study uses an SVAR model to study the relative contribution of global and country-specific variables to the volatility of macroeconomic variables and credit spread. In order to account for the endogeneity of sovereign spread and risk aversion, I include the following sets of foreign (global) and domestic (country-specific) variables:

$$FOREIGN = (TERM\ STRUCTURE, CBS, VRP, DOLLAR) \quad (2.6a)$$

$$DOMESTIC = (TRADE/GDP, DEBT/GDP, LOGSPREAD) \quad (2.6b)$$

The vector of foreign variables (*FOREIGN)* in equation (2.6a) includes four sets of global variables: the term structure of US interest rate (TERM STRUCTURE); the US-BAA[13] corporate bond spread (CBS); the variance risk premium (VRP) and the

[13] BAA: The credit rating grade of BAA which is issued by Standard and Poor

Dollar index (DOLLAR). Similarly, the vector of domestic variables *(DOMESTIC)* in equation (2.6b) contains the trade balance to GDP ratio (TRADE/GDP); the debt to GDP ratio (DEBT/GDP) and the LOGSPREAD, as measured by the log of the level of the Emerging Markets Bond Index (EMBI) global index.

In particular, I control for the future short term interest rate and future prospects of the US economy using the term structure of the US interest rate. To account for global risk aversion I use two proxies: the US-BAA spread (CBS) and the variance risk premium (VRP). The Dollar index is used as a proxy of the real value change of the US dollar. Turning to the variables capturing the domestic factors, I use the trade balance to GDP ratio (TRADE/GDP) as a proxy for domestic liquidity condition, which measures the short term ability for repayment of debt, and the debt to GDP ratio (DEBT/GDP) as a proxy for the domestic solvency condition, which measures the long term ability for repayment of debt. Both variables have been identified as important determinants of emerging market sovereign spreads (see Min, 1998; Arora and Cerisola, 2001). Finally, the LOGSPREAD variable is a measure of the cost of borrowing. Table 2.1 provides detailed information on the variables employed in the model.

<Insert Table 2.1 about here>

The sovereign spread of a US dollar denominated bond is defined as the difference in yield between the bond and a benchmark US Treasury bond of a similar maturity, and is normally expressed in basis points. The return on emerging market issues is

expressed as their spread rather than their absolute yield (LOGSPREAD). This study uses the J.P. Morgan EMBI Global spread index as a proxy of sovereign spread for different countries. The EMBI Global is a weighted average of the spreads of US dollar-denominated individual bonds issued by a similar maturity, and is normally expressed in basis points. The return on emerging market issues is expressed as their spread rather than their absolute yield (LOGSPREAD). This study uses the J.P. Morgan EMBI Global spread index as a proxy of sovereign spread for different countries. The EMBI Global is a weighted average of the spreads of US dollar-denominated individual bonds issued by a particular emerging market country[14]. The EMBI Global index controls for floating coupons, principal collateral, rolling interest guarantees, and other unusual features of the bonds. It is computed for all the main emerging market sovereign issuers; this allows direct comparability of the results across countries in the sample.

The dataset used in this study is composed of different sample periods for each country under investigation. In particular, and due to data availability,[15] the chosen time-span per country is as follows: Chinese data are from Jan. 1995 to Sep. 2009; Malaysian data are from Nov. 1996 to Sep. 2009; Philippine data are from Jan. 1998 to

[14]Other studies (e.g. Dungey et al., 2004) use a benchmark bond for each country to define the spread. However, given that purpose of the present study is to look at the spread related to the risk of a sovereign issuer rather than the spreads of individual bonds, the EMBI Global is considered more appropriate for this type of investigation.

[15]Since the information on the J.P. Morgan EMBI Global index is not available for all countries and years, we constructed our analysis based on the available data.

Sep. 2009; Indonesian data are from Jun. 2004 to Sep. 2009; Argentinean data are from Jan. 1995 to Mar. 2009; Brazilian data are from Jan. 1995 to Mar. 2009; Chilean data are from Jan. 2003 to Mar. 2009; Colombian data are from Jan. 2001 to Mar. 2009; Peruvian data are from Apr. 1997 to Mar. 2009; Uruguayan data are from Jun. 2001 to Dec. 2008; Bulgarian data are from Jan. 2000 to Mar. 2009; Hungarian data are from Mar. 1999 to Mar. 2009； Polish data are from Mar, 1999 to Mar. 2009; Russian data are from Mar. 2003 to Mar. 2009 and finally Turkish data are from July 1996 to Mar. 2009. For similar reasons, when only quarterly and annual data are available[16] I convert the corresponding series to the monthly frequency. Table 2.2 presents the full raw data information.

<Insert Table 2.2 about here>

Table 2.3 reports the descriptive statistics for the variables employed in the model per country. In Asia, China presents the lowest mean value of sovereign spread and debt to GDP level. On the other hand, the Philippines present the highest mean value of sovereign spread and debt to GDP level. Malaysia presents the highest mean value of trade balance to GDP ratio, whereas Indonesia has the lowest trade balance to GDP ratio. When ranking the by mean value of DEBT/GDP ratio, the Philippines represents the largest in the Asian group, followed by Indonesia, Malaysia and China. In South

[16] This is due to the fact that data for the debt level in China is only available on an annual basis.

America, Chile presents the lowest mean value of sovereign spread and Argentina represents the lowest mean value of debt to GDP level. On the other hand, Argentina present the highest mean value of sovereign spread and Colombia represents the highest mean value of debt to GDP level. Chile presents the highest mean value of trade balance to GDP ratio, whereas Uruguay has the lowest trade balance to GDP ratio. By ranking the mean value of the DEBT/GDP ratio, Colombia represents the largest in the Latin American group, followed by Brazil, Uruguay, Peru, Chile and Argentina. In Eastern Europe, Hungary presents the lowest mean value of sovereign spread and Turkey represents the lowest mean value of debt to GDP level. On the other hand, Turkey present the highest mean value of sovereign spread and Bulgaria represents the highest mean value of debt to GDP level. Russia presents the highest mean value of trade balance to GDP ratio, whereas Poland has the lowest trade balance to GDP ratio. By ranking the mean value of the DEBT/GDP ratio, Bulgaria represents the largest in the Eastern European group, followed by Hungary, Poland, Russia and Turkey.

Table 2.3 also shows the results after checking for stationarity.[17] I(1) represents non-stationary, with I(0) being stationary. Therefore, the non-stationary series are measured by taking log differences except simply taking the difference for trade balance to GDP ratio.

[17] The unit root tests we use are the Augmented Dickey Fuller (ADF) test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test.

<Insert Table 2.3 about here>

2.4.2 Empirical methodology

My regression framework uses an SVAR model that allows the generation of an impulse response function, which simulates the effects of a shock to one variable in the system on the conditional forecast of another variable. In this context, the application of an SVAR model allows us to obtain the variance decomposition. This determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. Finally, I also compare the short-term and the long-term effects. Specifically, I estimate the following econometric model that constructs impulse response functions and variance decomposition:

$$AY_t = \alpha + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + B\varepsilon_t \qquad (2.7)$$

Where, A represents a matrix of instantaneous relations between the variables in Y; B is a matrix of contemporaneous relations among the structural disturbances ε; and p is the lag length of the VAR. The vector Y_t in the model contains the set of global and country-specific variables as specified in equations (2.6a) and (2.6b).Therefore, equation (2.7) can be re-written as follows:

$$A\begin{pmatrix} TERM\ \ STRUCTURE_t \\ CBS_t \\ VRP_t \\ DOLLAR_t \\ TRADE/GDP_t \\ DEBT/GDP_t \\ LOGSPREAD_t \end{pmatrix} = A_1\begin{pmatrix} TERM\ \ STRUCTURE_{t-1} \\ CBS_{t-1} \\ VRP_{t-1} \\ DOLLAR_{t-1} \\ TRADE/GDP_{t-1} \\ DEBT/GDP_{t-1} \\ LOGSPREAD_{t-1} \end{pmatrix} + ...A_p\begin{pmatrix} TERM\ \ STRUCTURE_{t-p} \\ CBS_{t-p} \\ VRP_{t-p} \\ DOLLAR_{t-p} \\ TRADE/GDP_{t-p} \\ DEBT/GDP_{t-p} \\ LOGSPREAD_{t-p} \end{pmatrix} + B\varepsilon_t$$

In order to estimate the SVAR model, two issues have to be considered: impulse restrictions and autocorrelation. In particular, the solution of the SVAR model involves a number of restrictions that have to be implemented. That is, given that the US market is a large, integrated financial center, this implies that the US dollar and the international investors play a very important role in the global financial market. As such, I implicitly assume that the US variables are appropriate proxies of global factors, and that all of the US variables should be treated as exogenous ones. I adopt this restriction, because it is reasonable to assume that effect of the emerging markets is so small relative to the World market that US variables may affect, but not be affected by the domestic ones.

The following restrictions are imposed on the SVAR system. First the TERM STRUCTURE relation is not affected by contemporaneous variables. Second, the TERM STRUCTURE has a contemporaneous effect on the CBS and VRP relations, but CBS and VRP do no contemporaneously affect each other. Third, the TERM STRUCTURE, CBS and VRP have a contemporaneous effect on the US DOLLAR relation. In addition, all of the global variables have a contemporaneous effect on the TRADE/GDP relation, while the DEBT/GDP relation is contemporaneously affected

by the global variables and the TRADE/GDP relation. Finally, all variables have a contemporaneous effect on sovereign spread. Such restrictions are also implicit in my theoretical framework, which treats the US interest rate and degree of risk aversion as parameters while they affect the exchange rate (as proxied by the Dollar index in the empirical construct). Debt level and risk of default, in turn also affect the sovereign spread. Thus, the recursive nature of the SVAR model is built up from the structure of my theoretical model. By adopting the above assumptions, matrix A is restricted to be a lower triangular matrix and is expressed as following:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{pmatrix}$$

Another important issue for the estimation of the SVAR model is to correctly identify the lag order of the model. In order to make sure no autocorrelation appears in the error term after estimation, a sufficient number of lags have to be employed. I firstly select the lag length using both the Akaike Information Criterion (AIC) and the Hannan-Quinn Information Criterion (HQIC). By careful consideration of these two criteria, I end up with 4 lags for Malaysia, Indonesia, Philippines and Uruguay, 14 lags for China, 11 lags for Argentina, 7 lags for Brazil and Bulgaria, 5 lags for Colombia and Peru, 3 lags for Chile, Hungary, Poland and Turkey and 6 lags for Russia.

2.5 Empirical results

2.5.1 Variance decomposition analysis

To consider the contribution of the various shocks in the empirical model, I perform a variance decomposition of the variables contained in the system at different horizons. Specifically, I focus on the fraction of the variance of the forecasting error explained by each shock. The analysis in this section will be divided into subsections based on the country's geographical regions, in particular, Asia, South American and Eastern Europe.

2.5.1.1 Asia

Table 2.4 presents the contribution of all variables to the forecast error variance of the sovereign spread for Asian countries. The aggregate foreign factor column is the sum of the TERM STRUCTURE, CBS, VRP and US DOLLAR variables. At 24 month horizons, foreign shocks could explain 46%, 83%, 67% and 33% of the fluctuation in the LOGSPREAD for Malaysia, Indonesia, China and the Philippines respectively. At longer horizons, foreign shocks have a greater effect. Overall, the impact of foreign variables on the sovereign spread is notable. The TERM STRUCTURE shock appears to be the most important driver for LOGSPREAD for Indonesia and China. It could explain about one third of the variation of LOGSPREAD at the 24 months horizon, whereas TERM STRUCUTRE shock has limited effect on LOGSPREAD for Malaysia and Philippine. Focusing on the different variables capturing risk aversion, credit risk

(CBS) appears to be more important than volatility risk (VRP) for Indonesia and China, however, for Malaysia and the Philippines, VRP is a more important factor and CBS has a limited effect on LOGSPREAD. DOLLAR shock could explain about around 10% variation of LOGSPREAD for all Asian countries.

<Insert Table 2.4 about here>

As far as the country-specific variables are concerned, their explanatory power averages less than 10%. This implies that domestic shocks have a limited effect on the fluctuation of LOGSPREAD. The results for the Philippines indicate that the DEBT/GDP shock can explain about 15% of the variation in the LOGSPREAD at the 6 month horizon and that this effect can persist until the 24 month horizon.

Table 2.5 reports the results for the contribution of the US variables to the forecasting error variance of the TRADE/GDP ratio for Asian countries. Overall, aggregate foreign shocks could explain 7%, 80%, 53% and 31% of fluctuations in TRADE/GDP for Malaysia, Indonesia, China and the Philippines respectively at the 24 month horizon.

<Insert Table 2.5 about here>

Table 2.6 presents the contribution of the US variables to the forecasting error variance of the DEBT/GDP ratio for Asian countries. The results show that aggregate foreign shocks could explain 35%, 65%, 53% and 16% of fluctuations in DEBT/GDP for Malaysia, Indonesia, China and the Philippines respectively at the 24 month horizon.

This suggests that unexpected foreign shocks could explain a large component of the fluctuation in domestic macroeconomic fundamentals and that the impact increases at longer horizons.

<Insert Table 2.6 about here>

The next step is to examine whether the LOGSPREAD shock can also drive domestic variables. Table 2.7 reports the results from the contribution of sovereign spread to the forecasting error variance of TRADE/GDP and DEBT/GDP for Asian countries. The explanatory power of LOGSPREAD shock at 24 months horizons is under 7% for Philippines. For Malaysia LOGSPREAD shock can explain 13% and 4% of the variation in the TRADE/GDP and DEBT/GDP at the 24 months horizon. For Indonesia at 24 month horizons LOGSPREAD shock can explain 6% and 14% of the variation in the TRADE/GDP and DEBT/GDP respectively. For China, LOGSPREAD shock at 24 month horizons can explain 13% and 11% of the variation in the TRADE/GDP and DEBT/GDP respectively.

<Insert Table 2.7 about here>

2.5.1.2 South America

Table 2.8 presents the contribution of all variables to the forecast error variance of the sovereign spread for South American countries. The aggregate foreign factor column is the sum of the TERM STRUCTURE, CBS, VRP and US DOLLAR variables. At 24 month horizons, foreign shocks could explain 72%, 46%, 41%, 46%, 43% and 58% of

the fluctuation in the LOGSPREAD for Argentina, Brazil, Chile, Colombia, Peru and Uruguay respectively. At longer horizons foreign shocks have a greater effect. Overall, the impact of foreign variables on the sovereign spread is notable. The VRP shock appears to be the most important driver for LOSGPREAD, except for Argentina where TERM STRUCTURE shock is the most important factor. TERM STRUCTURE shock could explain about 48% variation of LOGSPREAD for Argentina at the 24 month horizon. Focusing on the different variables capturing risk aversion, volatility risk (VRP) appears to be more important than credit risk (CBS) because VRP shock could explain about one third variation of LOGSPREAD and the CBS shocks have limited effect. The explanatory power of DOLLAR shock is limited for Latin American countries' LOGSPREAD, and the explanatory powers are under 8% except for Argentina where DOLLAR shock could explain 14% variation of LOGSPREAD.

<Insert Table 2.8 about here>

Regarding to the contribution of country-specific variables; for Chile, TRADE/GDP shock can explain 20% of the variation in the LOGSPREAD in the median term, whereas DEBT/GDP shock can explain 10% of the variation in the LOGSPREAD in the median and long term because Chile has the highest TRADE/GDP of the South American countries. For Colombia, TRADE/GDP and DEBT/GDP shock can explain 12% and 9% of the variation in the LOGSPREAD respectively in the median and long term. For Uruguay, TRADE/GDP shock can explain 13% of the variation in the LOGSPREAD in median and long run, whereas DEBT/GDP shock has

limited effect on LOGSPREAD. For the rest of the Latin American countries, the contribution of TRADE/GDP and DEBT/GDP to the variation of LOGSPREAD is under 10%.

Table 2.9 reports the results for the contribution of the US variables to the forecasting error variance of the TRADE/GDP ratio for the South American countries. Overall, at the 24 month horizon aggregate foreign shocks could explain 42%, 24%, 26%, 35%, 28% and 43% of the fluctuations in TRADE/GDP for Argentina, Brazil, Chile, Colombia, Peru and Uruguay respectively.

<Insert Table 2.9 about here>

Table 2.10 presents the contribution of the US variables to the forecasting error variance of the DEBT/GDP ratio for South American countries. The results show that, at the 24 month horizon, aggregate foreign shocks could explain 36%, 39%, 24%, 46%, 18% and 63% of fluctuations in DEBT/GDP for Argentina, Brazil, Chile, Colombia, Peru and Uruguay respectively. This suggests that unexpected foreign shocks could explain a large component of the fluctuation in domestic macroeconomic fundamentals and that the impact increases at longer horizons.

<Insert Table 2.10 about here>

The next step is to examine whether the LOGSPREAD shock can also drive domestic variables. Table 2.11 reports the results from the contribution of sovereign spread to the forecasting error variance of TRADE/GDP and DEBT/GDP for the South

American countries. LOGSPREAD shock can explain under 10% of the variation in TRADE/GDP and DEBT/GDP.

<Insert Table 2.11 about here>

2.5.1.3 Eastern Europe

Table 2.12 presents the contribution of all variables to the forecast error variance of the sovereign spread for the Eastern European countries. The aggregate foreign factor column is the sum of the TERM STRUCTURE, CBS, VRP and US DOLLAR variables. At 24 month horizons, foreign shocks could explain 65%, 24%, 28%, 54% and 38% of the fluctuation in the LOGSPREAD for Bulgaria, Hungary, Poland, Russia and Turkey respectively. At longer horizons foreign shocks have a greater effect. Overall, the impact of foreign variables on the sovereign spread is notable. TERM STRUCTURE shock could explain 16% and 11% of the variation of LOGSPREAD in Bulgaria and Russia respectively, but it has a very limited effect in the other Eastern European countries. Focusing on the different variables capturing risk aversion, the importance of VRP is about twice that of CBS for Bulgaria. For Hungary and Poland, the importance of VRP and CBS are similar. For Russia and Turkey, VRP is much more important than CBS. The explanatory power of DOLLAR shock is limited for Eastern European countries' LOGSPREAD, and the explanatory powers are under 6% except for Bulgaria where DOLLAR shock could explain 9% variation of LOGSPREAD at 24 months horizon.

<Insert Table 2.12 about here>

As far as the country-specific variables are concerned, their explanatory power is under 10% for all Eastern European countries. This implies that the domestic shocks have a limited effect on the fluctuation of LOGSPREAD.

Table 2.13 reports the results of the contribution of the US variables to the forecasting error variance of the TRADE/GDP ratio for Eastern European countries. Overall, at the 24 month horizon, aggregate foreign shocks could explain 53%, 16%, 18%, 46% and 23% of fluctuations in TRADE/GDP in Bulgaria, Hungary, Poland, Russia and the Turkey respectively.

<Insert Table 2.13 about here>

Table 2.14 presents the contribution of the US variables to the forecasting error variance of the DEBT/GDP ratio for the Eastern European countries. The results show that, at the 24 month horizon, aggregate foreign shocks could explain 38%, 18%, 17%, 53% and 35% of fluctuations in DEBT/GDP for Bulgaria, Hungary, Poland, Russia and Turkey respectively. This suggests that unexpected foreign shocks could explain a large component of the fluctuation in domestic macroeconomic fundamentals and that the impact increases at longer horizons.

<Insert Table 2.14 about here>

The next step is to examine whether the LOGSPREAD shock can also drive domestic variables. Table 2.15 reports the results of the contribution of sovereign spread to the forecasting error variance of TRADE/GDP and DEBT/GDP for the

Eastern European countries. The explanatory power of LOGSPREAD shock at 24 month horizons is under 5% for Hungary and Poland. For Bulgaria, it can explain 10% of the variation in the TRADE/GDP and DEBT/GDP in the median and long run. For Russia, at 24 month horizons LOGSPREAD shock can explain 13% and 25% of the variation in the TRADE/GDP and DEBT/GDP respectively. For Turkey, LOGSPREAD shock at 24 month horizons can explain 27% and 17% of the variation in the TRADE/GDP and DEBT/GDP respectively.

<Insert Table 2.15 about here>

2.5.1.4 Summary

The results for Asian countries is mixed: all the global factors played important role in the variation of LOGPSREAD. For Latin American and Eastern European countries VRP is clearly the most important driver for the variation of LOGSPREAD. In addition, DOLLAR shock has a limited effect on LOGSPREAD for all countries. LOGSPREAD shock has a limited effect on TRADE/GDP and DEBT/GDP for Latin American countries, whereas LOGSPREAD shock shows a remarkable effect on TRADE/GDP and DEBT/GDP in Asian and Eastern European countries.

Table 2.16 reports the average aggregate contribution of US variables to the forecasting error variance of domestic variables across different regions. The results show that foreign factors play an important role in the variation of domestic economic fundamentals. Foreign factors affect Asia at most, followed by South America and then Eastern Europe. From the above results it becomes apparent that policy makers should

always counteract unexpected changes in the US (foreign) factors, since they affect LOGSPREAD, TRADE/GDP and DEBT/GDP in the medium and long term.

<Insert Table 2.16 about here>

2.5.2 Impulse response analysis

This section discusses the results derived from the impulse response function of the variables employed in the VAR system. Recall that the structure of the SVAR provides an ordering that is used to generate the impulse response function. This simulates the effects of a shock to one variable in the system on the conditional forecast of another variable. I therefore attempt to further investigate the response pattern of the various shocks in the empirical model.[18]

<Insert Figure 2.2 about here>

Figure 2.2 illustrates the impulse response of sovereign spread to US variable shocks. The rationale is straightforward; when there is a one unit unexpected increase in one variable, the effect on the other variables can be monitored over the next 24 months. The solid line depicts the computed impulse response and the dotted lines depict 95% confidence intervals. The results in Figure 2.2 are consistent for all

[18]Given that our findings suggest that the response of sovereign spread to domestic variable shocks demonstrates an ambiguous pattern, the analysis for the domestic variable shocks are not presented in the paper. The figures for the domestic variable shocks are not reported but are available from the author upon request.

countries. The LOGSPREAD increases whenever there is a positive shock on the TERM STRUCTURE, CBS, VRP or the US DOLLAR index. These effects continue over a 3-6 month horizon and then become ambiguous because they are not distinguishable from zero effect at the 95% confidence intervals.

These response patterns are consistent with the predictions of my theoretical model. The findings here related to the response of the CBS shocks are also consistent with Garcia-Herrero and Ortiz (2006), who found a positive relationship between risk aversion and sovereign spread. The result for the TERM STRUCTURE shock indicates that if there is a shock related to an increase in expected future US short term interest rates, the present LOGSPREAD would be higher. This result suggests that when the US Federal Reserve uses quantitative easing (QE) or "operational twist", this causes a decline in the term structure of US interest rates. The countries in my sample would benefit from this US monetary policy because it would result in a lower cost of sovereign borrowing. This result is in line with Weigel and Gemmill (2006), who suggest that the default probability is positively related to the term structure of US interest rates.

2.5.3 Robustness check: Estimation of impulse responses

To examine the robustness of my results I conducted a variety of additional tests. These tests deal with the transmission of the impulse responses using alternative orderings of the SVAR. I perform this exercise under the assumption that country-specific variables

are affected by global variables, thus global variables always proceed country-specific ones in terms of the ordering. Moreover, given that my global variables (CBS and VRP) do not contemporaneously affect each other, I further assume that changing their order would not make any difference to my results.

In addition, I also carry out a sensitivity analysis using a smaller SVAR, with one global and one country-specific factor in addition to the sovereign spread, and check on such alternative combinations. The justification for carrying out these additional tests is based on the fact that the impulse response function is sensitive to the assumptions used in estimation, particularly the variables and the sample used (Cover and Mallick, 2012; Granville *et al*., 2011).

Taken together, the sensitivity analysis performed here seem to be consistent with the results presented earlier (Figure 2.2). Specifically, LOGSPREAD continues to increase in response to shocks in the TERM STRUCTURE, CBS or the US DOLLAR index. I also find the same relations when considering smaller systems while checking for alternative variables, thus helping to confirm the robustness of some of the patterns in the response of the sovereign spread to global shocks. The results from all the alternative sensitivity checks remain virtually the same for all the countries in my sample.[19]

[19]The results for all alternative sensitivity tests are not reported in the tables but are available upon request from the authors.

2.6 Conclusion

This chapter contributes to the existing literature by analyzing the dynamic relations between global factors, country-specific factors and sovereign spreads in emerging countries. My analysis includes a theoretical framework that combines an incentive model of debt overhang (Obstfeldt and Rogoff, 1996) with the portfolio allocation model of Blanchard (2005). I then apply the resulting model framework to empirically investigate how the spread of sovereign debt is influenced over time by both global and country-specific factors. I then use the estimated SVAR model to generate variance decompositions and impulse response functions.

My findings clearly support the hypothesis that variations of sovereign spreads in emerging countries are mainly driven by global shocks, with the term structure of US interest rates and risk aversion playing the most important roles. The results also indicate that shocks from the US could largely explain fluctuations in country-specific macroeconomic fundamentals; implying that emerging economies rely heavily on US factors. This in turn implies that the US variables have a direct effect on sovereign spread and an indirect effect on sovereign spread via country-specific macroeconomic fundamentals. My findings also validate the presence of some response patterns of the sovereign spread to global shocks and indicate that sovereign spreads increase in response to all kinds of global shocks.

From a public policy perspective, understanding the relationships between global and country-specific factors and sovereign spread is important, for both investors and policy makers alike, in deciding a suitable investment or government policy, especially in emerging economies. Furthermore, my evidence highlights the crucial role of sovereign bonds in emerging countries, which are mainly driven by the US economy. Emerging economies appear to be heavily dependent on the US, which in turn implies that when a shock is coming from the US, its affect can persist in the medium and long terms. It follows that policy makers and researchers in these countries ought to use instruments that shield their economies from global disturbances.

There are limitations of this chapter. The model can be made dynamic, the mechanisms of the model will still work in the same way, but the probability of default will depend on the distribution of the future path of debt. In this case, instead of analyzing the effect of current debt to GDP ratio on sovereign bond spread, the empirical model should focus on analyzing the effect of the sustainability of the debt level on sovereign bond spread.

Table 2.1 Variables employed in the model estimation

Symbol	Definition	Calculation	Description and sources
Global variables			
TERM STRUCTURE	Term structure of US interest rate	Yield of 20 US years Treasury notes minus yield of 2 years US Treasury notes	Proxy for future short-term interest rate and future US economy (source: DataStream)
CBS	BAA corporate bond spread	Yield of US-BAA bond minus yield of 10 years US Treasury notes	Proxy for global investor's risk aversion. The higher the global investor's risk aversion, the higher premium required (source: DataStream)
VRP	Variance risk premium	Difference between the implied and expected VIX[20]	Proxy for global investor's risk aversion. The higher the global investor's risk aversion, the higher premium required (source: Federal Reserve System; Zhou, 2010)
DOLLAR	Dollar Index	Weighted average measure of the dollar against major currencies.	Proxy for the real value changed of Dollar (source: DataStream)
Country-specific variables			
TRADE/GDP	Trade balance to GDP ratio	(trade balance * exchange rate)/GDP	Proxy for domestic liquidity conditions (source: DataStream)
DEBT/GDP	Debt to GDP ratio	(Debt*exchange rate)/GDP	Proxy for domestic solvency conditions (source: DataStream)
LOGSPREAD	Logspread	Log to the level of EMBI Global index	Proxy for the cost of borrowing (source: DataStream)

[20] Trademarked ticker symbol for the Chicago Board Options Exchange Market Volatility Index

Table 2.2 Raw data sample size and frequency

Country	Sample size	Variable	Data Frequency
US	Jan.1995-Sep 2009	Yield of 2 years treasury note	Monthly
		Yield of 10 years treasury note	Monthly
		Yield of 20 years treasury note	Monthly
		Yield of US-BAA bond	Monthly
		Variance risk premium	Monthly
		Dollar index	Monthly
China	Jan.1995-Sep.2009	GDP	Quarterly
		Trade balance	Monthly
		External debt	Annually
		Nominal exchange rate	Monthly
		EMBI Global Index	Monthly
Malaysia	Nov.1996-Sep.2009	GDP	Quarterly
		Trade balance	Monthly
		External debt	Monthly
		Nominal exchange rate	Monthly
		EMBI Global Index	Monthly
Philippines	Jan.1998 to Sep.2009	GDP	Quarterly
		Trade balance	Monthly
		External debt	Quarterly
		Nominal exchange rate	Monthly
		EMBI Global Index	Monthly
Indonesia	Jun.2004-Sep.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Argentina	Jan.1995-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly

(Continued)

Country		Sample size	Variable
Brazil	Jan.1995-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Chile	Jan.2003-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Colombia	Jan.2001-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Peru	Apr.1997-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Uruguay	Jun.2001-Dec.2008	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Bulgaria	Jan.2000-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Hungary	Mar.1999-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly

(Continued)

Country		Sample size	Variable
Poland	Mar.1999-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Russia	Mar.2003-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly
Turkey	July.1996-Mar.2009	GDP	Quarterly
		Nominal exchange rate	Monthly
		Trade balance	Monthly
		External debt	Quarterly
		EMBI Global Index	Monthly

Source: All data are from DataStream. Data for the VRP variable is from Zhou (2010).

Table 2.3 Selected descriptive statistics of the variables employed in the model

US					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TERM STRUCTURE	1.39	1.12	0.90	177	I(0)
CBS	2.35	0.91	2.07	177	I(1)
VRP	19.75	24.85	14.13	177	I(0)
DOLLAR	110.80	10.13	111.19	177	I(1)
Asia					
China					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.036	0.027	0.031	177	I(0)
DEBT/GDP	1.448	0.267	1.442	177	I(1)
LOGSPREAD	4.575	0.441	4.610	177	I(0)
Malaysia					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.163	0.065	0.170	155	I(0)
DEBT/GDP	1.688	0.331	1.691	155	I(1)
LOGSPREAD	5.051	0.614	5.081	155	I(0)
Philippines					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.039	0.099	-0.058	141	I(0)
DEBT/GDP	11.691	3.158	12.650	141	I(1)
LOGSPREAD	5.944	0.389	5.999	141	I(0)
Indonesia					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.075	0.041	0.092	64	I(0)
DEBT/GDP	4.371	1.035	3.979	64	I(1)
LOGSPREAD	5.684	0.456	5.624	64	I(0)
South America					
Argentina					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.017	0.021	0.012	171	I(1)
DEBT/GDP	0.974	0.585	0.959	171	I(1)
LOGSPREAD	6.966	1.052	6.619	171	I(0)

(Continued)

Brazil					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.017	0.024	0.007	171	I(1)
DEBT/GDP	3.254	1.290	3.047	171	I(1)
LOGSPREAD	6.344	0.623	6.454	171	I(1)
Chile					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.102	0.075	0.097	75	I(0)
DEBT/GDP	1.639	0.162	1.597	75	I(1)
LOGSPREAD	4.659	0.490	4.446	75	I(0)
Colombia					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.007	0.014	-0.006	-0.007	I(0)
DEBT/GDP	3.671	1.091	3.449	3.671	I(1)
LOGSPREAD	5.863	0.530	6.007	5.863	I(1)
Peru					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.020	0.046	0.010	141	I(1)
DEBT/GDP	1.739	0.396	1.876	141	I(1)
LOGSPREAD	5.907	0.551	6.064	141	I(1)
Uruguay					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.023	0.045	-0.017	91	I(0)
DEBT/GDP	2.672	0.815	2.517	91	I(1)
LOGSPREAD	6.038	0.612	5.899	91	I(1)
Eastern Europe					
Bulgaria					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.171	0.072	-0.172	111	I(1)
DEBT/GDP	9.259	2.060	8.921	111	I(1)
LOGSPREAD	5.362	0.875	5.349	111	I(1)
Hungary					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.040	0.035	-0.041	120	I(1)
DEBT/GDP	9.071	2.928	7.936	120	I(1)
LOGSPREAD	4.242	0.754	4.182	120	I(0)

(Continued)

Poland					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.417	0.259	-0.394	121	I(1)
DEBT/GDP	5.195	0.708	5.122	121	I(1)
LOGSPREAD	4.755	0.668	4.705	121	I(1)
Russia					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	0.127	0.031	0.131	73	I(0)
DEBT/GDP	3.880	0.590	3.763	73	I(1)
LOGSPREAD	5.278	0.571	5.227	73	I(1)
Turkey					
Variable	**Mean**	**Std. Dev.**	**Median**	**Observations**	**Stationarity**
TRADE/GDP	-0.084	0.028	-0.087	153	I(0)
DEBT/GDP	1.695	0.346	1.581	153	I(0)
LOGSPREAD	5.999	0.532	5.951	153	I(0)

Sources: All data are from DataStream. Data for the VRP variable is from Zhou (2010).

Table 2.4 Contribution of all variables to the forecasting error variance of sovereign spread for Asian countries

Malaysia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.39	2.74	3.22	4.25	10.60	1.33	2.43
	6	0.61	0.68	31.31	10.36	42.96	0.91	1.95
	12	0.77	0.64	32.46	11.08	44.94	3.51	1.42
	18	1.47	0.61	32.54	11.43	46.05	8.57	1.45
	24	2.56	0.57	31.76	11.36	46.26	11.44	1.78
Indonesia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	13.69	2.68	7.21	11.27	34.85	1.98	0.37
	6	23.72	16.65	8.31	19.16	67.84	8.66	1.15
	12	31.07	17.79	5.60	13.18	67.65	14.63	3.36
	18	35.77	20.80	15.17	10.58	82.32	6.30	2.48
	24	36.66	19.60	18.69	8.51	83.46	6.17	2.16
China	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.67	15.63	5.39	0.00	21.69	0.72	1.88
	6	7.36	26.12	17.57	2.95	54.01	1.77	1.96
	12	18.69	23.14	13.60	3.28	58.71	2.67	2.21
	18	24.85	20.54	13.59	4.13	63.10	3.06	2.69
	24	30.57	18.59	10.68	7.47	67.31	3.54	3.02

(Continued)

Philippines	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	1.47	4.01	7.70	0.76	13.94	1.44	9.13
	6	0.99	1.97	18.05	8.84	29.84	1.69	15.08
	12	0.76	2.14	18.30	10.39	31.59	1.31	15.72
	18	0.74	2.04	18.80	10.69	32.28	1.27	15.80
	24	1.06	2.00	19.06	10.71	32.83	1.26	15.79

Sources: All data are from DataStream. Data for the VRP variable is from Zhou (2010).

Notes: TERM STRUCTURE = Term structure of US interest rate (%); CBS = BAA Corporate Bond Spread (%); VRP = Variance Risk Premium; Dollar = Dollar index; Aggregate Foreign Factor = TERM STRUCTURE+CBS+VRP+DOLLAR; TRADE/GDP = Trade balance to GDP ratio; and DEBT/GDP = debt to GDP ratio.

Table 2.5 Aggregate contribution of US variables to the forecasting error variance of TRADE/GDP ratio for Asian countries

Malaysia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.11	0.38	0.81	0.71	2.02
	6	1.74	1.58	1.78	2.70	7.79
	12	1.56	1.48	1.69	2.41	7.15
	18	1.55	1.47	1.72	2.39	7.13
	24	1.56	1.47	1.81	2.42	7.25
Indonesia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	7.70	0.25	2.60	5.16	15.71
	6	34.53	8.67	6.16	5.40	54.75
	12	39.26	16.90	13.86	6.81	76.84
	18	39.25	17.69	18.01	5.35	80.30
	24	39.48	18.20	17.84	4.67	80.18
China	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.34	1.56	0.02	4.69	6.60
	6	13.12	6.22	12.58	3.52	35.45
	12	19.47	6.09	14.67	4.31	44.54
	18	17.52	6.42	17.62	5.28	46.83
	24	15.39	15.22	15.79	6.37	52.77
Philippines	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	4.14	0.96	1.19	0.49	6.78
	6	5.49	1.98	10.61	1.41	19.50
	12	13.25	2.00	9.80	1.75	26.80
	18	16.30	1.93	9.35	1.75	29.33
	24	17.95	1.90	9.21	1.72	30.77

Sources: All data are from DataStream. Data for the VRP variable is from Zhou (2010).

Notes: TERM STRUCTURE = Term structure of US interest rate (%); CBS = BAA Corporate Bond Spread (%); VRP = Variance Risk Premium; Dollar = Dollar index; Aggregate Foreign Factor = TERM STRUCTURE+CBS+VRP+DOLL

Table 2.6 Aggregate contribution of US variables to the forecasting error variance of DEBT/GDP ratio for Asian countries

Malaysia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	1.32	0.02	1.16	20.18	22.68
	6	5.16	3.63	4.13	21.63	34.55
	12	5.13	4.17	4.16	21.47	34.93
	18	5.15	4.17	4.16	21.42	34.90
	24	5.15	4.17	4.16	21.42	34.90
Indonesia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	12.15	0.83	18.53	6.98	38.49
	6	13.07	10.83	22.63	12.79	59.31
	12	15.01	14.27	21.40	12.76	63.44
	18	15.68	14.50	22.97	12.70	65.85
	24	15.55	14.41	22.64	12.79	65.38
China	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.19	2.40	1.30	0.19	4.08
	6	0.46	10.26	5.43	7.57	23.71
	12	4.85	26.18	8.74	4.61	44.37
	18	3.92	21.43	13.28	8.08	46.72
	24	9.78	21.85	12.80	8.21	52.64
Philippines	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.03	0.12	0.85	3.73	4.72
	6	0.83	2.14	8.57	3.13	14.67
	12	1.75	3.17	7.71	3.21	15.84
	18	1.76	3.18	7.65	3.22	15.80
	24	1.76	3.18	7.65	3.22	15.81

Sources: All data are from DataStream. Data for the VRP variable is from Zhou (2010).

Notes: TERM STRUCTURE = Term structure of US interest rate (%); CBS = BAA Corporate Bond Spread (%); VRP = Variance Risk Premium; Dollar = Dollar index; Aggregate Foreign Factor = TERM STRUCTURE+CBS+VRP+DOLL

Table 2.7 Contribution of sovereign spread to the forecasting error variance of domestic variables for Asian countries

Malaysia	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	7.74	3.74
	12	12.13	4.35
	18	13.15	4.44
	24	13.28	4.45
Indonesia	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	3.13	16.83
	12	4.90	15.12
	18	5.30	14.04
	24	5.50	13.77
China	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	15.14	11.35
	12	16.26	7.22
	18	14.73	12.38
	24	12.59	11.43
Philippines	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	4.39	2.79
	12	5.50	3.18
	18	6.01	3.21
	24	6.08	3.21

Sources: All data are from DataStream.

Notes: TRADE/GDP = Trade balance to GDP ratio and DEBT/GDP = Debt to GDP ratio.

Table 2.8 Contribution of all variables to the forecasting error variance of sovereign spread for South American countries

Argentina	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.23	1.80	9.90	2.09	14.02	0.41	0.00
	6	5.30	3.08	6.10	1.18	15.66	1.83	6.20
	12	25.45	2.08	5.81	6.59	39.94	3.51	3.32
	18	39.83	2.57	7.27	12.06	61.73	4.67	1.96
	24	47.22	3.57	6.87	13.88	71.53	6.13	1.47
Brazil	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	1.99	0.07	34.61	0.35	37.03	0.02	9.14
	6	3.04	1.68	33.12	2.99	40.83	1.97	8.65
	12	4.44	2.27	35.68	3.17	45.55	2.58	8.01
	18	4.61	2.53	35.68	3.33	46.15	2.88	7.90
	24	4.68	2.57	35.72	3.35	46.31	2.94	7.89
Chile	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	17.07	8.24	17.74	0.67	43.71	0.01	1.46
	6	7.95	2.98	29.13	1.98	42.04	19.63	8.74
	12	4.16	3.40	30.65	1.16	39.38	20.19	9.83
	18	3.37	3.47	31.73	0.89	39.45	19.07	9.97
	24	4.46	3.50	32.08	0.78	40.83	17.78	9.78

(Continued)

Colombia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	15.48	2.49	31.78	1.12	50.87	0.20	3.77
	6	13.31	2.50	21.46	5.71	42.98	12.41	9.03
	12	13.24	3.57	22.45	6.42	45.68	12.44	8.99
	18	13.38	3.53	22.47	6.92	46.29	12.27	8.96
	24	13.33	3.53	22.49	7.09	46.44	12.23	9.04
Peru	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	6.54	2.59	24.84	0.55	34.52	0.69	2.94
	6	6.83	3.17	24.66	7.52	42.18	2.09	4.04
	12	6.71	3.85	24.86	7.60	43.02	2.91	4.14
	18	6.68	4.00	24.91	7.53	43.12	3.15	4.38
	24	6.68	4.03	24.90	7.54	43.15	3.17	4.43
Uruguay	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	10.00	1.51	29.97	0.05	41.53	0.73	1.31
	6	11.83	14.18	28.72	5.45	60.17	7.21	3.90
	12	11.74	12.17	25.95	7.42	57.27	12.37	3.74
	18	12.11	12.29	25.92	7.41	57.74	12.45	3.82
	24	12.27	12.24	25.82	7.42	57.75	12.68	3.80

Sources: Same as Table 2.4.

Notes: Same as Table 2.4.

Table 2.9 Aggregate contribution of US variables to the forecasting error variance of TRADE/GDP ratio for South American countries

Argentina	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.14	0.22	1.63	5.95	7.94
	6	4.48	5.24	9.43	6.78	25.93
	12	9.81	10.88	8.74	7.15	36.58
	18	11.31	9.98	11.15	7.38	39.82
	24	12.99	10.21	10.59	8.03	41.83
Brazil	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.65	0.34	0.03	0.04	1.06
	6	3.29	1.64	1.01	3.70	9.63
	12	3.29	2.27	12.77	3.50	21.82
	18	3.46	2.59	13.32	3.58	22.95
	24	3.60	2.61	13.86	3.61	23.67
Chile	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	1.15	0.03	1.24	0.08	2.50
	6	2.39	1.97	4.36	0.87	9.57
	12	11.83	1.83	5.47	1.20	20.32
	18	13.27	1.83	7.73	1.51	24.35
	24	12.41	1.96	10.17	1.45	25.99
Colombia	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.18	6.46	1.41	2.95	11.00
	6	9.24	5.02	7.22	6.07	27.54
	12	10.30	5.42	9.57	8.40	33.69
	18	11.21	5.31	9.28	8.59	34.39
	24	11.21	5.26	9.54	8.81	34.81
Peru	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	1.69	0.12	1.31	0.30	3.43
	6	2.14	6.52	13.77	1.12	23.55
	12	3.44	8.72	14.31	1.37	27.83
	18	3.54	8.99	14.38	1.41	28.32
	24	3.54	9.04	14.39	1.41	28.38

(Continued)

Uruguay	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	7.41	2.94	3.67	0.46	14.48
	6	7.96	13.39	8.47	3.02	32.84
	12	8.38	14.66	12.29	4.13	39.47
	18	10.22	14.73	11.84	4.62	41.41
	24	11.41	15.06	11.65	4.82	42.94

Sources: Same as Table 2.5.

Notes: Same as Table 2.5.

Table 2.10 Aggregate contribution of US variables to the forecasting error variance of DEBT/GDP ratio for South American countries

Argentina	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.01	1.58	2.92	1.23	5.74
	6	0.85	3.16	8.06	9.35	21.42
	12	5.31	3.46	9.51	10.93	29.21
	18	10.64	3.97	9.42	10.16	34.19
	24	11.15	4.89	9.29	11.15	36.48
Brazil	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	1.76	0.00	5.40	2.02	9.17
	6	5.52	0.51	14.35	2.49	22.87
	12	5.93	1.05	25.93	3.44	36.35
	18	6.17	1.81	26.37	3.70	38.05
	24	6.53	1.87	26.48	3.70	38.59
Chile	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.86	0.30	0.00	1.46	2.62
	6	7.79	0.64	3.76	7.71	19.90
	12	8.42	0.77	4.52	9.07	22.78
	18	8.64	0.79	4.76	9.30	23.48
	24	8.87	0.80	4.90	9.27	23.84
Colombia	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	4.80	1.31	27.63	3.80	37.53
	6	6.21	4.20	22.56	9.43	42.40
	12	6.38	4.11	24.17	10.36	45.02
	18	6.50	4.05	24.23	10.77	45.55
	24	6.59	4.03	24.32	11.03	45.97
Peru	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.38	0.79	1.40	0.00	2.57
	6	1.22	5.56	5.90	1.60	14.29
	12	1.39	7.87	6.39	2.36	18.01
	18	1.35	8.11	6.45	2.25	18.15
	24	1.34	8.21	6.41	2.23	18.20

(Continued)

Uruguay	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	10.86	9.31	12.50	0.08	32.74
	6	7.73	22.40	28.21	6.14	64.47
	12	8.82	19.35	29.30	5.96	63.43
	18	8.67	19.63	28.67	5.96	62.93
	24	8.60	19.79	28.39	5.95	62.73

Sources: Same as Table 2.6.

Notes: Same as Table 2.6.

Table 2.11 Contribution of sovereign spread to the forecasting error variance of domestic variables for South American countries

Argentina	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	3.92	3.97
	12	5.30	6.13
	18	6.01	5.99
	24	5.93	6.24
Brazil	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	6.14	5.80
	12	5.72	7.19
	18	5.76	7.73
	24	5.73	7.76
Chile	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	2.84	5.75
	12	4.85	6.30
	18	7.04	6.53
	24	9.37	6.62
Colombia	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	7.44	1.21
	12	6.93	2.46
	18	7.32	2.91
	24	7.27	2.99
Peru	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	3.96	3.43
	12	3.56	3.46
	18	3.60	3.56
	24	3.60	3.61
Uruguay	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	3.47	4.05
	12	4.62	4.78
	18	4.60	4.68
	24	4.49	4.66

Sources: Same as Table 2.7.

Notes: Same as Table 2.7.

Table 2.12 Contribution of all variables to the forecasting error variance of sovereign spread for Eastern European countries

Bulgaria	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	16.28	0.04	18.64	1.03	35.98	0.22	0.00
	6	17.81	5.33	17.87	6.69	47.70	3.77	2.36
	12	17.18	12.35	20.20	6.60	56.34	3.30	2.52
	18	16.26	12.72	24.76	7.48	61.21	3.75	3.08
	24	15.50	14.12	25.52	9.44	64.58	3.92	3.38
Hungary	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.28	6.08	1.72	0.15	8.23	0.64	1.70
	6	0.90	8.82	9.83	0.57	20.13	1.16	4.08
	12	1.85	8.76	10.85	0.53	21.99	1.07	4.33
	18	2.91	8.46	10.97	0.51	22.85	0.99	4.53
	24	4.01	8.16	10.94	0.49	23.60	0.93	4.65
Poland	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.51	10.37	7.49	0.17	18.54	0.00	4.16
	6	1.98	10.94	8.27	5.66	26.85	0.77	5.41
	12	2.32	10.93	8.28	5.69	27.22	0.95	5.82
	18	2.59	10.91	8.25	5.68	27.44	0.95	5.82
	24	2.77	10.90	8.24	5.67	27.57	0.95	5.81

(Continued)

Russia	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	8.41	0.34	42.98	0.56	52.29	2.96	0.00
	6	11.58	3.89	31.02	3.74	50.22	6.30	4.33
	12	11.11	6.29	30.92	4.88	53.19	5.35	5.80
	18	10.69	7.17	30.87	4.88	53.62	6.04	6.28
	24	11.20	6.90	31.39	4.83	54.32	5.88	6.75
Turkey	Horizon	TERM STRUCTURE	CBS	VRP	DOLLAR	Aggregate Foreign Factor	TRADE/GDP	DEBT/GDP
	1	0.74	1.50	26.69	0.01	28.94	0.35	3.10
	6	2.74	0.56	37.21	0.27	40.78	4.29	1.40
	12	2.34	0.54	35.73	0.19	38.80	7.46	1.71
	18	2.05	0.49	35.22	0.21	37.97	8.72	1.96
	24	2.44	0.46	34.80	0.24	37.94	9.13	2.00

Sources: Same as Table 2.4.

Notes: Same as Table 2.4.

Table 2.13 Aggregate contribution of US variables to the forecasting error variance of TRADE/GDP ratio for Eastern European countries

Bulgaria	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.06	7.88	1.83	0.09	9.86
	6	3.99	7.79	10.54	5.55	27.87
	12	10.09	5.37	25.33	4.13	44.91
	18	9.36	9.59	23.42	6.55	48.93
	24	11.18	9.25	25.57	7.12	53.12
Hungary	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.08	0.73	0.34	1.39	2.53
	6	1.82	1.81	6.23	4.64	14.51
	12	1.80	1.85	7.10	4.99	15.74
	18	1.81	1.85	7.13	5.01	15.80
	24	1.81	1.86	7.14	5.01	15.81
Poland	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.17	3.60	0.12	0.30	4.19
	6	2.52	4.84	5.61	4.44	17.42
	12	2.62	4.91	5.82	4.92	18.27
	18	2.62	4.92	5.80	4.95	18.28
	24	2.63	4.92	5.80	4.95	18.29
Russia	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	2.38	0.46	1.38	1.14	5.36
	6	5.28	1.66	27.71	1.85	36.51
	12	4.64	1.58	28.77	2.73	37.72
	18	3.97	2.95	30.12	3.82	40.86
	24	7.22	3.45	31.33	4.35	46.35
Turkey	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.66	0.88	0.04	0.12	1.71
	6	3.18	3.04	10.66	0.63	17.50
	12	2.88	2.43	15.38	0.52	21.20
	18	2.73	2.26	17.14	0.49	22.63
	24	2.67	2.16	17.88	0.49	23.19

Sources: Same as Table 2.5.

Notes: Same as Table 2.5.

Table 2.14 Aggregate contribution of US variables to the forecasting error variance of DEBT/GDP ratio for Eastern European countries

Bulgaria	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.36	0.45	2.54	0.19	3.54
	6	4.97	3.48	6.56	6.76	21.77
	12	5.50	6.46	9.57	9.35	30.87
	18	5.97	6.21	14.11	10.82	37.11
	24	5.52	6.96	14.17	11.22	37.87
Hungary	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.09	0.20	3.36	0.11	3.76
	6	2.35	3.28	6.38	4.47	16.48
	12	2.59	3.38	6.55	4.82	17.34
	18	2.71	3.50	6.64	4.77	17.61
	24	2.73	3.63	6.75	4.70	17.82
Poland	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.06	0.14	0.94	2.46	3.61
	6	1.81	6.26	2.17	6.20	16.44
	12	1.87	6.36	2.17	6.26	16.65
	18	1.91	6.37	2.16	6.27	16.72
	24	1.94	6.37	2.16	6.28	16.75
Russia	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	0.96	0.11	2.64	11.27	14.98
	6	2.05	6.82	23.55	9.53	41.94
	12	6.05	6.22	32.20	6.23	50.70
	18	6.73	6.70	34.08	5.96	53.47
	24	7.25	6.49	33.57	5.42	52.73
Turkey	Horizon	TERM STRUCTUR	CBS	VRP	DOLLAR	Aggregate Foreign Factor
	1	2.15	0.80	9.32	0.00	12.27
	6	18.56	2.28	8.28	1.85	30.97
	12	16.86	2.13	14.70	1.90	35.59
	18	15.26	1.95	15.86	1.72	34.80
	24	14.84	1.89	16.32	1.68	34.73

Sources: Same as Table 2.6.

Notes: Same as Table 2.6.

Table 2.15 Contribution of sovereign spread to the forecasting error variance of domestic variables for Eastern European countries

Bulgaria	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	4.36	7.78
	12	9.63	8.95
	18	10.79	8.94
	24	9.92	10.10
Hungary	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	0.73	1.64
	12	0.93	2.44
	18	0.94	3.44
	24	0.95	4.43
Poland	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	1.61	3.64
	12	1.68	3.44
	18	1.68	3.43
	24	1.68	3.43
Russia	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	3.50	10.26
	12	10.03	17.32
	18	12.64	20.99
	24	12.82	24.71
Turkey	Horizon	TRADE/GDP	DEBT/GDP
	1	0.00	0.00
	6	14.35	7.77
	12	24.05	11.64
	18	26.04	15.70
	24	27.02	16.74

Sources: Same as Table 2.7.

Notes: Same as Table 2.7.

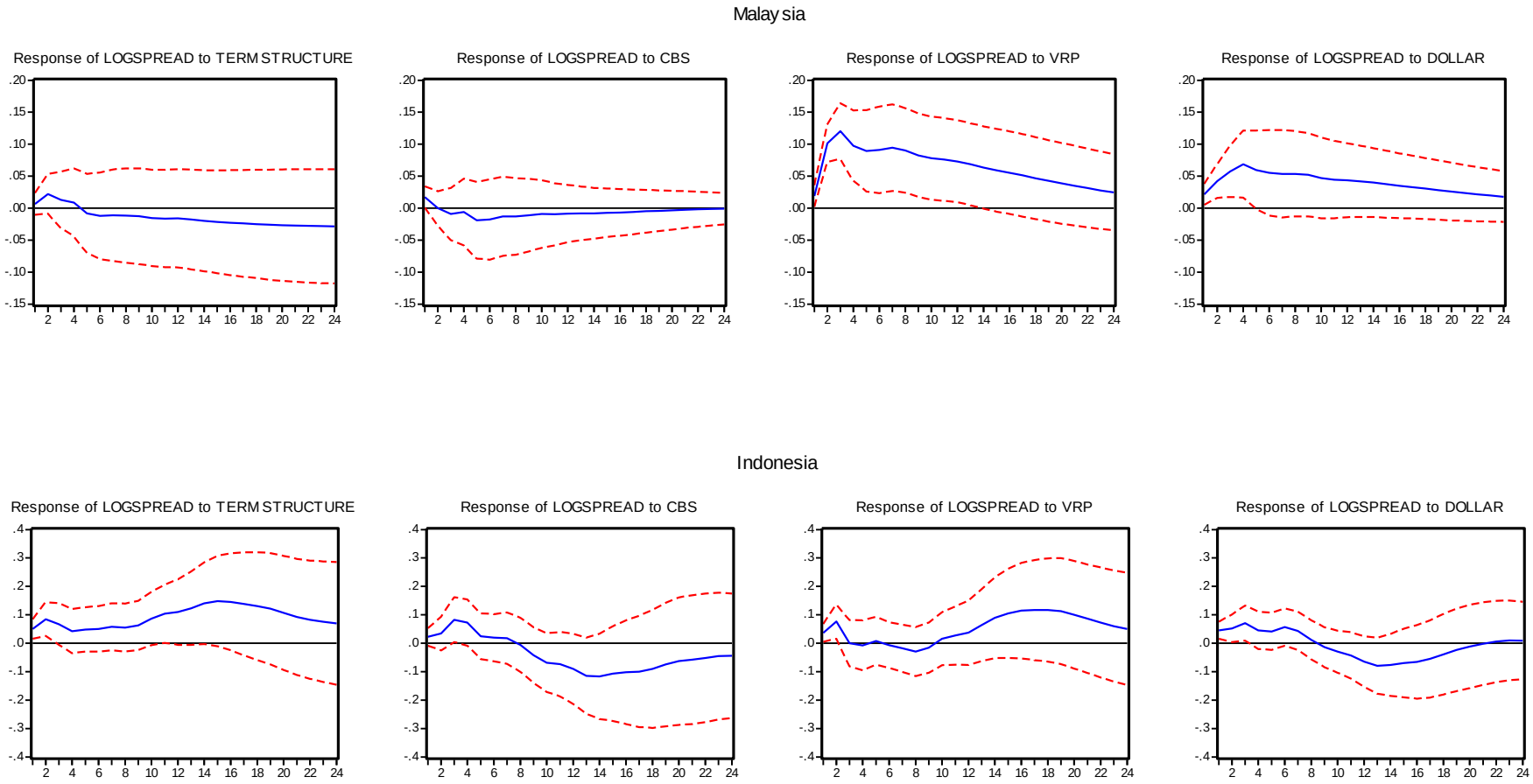
Table 2.16 Average of Aggregate contribution of US variables to the forecasting error variance of domestic variables across different regions

Asia	Horizon	LOGSPREAD	TRADE/GDP	DEBT/GDP
	1	20.27	7.78	17.49
	6	48.66	29.37	33.06
	12	50.72	38.83	39.65
	18	55.94	40.90	40.82
	24	57.47	42.74	42.18
South America	Horizon	LOGSPREAD	TRADE/GDP	DEBT/GDP
	1	36.95	6.73	15.06
	6	40.64	21.51	30.89
	12	45.14	29.95	35.80
	18	49.08	31.87	37.06
	24	51.00	32.94	37.64
Eastern Europe	Horizon	LOGSPREAD	TRADE/GDP	DEBT/GDP
	1	28.80	4.73	7.63
	6	37.13	22.76	25.52
	12	39.51	27.57	30.23
	18	40.62	29.30	31.94
	24	41.60	31.35	31.98

Sources: All date are from DataStream. Data for the VRP variable is from Zhou (2010).

Notes: LOGSPREAD=Log(spread); TRADE/GDP = Trade balance to GDP ratio; and DEBT/GDP = debt to GDP ratio.

Figure 2.2 Impulse response of sovereign spread to US variable shocks



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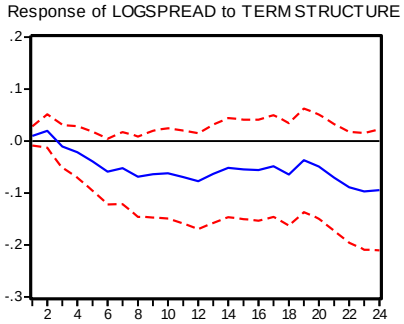

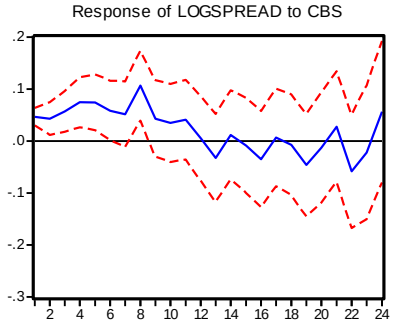

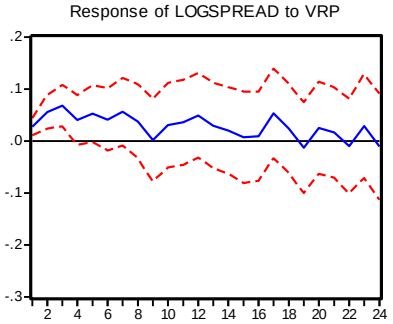

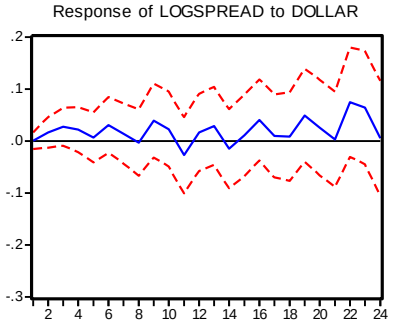

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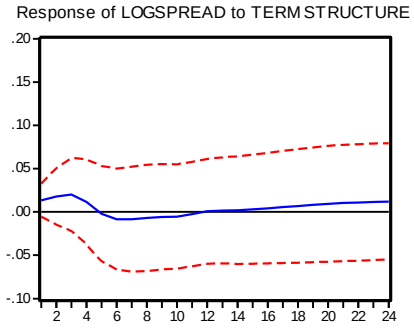

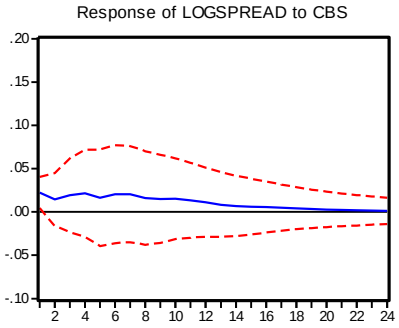

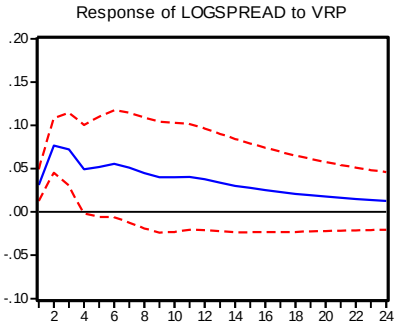

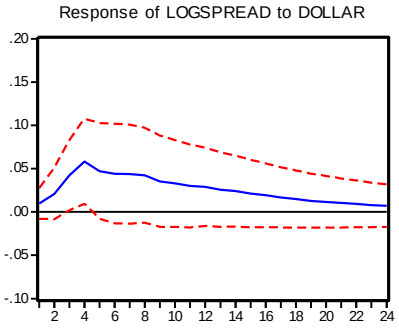

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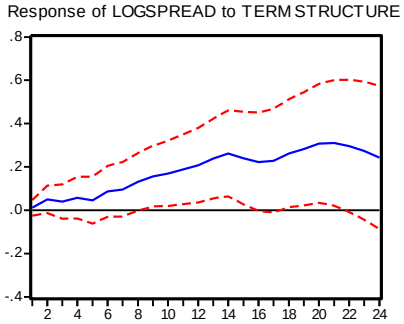
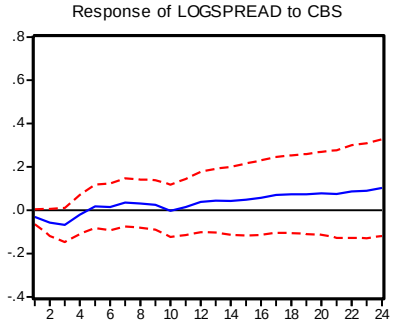
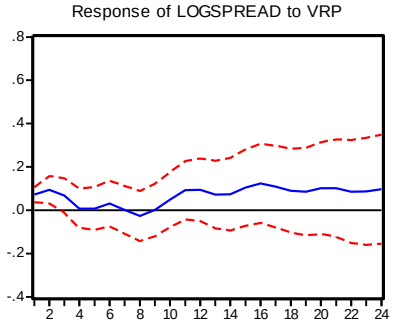
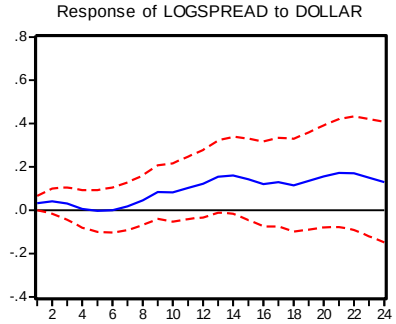
Argentina

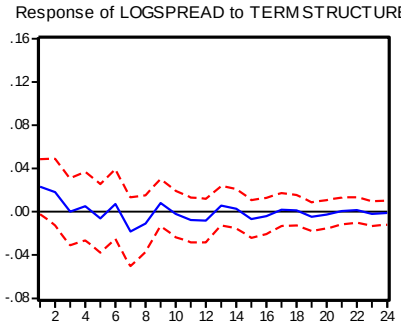


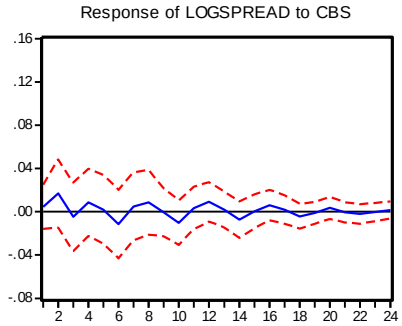


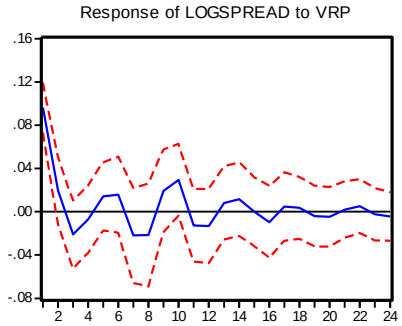


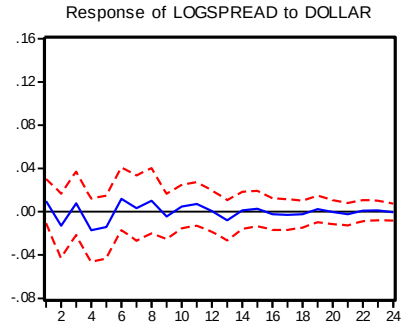


Brazil









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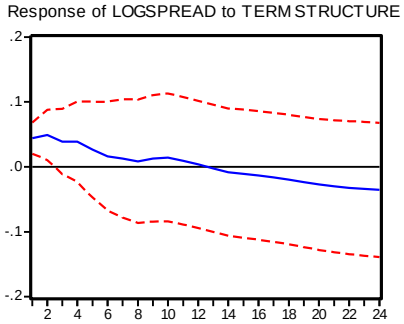
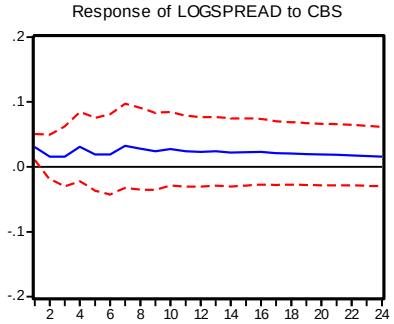
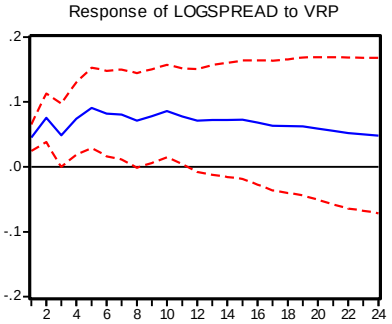
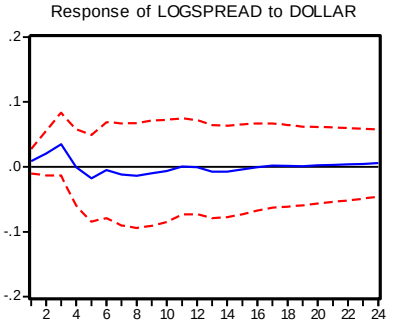
Chile

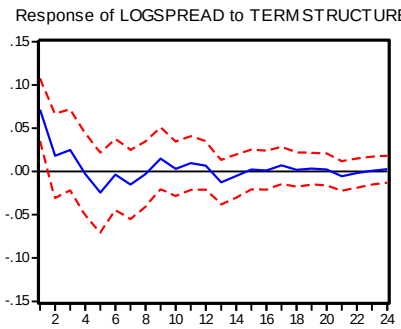


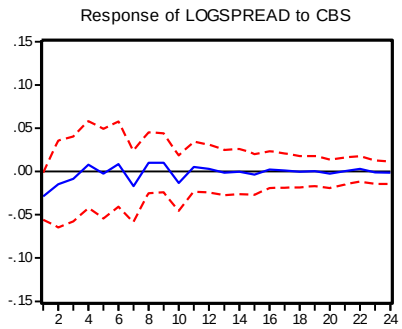


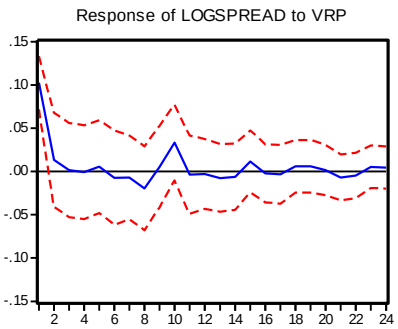


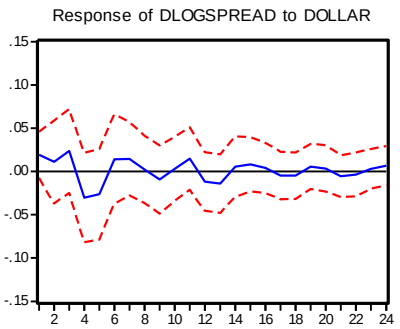


Colombia









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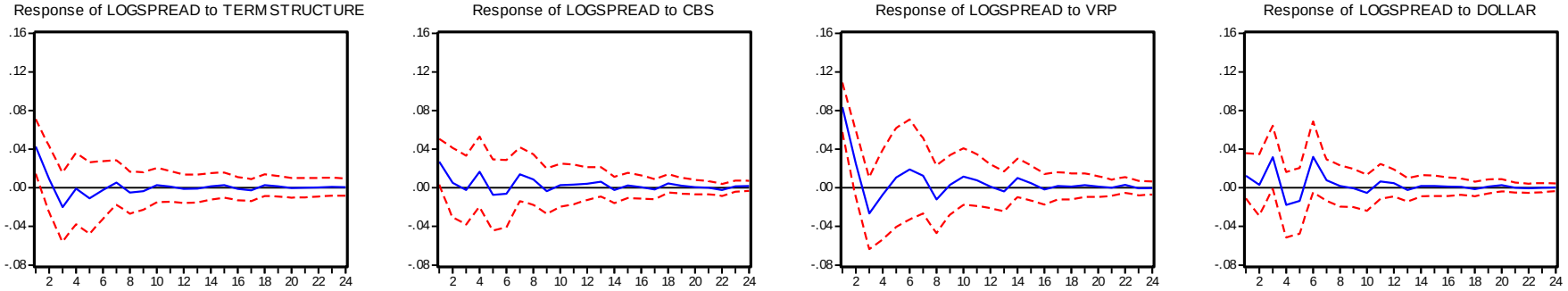
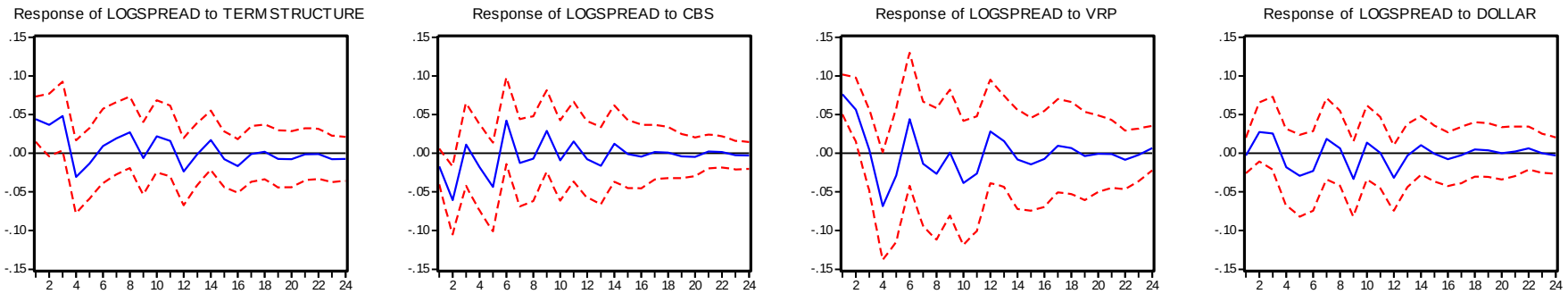
Peru



Uruguay



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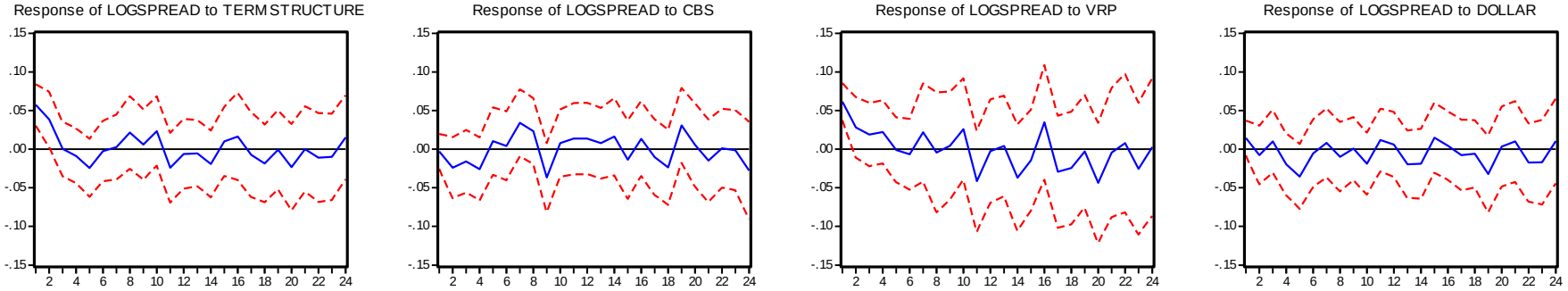
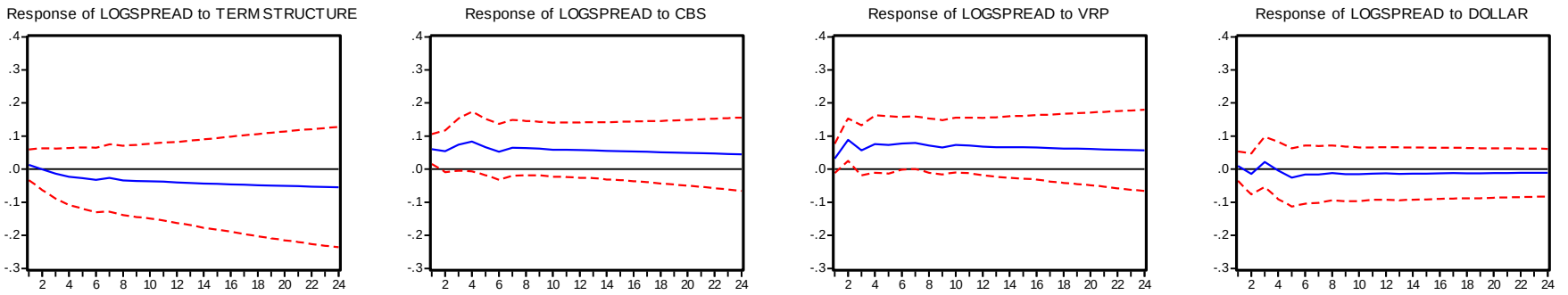
Bulgaria



Hungary



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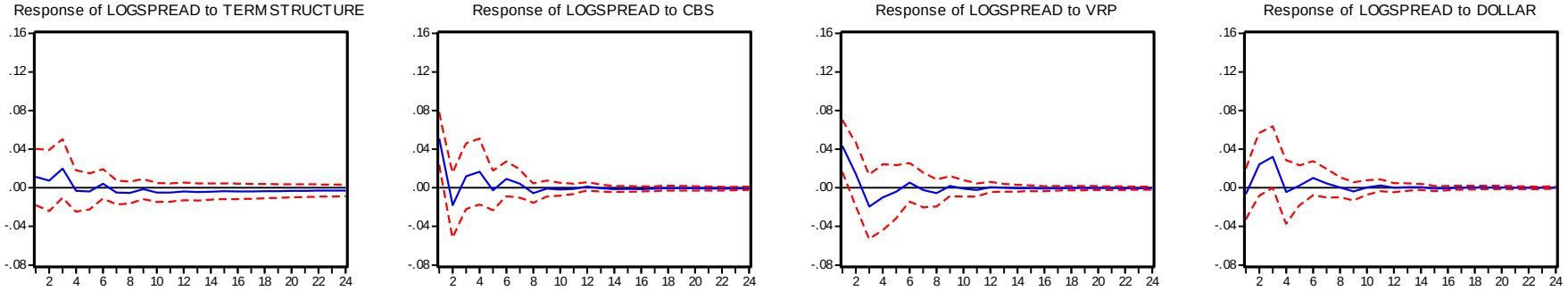
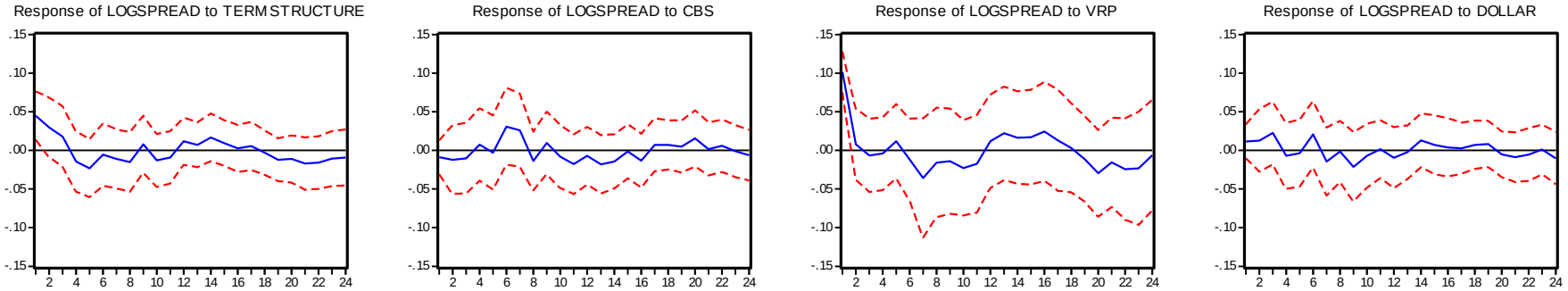


Russia



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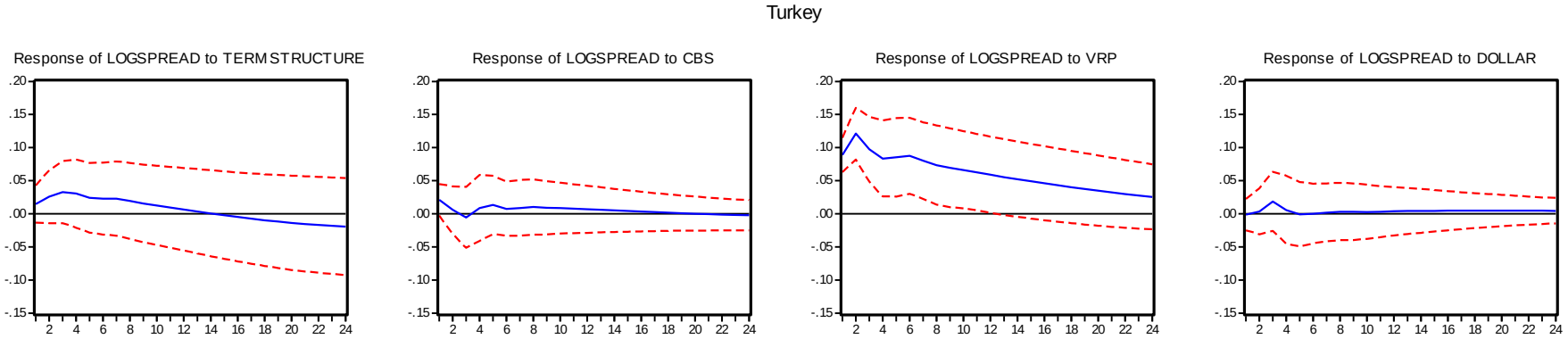

Notes: Solid lines depict point estimates of impulse response and dotted lines depict 95% confidence intervals.

Appendix 2.A: Derivation of equation (2.1)

The expected wealth in the next period by investing in Malaysian US dollar bonds is:

$$q0 + (1-q)\frac{\gamma'}{\gamma}(1+r^{MA})$$

The definition of the risk premium should satisfy:

$$qU(0) + (1-q)U[\frac{\gamma'}{\gamma}(1+r^{MA})] = U[(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) - \pi] \quad (2A1)$$

Where, π is the risk premium.

The no arbitrage condition implies that:

$U[(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) - \pi] = U(1+r)$ must hold as well.

The next step is to discover π.

The Taylor series approximation of the expected utility function around $a = (1-q)\frac{\gamma'}{\gamma}(1+r^{MA})$ yields the following:

$$E = qU(0) + (1-q)U[\frac{\gamma'}{\gamma}(1+r^{MA})]$$
$$\approx qU(a)$$
$$+ qU'(a)[-(1-q)\frac{\gamma'}{\gamma}(1+r^{MA})] + qU''(a)[(1$$
$$- q)\frac{\gamma'}{\gamma}(1+r^{MA})]^2/2 + (1-q)U(a) + (1$$
$$- q)U'(a)[q\frac{\gamma'}{\gamma}(1+r^{MA})] + (1-q)U''(a)[q\frac{\gamma'}{\gamma}(1+r^{MA})]^2/2$$
$$= U(a) + \frac{U''(a)}{2}\{q[(1-q)\frac{\gamma'}{\gamma}(1+r^{MA})]^2 + (1$$
$$- q)[q\frac{\gamma'}{\gamma}(1+r^{MA})]^2\}$$

The Taylor series approximation of the right hand side of (2A1) around $a = (1-q)\frac{\gamma'}{\gamma}(1+r^{MA})$ yields:

$$U[(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) - \pi] \approx U(a) + U'(a)(-\pi)$$

I know the above two Taylor approximation equals as stated from the expected utility theorem, hence by equating them, I can get:

$\pi = -\frac{U''(a)}{U'(a)}\frac{q(1-q)[\frac{\gamma'}{\gamma}(1+r^{MA})]^2}{2}$ Where $-\frac{U''(a)}{U'(a)}$ is the measure of risk aversion and $q(1-q)[\frac{\gamma'}{\gamma}(1+r^{MA})]^2$ is the variance V, so that $\pi = A\frac{V}{2}$, where A is the degree of absolute risk aversion of the investor

Next, I know $(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) = (1+r) + \pi$. By substituting π, I get: $(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) = (1+r) + A\frac{V}{2}$

By using the no arbitrage equation, I get $(1-q)V = q[1+r+AV]^2$.

Solving the quadratic equation:

$$V = \frac{-[q(1+r)A-(1-q)] \pm \sqrt{[q(1+r)A-(1-q)]^2 - [qA(1+r)]^2}}{\frac{A^2 q}{2}}$$

As I check the data, the sample central bank rate is 3-6%, so I can assume r = 0.045. The average value of A is 0.02. Then when q is less than 0.2, $V \approx q$. Hence I arrive at equation (2.1) being $(1-q)\frac{\gamma'}{\gamma}(1+r^{MA}) = (1+r) + Aq$

Appendix 2.B: Derivation of Result I and II:

The Malaysian government needs to repay D' in the second period, for which there are two output states: good state output Y_G and bad state out Y_B. I assume that $Y_G > D' > Y_B$, and in the bad state, the Malaysian government defaults and pays nothing to the bond holder. The state depends on the Malaysian government's effort e, hence the probability of the default depends on the Malaysian government's effort. There is a dislike of effort, so the cost of effort is $\varphi(e)$, where e is continuous, $\varphi(e)$ is a convex function with $\varphi(0) = 0$, $\varphi'(0) = 0$ and $\varphi(1) = +\infty$. In order to simplify the problem, I assume that $q(e) = 1 - e$ and $\varphi(e) = 0.5me^2$. This assumption does not affect my results. The Malaysian government maximizes utility of her citizens:

$$eU(Y_G - D') + (1 - e)U(Y_B) - 0.5me^2$$

By first order condition:

$$U(Y_G - D') - U(Y_B) = me$$

Replacing e with $1 - q$, I get:

$$U(Y_G - D') - U(Y_B) = m(1 - q) \Rightarrow q = 1 - \frac{U(Y_G - D') - U(Y_B)}{m}$$

It can be readily checked that $\frac{\partial q}{\partial D'} > 0$.

To summarize, the equilibrium capital flow condition and debt dynamics (equation (2.3)), together with the incentive compatibility condition (equation (2.4)) jointly determine q and D'. They are given again below for convenience:

$$D' = \left(\frac{1+r}{1-q} + \frac{\mu A^* q}{1-q}\right) D^{\$}\gamma(q) - R \tag{2.3}$$

$$U(Y_G - D') - U(Y_B) = m(1-q) \tag{2.4}$$

The comparative statics of q with respect to r^{US} and A^* yield the result I as reported below:

$$\frac{\partial q}{\partial r^{US}} = \frac{\begin{vmatrix} 1 & D^{\$}\left(\frac{\mu A^* q + 1 + r}{1-q}\right)\frac{\partial \gamma}{\partial r^{US}} \\ -U' & 0 \end{vmatrix}}{|J|} = \frac{U' D^{\$}\left(\frac{\mu A^* q + 1 + r}{1-q}\right)\frac{\partial \gamma}{\partial r^{US}}}{|J|} > 0$$

$$\frac{\partial q}{\partial A^*} = \frac{\begin{vmatrix} 1 & \frac{\mu q}{1-q} D^{\$}\gamma \\ -U' & 0 \end{vmatrix}}{|J|} = \frac{U' \frac{\mu q}{1-q} D^{\$}\gamma}{|J|} > 0$$

Where $|J| = m - U'\left\{-D^{\$}\left[\left(\frac{\mu A^* q + 1 + r}{1-q}\right)\frac{\partial \gamma}{\partial q} + \frac{\mu A^* q + 1 + r}{(1-q)^2}\gamma\right]\right\} > 0$

Recalling equation (2.2):

$$C\{1 + r - \gamma^{\eta-1}(1 + r^{US}) + (1-\mu)A^* q\} + N(\gamma) = 0 \tag{2.2}$$

Since I defined $C' > 0$, C is a decreasing function of r^{US}, A^* and q, together with equation (2.2), I get N is an increasing function of r^{US}, A^* and q. Using the defined condition $N' > 0$, γ is an increasing function of r^{US}, A^* and q.

Recalling the sovereign spread equation (2.5):

$S = r^{MA} - r^{US} = \frac{1+r+\mu A^* q}{(1-q)\gamma(q)^{\eta-1}} - 1 - r^{US}$ and using the equation (2.3) and (2.4) for the comparative statics, I get:

$$\frac{\partial S}{\partial A^*}$$

$$= \frac{(1-q)\gamma^{\eta-1}\left(\mu q + \mu A^* \frac{\partial q}{\partial A^*}\right) - (1+r+\mu A^* q)[(\eta-1)(1-q)\gamma^{\eta-2}\frac{\partial \gamma}{\partial A^*} - \gamma^{\eta-1}\frac{\partial q}{\partial A^*}]}{[(1-q)\gamma^{\eta-1}]^2}$$

$$> 0$$

Since $\eta \leq 1, \frac{\partial q}{\partial A^*} > 0$ and $\frac{\partial \gamma}{\partial A^*} > 0$

$$\frac{\partial S}{\partial r^{US}}$$

$$= \frac{(1-q)\gamma^{\eta-1}\left(\mu A^* \frac{\partial q}{\partial r^{US}}\right) - (1+r+\mu A^* q)[(\eta-1)(1-q)\gamma^{\eta-2}\frac{\partial \gamma}{\partial r^{US}} - \gamma^{\eta-1}\frac{\partial q}{\partial r^{US}}]}{[(1-q)\gamma^{\eta-1}]^2}$$

$$- 1$$

$$= \frac{(1-q)\left(\mu A^* \frac{\partial q}{\partial r^{US}}\right) - (1+r+\mu A^* q)\left[(\eta-1)(1-q)\gamma^{-1}\frac{\partial \gamma}{\partial r^{US}} - \frac{\partial q}{\partial r^{US}}\right]}{(1-q)^2\gamma^{\eta-1}} - 1$$

$$> 0$$

Since $\eta \leq 1, \frac{\partial q}{\partial r^{US}} > 0$ and $\frac{\partial \gamma}{\partial r^{US}} > 0$. Furthermore $(1-q)^2\gamma^{\eta-1}$ tends to 0, the first tiem becomes very large, making the last expression larger than 1, establishing the Result II.

Appendix 2.C: Selected studies on sovereign spread

Author (publication date)	Period under study	Sample	Methodology	Main Findings
Edwards (1984)	1976-1980	727 public and publicly guaranteed Eurodollar loans	Panel regression	Spreads are determined by the debt-to-GNP and the debt service rations, as well as by the propensity to invest.
Min (1998)	1991-1995	11 Emerging countries	Panel regression	Spreads are determined by the debt-to-GDP, reserves-to-GDP and debt-service-to exports ratios, as well as by the import-export growth rates, the inflation rate, the net foreign assets, the terms of trade and the real exchange rate.
Eichengreen and Mody (1998)	1991-1996	1,000 developing country bonds	Panel regression	The launch spreads depend on the issue size, the credit rating of the issuer, the debt-to-GDP and the debt-service-to-exports rations.
Arora and Cerisola (2001)	1994-1999	11 Emerging countries	OLS and ARCH methods	Country-specific fundamentals are important in explaining the fluctuations in country risk and domestic interest rate, while the level of US interest rates has a direct positive effect on sovereign bond spreads.
Dungey *et al*. (2004)	Russian crisis; LTCM crisis; Brazilian crisis	9 Emerging countries	SVAR method	The Russian crisis is characterized by a sharp increase in global credit risk, while the relative size of global risk factors is mixed for the Brazilian crisis.

(Continued)

Author (publication date)	**Period under study**	**Sample**	**Methodology**	**Main Findings**
Garcia-Herrero *et al*. (2006)	1994-2003	9 Latin American countries	SVAR method	US growth and interest rates have a direct effect on sovereign spread and an indirect effect on sovereign spread via global risk aversion. Global risk aversion shows a positive and significant relationship with Latin American sovereign spreads.
Weigel and Gemmill (2006)	1994-2001	4 Latin American countries	OLS regression	Credit risk is mainly driven by systematic global and regional factors, implying that credit risk should be treated as non-diversifiable.
Uribe and Yue (2006)	1994-2001	7 emerging countries	Panel VAR method	Sovereign spreads affect aggregate activity; while at the same time responding to domestic macroeconomic fundamentals.
Fracasso (2007)	1995-2004	Brazil	VAR method	The Brazilian series, in particular EMBI spread and external debt, are strongly affected by foreign exogenous innovations.

3 DEBT EQUITY SWAP AND RESTRUCTURING OF SOVEREIGN DEBT UNDER INCENTIVES AND AUSTERITIES

3.1 Introduction

The recent experiences in Europe, and similar incidences in the past occurring at regular intervals[21] overwhelmingly demonstrate the enormous complexities associated with

[21] Like the Argentina's similar experience in the early 2000 or East Asian debt crisis in the 90s or the Mexican Peso problems in the80s and many such events in between serve reminders about regularities of international debt restructuring problems.

the sovereign debt renegotiations, especially when countries are on the brink of default. The current interest in the subject has been triggered by the events in the countries within Eurozone like Italy, Spain and in particular Greece which is facing huge difficulties in dealing with both domestic political turmoil from the imposition of austerity to her citizens and complex debt renegotiations with both new and old creditors.[22]

These examples demonstrate that much of the complexities arise because the process of debt renegotiations often go beyond the jurisdictions of the original creditors and borrowers. This gives rise to conflicts between multiple stakeholders and worsens the already murky financial environment; for example, neither the new creditor nor the borrowing countries' citizens were directly or explicitly involved at the time when the original debt contracts were signed, but both got involved in the contingency of default and renegotiations.

The entry of the new creditor, together with the austerity programme curtailing consumption of citizens of the borrowing countries, could heighten conflicts that could

[22] The Greek sovereign debt problems attracted worldwide attention in May 2010 when the Eurozone countries and IMF offered a bailout program with an infusion of €110 billion. However, debt renegotiations were marred by political turmoil within the country and impasse over seniority between private (old) and Eurozone Government (new) creditors, followed by a second round of restructuring with a buyback of a large portion of the newly exchanged sovereign bond in December 2012, resulting in the new Greek bond being traded between 19 and 34 cents per Euro face value immediately after. See Zettelmeyer, Trebesch and Gulati, 2013 for more detail.

render the problem intractable. The new and old creditors may clash over obtaining the seniority status of the outstanding debt (old plus new) incurred by the sovereign and too much austerity not only foments political troubles but also dampens the incentives of the citizens to work harder to repay the loans in the future.

Although researchers are still trying to discover ways of resolving this impasse, ideas relating to financial restructuring in the form of debt equity swap are gaining traction from both academics and practitioners.[23] This idea of a swap, which converts the foreign bond into domestic equity claims, has been resurrected in the aftermath of problems in Greece (Allen, Eichengreen and Evan, 2014[24]). In this chapter, I explore the effectiveness of debt equity swap to resolve the sovereign debt renegotiation problems in (a) the conflicts between the creditors over status of seniority and (b) the clash of interests between the Government (responsible for repayment) and citizens on the issue of austerity.

The situation I use below is: A current Government in a country has defaulted on the sovereign debt and needs extra funds to invest in new risky but profitable projects

[23] Earlier instances of debt equity swap were Chile retiring debt though swaps in investment in forestry in 1988, The Philippines retiring foreign debt through debt equity swap in four sectors in 1987, Mexico doing similar swaps in the automobile and export sectors in 1987, and Ecuador's swap innovatively involving in the education sector in 1992.

[24] See, ''Free Lunch: A sovereign debt-for-equity swap'' in Financial Times, February 4, 2015 or a related article in the Wall Street Journal ''For Greece, GDP-linked Debt May Be More Curiosity Than Cure'' on the February 3rd, 2015.

to repay both old and new debt. The old creditor faces a severe liquidity problem due to bad exposure of its current loan portfolio. A new creditor can profitably lend to the positive (expected) NPV project but payments to old creditors and consumption of current citizens from the project's cash flow leave a meagre surplus. The Government thus introduces an austerity problem by cutting down on consumption to release the eligible surplus to the creditors. However, apart from the political turmoil, the programme dampens citizens' incentives to work harder and therefore lowers the probability of success of the new project and makes the new loan even riskier, compounding the debt renegotiation problems even further.

Using this scenario I show that a simple debt equity swap in which a voluntary reduction of $1 of debt obligations by the old creditors, matched by an increase of an equivalent amount of stake in equity holding, mitigates both austerity and seniority issues and improves the expected pay-off of all the stakeholders. The reason for this is that the old creditor swaps $1 of debt for an equivalent amount of equity, which leaves her expected pay-off unchanged. However, this voluntary operation automatically enhances the seniority of the new debt as the extra equity (swapped) is by definition junior to all debt. The enhanced priority increases the pay-off of new lenders in the bad

state[25] because they would have first recourse to collaterals posted by the creditor nation and it reduces the riskiness of its loan exposure. Thus the debt equity swap at the margin makes new loans safer, leading to a lower face value and reduced outstanding obligations of the country in the good state, which in turn results in the greater pay-off in the good state and reduces the severity of austerity measures. This surplus available to the defaulting nation at a time of stress increases their incentives to work harder, which make the loan even safer because putting extra effort into the project reduces the probability of failure and avoids default premiums. I show that this is a win-win scenario for everyone when incentive and austerity problems, together with seniority issues of loan, create a hurdle to sovereign debt renegotiations.

Unlike other papers that discuss debt forgiveness, or buybacks, or some combination of the two as a tool for resolving sovereign debt, (e.g. Boot and Kanatas, 1995; Despande, 1997; Diwan and Spiegel, 1994; Fernandez-Ruiz, 1996; Prokop, 2012; etc.)[26] I focus exclusively on financial restructuring of sovereign debt in the form of the debt equity swap engineered by the original creditors. Although the introduction of

[25] In good states all investors are paid off their full dues. Hence, seniority does not matter. However, in bad states, when the total cash flow is not enough to pay dues to all creditors, the structure of seniority determines the magnitude of each party as the junior creditor is paid after the senior creditors are paid in full first.

[26] See also earlier papers on the subject, such as, Froot, Scharfstein and Stein (1989), Krugman (1989), Krugman (1988).

debt equity swap is neither new in practice[27] nor novel in academic literature, my approach sheds new light on this problem, which is gaining increasing levels of attention in the context of the Eurozone and especially in the context of Greek debt crisis.[28] My primary contribution is that unlike other approaches reviewed below, I bring the roles of debt and equity from the fundamental principles of finance differentiating these two financial claims on the basis of their priorities in claims to cash flow (debt with first bite to claims followed by equity) and apply in an international setting of austerity and dampened incentives for citizens. I show that in this scenario a pure conversion of old debt to equity unambiguously improves the value for everyone and is thus a Pareto improvement. Thus my approach is built on theories of multiple debt structure (Rajan, 1992; Rajan and Winton, 1996; Hackbarth *et.al*., 2007) and it shows how transformation of a part of financial claims from debt into equity creates value via its effects on incentives. In contrast, the extant literature on debt equity swap discusses the risk sharing or inefficient investment due debt overhang or secondary market expectations (Bow and Dean, 1993; Goldberg and Spiegel, 1992; Helpman, 1989). A major difference with this chapter is also while these papers show debt equity

[27] See, Borensztein and Mauro (2002) and Miyajima, Ken (2006) for IMF study on implementing such swaps in practice.

[28] Empirical study by Barr, Bush and Pienkowski (2014) on the welfare issues of GDP linked financial assets also confirm our findings.

swap partially Pareto improving under some conditions, I show that the full debt equity swap is the optimal arrangement when the borrowing country's incentives and the issue of seniority among existing creditors play a role.[29]

Since the crucial part of a successful debt equity swap is giving seniority to the new lender, I further examine the effect of debt exchange where the old creditor exchanges its existing debt for an equivalent amount of new junior debt; this in turn makes the new lender the senior creditor. My results show that debt exchange has the same effect as debt equity swap, thus debt exchange is Pareto improving.

The rest of the chapter is going to be structured as follows. Section 3.2 reviews the literature. Section 3.3 demonstrates the information structure and the benchmark model. Section 3.4 analyses the bailout package including new loan and extension of maturity. Section 3.5 analyses debt equity swap. Section 3.6 analyses debt exchange and section 3.7 concludes.

3.2 Literature Review

There are mainly two tranches of sovereign debt restructuring literature: 1) Different sovereign debt restructuring strategies (Krugman, 1989; Helpman, 1989; Saravia, 2010); 2) Coordination problem resolution; including creditor coordination

[29] Our paper also differs with others which discuss the seniority of creditors but ignores the incentive or the austerity issues of the sovereign. See Bolton and Jeanne (2009) and Saravia (2010).

and creditor-debtor coordination (Pitchford and Wright, 2011; Bai and Zhang, 2012; Bi, Chamon and Zettelmeyer, 2011; Trebesch, 2008; Engelen and Lambsdorff, 2009; Haldane, 2005).

Since this study focuses on debt restructuring strategies under moral hazard conditions, the literature review will be focused on the first tranche. Krugman (1988) showed the effect of debt overhang on investment incentives. When the debt is sufficiently large, the debtor country is reluctant to work hard since most of the future income goes to the creditor, thus he proved that a severe enough debt overhang may enable creditors to raise expected debt repayments simply by forgiving a portion of the debt. He further showed the trade-off between debt forgiveness and concerted lending, where the new money lent to the debtor is from the existing creditor. Concerted lending would give the creditor an option to share in the future outcomes if the outcome is relatively good, whereas a large amount of debt would distort the country's incentive to work hard. He concluded that the trade-off could be improved by linking the payment to the states of nature that the country cannot control, such as oil prices and world interest rates. By this kind of debt arrangement, moral hazard problem could be ruled out. Since the debt payment is linked to the state of nature, this kind of debt arrangement is also called debt indexation.

While Krugman (1988) proved that indexation of the debt payment to exogenous variables could rule out the moral hazard problem, Froot, Scharfstein and Stein (1989)

showed that indexation of the debt payment to endogenous variables such as output may be desirable when there is asymmetric information about some attributes of the country, in particular, when debtors know more about their willingness to invest than lenders.

Fernandez-Ruiz (1996) developed a dynamic model and showed that the debt forgiveness argument is strengthened when incentive problems are considered in a multi-period context. Deshpande (1997) empirically examined the debt overhang effect for 13 severely indebted countries and his results showed that the debt overhang theory is valid: external debt is found to exercise a negative influence on the investment ratio. Prokop (2012) used a game theory approach to analyse bargaining over debt rescheduling between debtor and creditor in the case of debt overhang. When the bargaining power lies with both creditor and debtor, he concluded that debt rescheduling is better for both debtor and creditor when compared with the case of borrower bankruptcy. In particular, the creditor forgives part of the debt and the debtor provides the reduced payment, this provides the same conclusion as Krugman (1988).

Other strategies which are widely analysed in the literature are market-based debt reduction schemes, which include debt buybacks, debt equity swap and issuing new bonds with seniority. Krugman (1989) used some numerical examples to examine several market-based debt reduction strategies, including concerted lending, debt forgiveness, debt buyback, debt equity swap and seniority of new bond. He concluded

that all these debt restructuring strategies would only be beneficial for both creditor and debtor if the debt is sufficiently large. In a debt overhang framework similar to that of Krugman (1988), Froot (1989) compared a market based debt reduction scheme with pure debt forgiveness. He confirmed the result of Krugman (1989 that market-based debt reduction only works if there is a debt overhang effect. He further showed the difference between pure debt forgiveness and market-based debt reduction, in particular, debt buybacks. The differences come from two sources. First, the sources of funding that are used for debt buybacks is crucial for the investment incentive effect. If the fund comes from foreign aid or the issuing of new senior debt against the future cash flows, debt buybacks are Pareto improving. On the other hand, if the fund comes from the current endowment such as reserve, debt buybacks might be worse off for the debtor country and thus reduce investment. Second, the amount of market based debt reduction scheme is chosen by the debtor country, whereas the amount of debt forgiveness is chosen by the creditor. Bulow and Rogoff (1988), on the other hand, have argued strongly against debt buybacks, since the transactions would only benefit the creditors: the debtor repurchases their debts at their post-buyback prices, which have already reflected all the efficiency gains from the debt reduction. But their conclusion is based on the assumption that the fund for debt repurchase comes from the debtor country's reserve. They further showed that if the debtor country could issue a new senior bond

and use the proceeds to repurchase the existing debt, debt buybacks might desirable for the debtor country. These conclusions are in line with Froot (1989).

The following studies showed how debt buybacks could be useful under a different asymmetric information environments. Cohen and Verdier (1995) proved that debt buyback may become a profitable investment if the debtor countries can undertake them secretly; but they assume that the banks cannot discriminate between intra-bank transactions and buybacks by the debtor country himself. Acharya and Diwan (1993), Marchesi and Thomas (1999) and Fernandez-Ruiz (2000) showed that when the willingness to undertake sound economic reforms is private knowledge, debt buyback could be used as signalling and that only countries that can pay the price of buyback could receive debt reduction. Cabral (1996) proved that buyback could be in the interest of the debtor if there is an alternative asset other than domestic investment. By assuming that the alternative asset is safe and unseizable by the creditor in the case of default, debt overhang would result an inefficient in investment allocation since more money is invested in the safe asset, thus there is efficiency gain of investment allocation by retiring part of the debt.

Most relevant to my study is the literature regarding debt equity swap and the seniority of the new lending. Debt equity swap is a process of exchanging foreign currency denominated debt into the domestic currency, and that domestic currency has to be invested in the domestic capital market or domestic firm's equity. Helpman (1989)

proved that there exist small Pareto improving debt equity swaps under the assumption of a risk averse debtor. He also showed that debt equity swap does not always increase the level of investment; in particular, investment could decrease if there is a higher demand for equity from the creditors. Goldberg and Spiegel (1992) modified the model of Helpman (1989) with an inclusion of a safe sector which is not exposed to seizure. When there is debt overhang, domestic agents tend to invest more in the safe sector, which in turn results in an inefficient investment allocation. They proved that debt equity swap could be a Pareto improving transaction, because more capital will flow from a safe sector to one exposed to seizure and result in a more efficient investment allocation. Bowe and Dean (1993) modified the model of Helpman (1989) in two ways. Firstly, they assumed debt is senior to equity, while Helpman's model implicitly assumed equity is more senior to debt because foreign creditors could only extract payment from a debtor government that received tax from domestic agents, so the equity of the domestic agent always gets paid first. Secondly, they assumed that the debtor is an indebted representative agent, making all investment decisions in the interest of debtor country residents, which in turn means that the tax rate is 100% and the residual after-debt repayment is redistributed to the debtor country residents. They argued that debt equity swap can be mutually beneficial both for debtors and creditors, as long as the amount the equity was swapped within a range for a given amount of debt. They also showed that investment incentive always increases with debt equity

swap and their results did not depend on the assumption of a risk averse debtor. Debt exchange is a process whereby the old creditor exchanges its existing debt into a new junior debt. Bolton and Jeanne (2009) claimed that if the late lender can always be senior to the early lender, this would lead to a Pareto improvement. Saravia (2010) found that by giving seniority to the new lender, the borrower country was always better off, since it provides cheaper funds, while the existing lender might be better or worse off, depending on the size of the economic shock.

Since the Brady Plan, a package of several different restructuring strategies, was regarded as success in the 1990s, other research has been done on menu deals, packing several strategies and the role of seniority. Diwan and Spiegel (1994) suggested that menu deals are likely to denominate market buybacks and pure concerted relending agreements with heterogeneous creditors, since banks differ widely in their valuation of claims on the debtor. Many deals mean that the debtor provides a menu of options for debt restructuring and the creditor can choose from those options. Boot and Kanatas (1995) showed that if a package consists of debt forgiveness, new money and sovereign precommitment of production, this Pareto dominates pure debt relief under symmetric information.

3.3 Basic Model

The basic set up below describes a situation where a country has currently defaulted on sovereign debt. It has, however, a project which generates a stochastic but positive NPV

in the future provided that (a) the country's citizens make an appropriate level of effort towards its success, and (b) the country can secure a fund to finance the project. Neither the country nor the old creditor has sufficient funds to execute the project. Successful debt renegotiations thus would require agreements between the old and new creditors and the country on a *bailout package* which stipulates an infusion of funds by parties, together with a payment contingent on the project's cash flows. I explain below the basic ingredients of debt renegotiations consisting of (a) a time line, (b) contents of the bailout package, and (c) the expected pay-off for all stakeholders.

3.3.1 The Borrowing country: Preference and Technology

The country used in the example has a small open economy and cannot affect the world interest rate, which is determined outside her domain of influence. The economy lives for two periods and a large number of identical individuals reside in it. The representative agent is assumed to be risk neutral[30] and her utility or pay-off function is given by:

$$U(C) = C_1 + C_2 - m(e) \qquad (3.1)$$

Where C_1 and C_2 denote the first and second periods of consumption respectively and $m(e)$ is the costs of effort (e). The country has defaulted on its payments to

[30] The agents are assumed to be risk neutral in the set up because the purpose of the paper is to highlight the incentive and efficiency issues of debt restructuring and thus puts aside the aspects of risk sharing arrangements relevant when agents are risk averse.

international creditors and thus inherited an old debt D that needs to be repaid in the second period.[31] The country has an exogenously given current endowment Y_1, which must be divided between current consumption C_1 and investment in a risky project which will yield cash flow in period 2. Hence, the current period consumption is governed by the following resource constraint: $C_1 = Y_1 - W$, where W is the amount of resource that the Government commits for future investment via taxes or by other means of her sovereign power.

The risky project in the next period that requires a fixed investment (k) in the current period. The project yields an uncertain outcome in the second period:

$$Y = \begin{cases} \theta_g, & with\ probability\ e \\ \theta_b, & with\ probability\ 1-e \end{cases}$$

Where Y is the output in period 2, e is the effort made by the citizens of the country and $0 < e < 1$. The cost of incurring effort is $m(e)$. I assume that $\theta_g > \theta_b$ and e is continuous. $m(e)$ is a convex function with $m(0) = 0$ and $m(1) = +\infty$. Simplifying the problem, I assume that the cost of effort is a quadratic function as with $m > 0$:

$$m(e) = 0.5me^2 \qquad (3.2)$$

[31] Alternatively, we could incorporate a debt rescheduling program in a way that determines the amount paid at each date. This would not affect any of the results derived in the paper.

Two important points should be noted: 1. The technology requires both the effort of the country's citizens and investment into the project; the greater the effort (e), the higher the probability of success. 2. The amount that the Government puts up for financing the investment of the risky project (W) and the effort levels are endogenous and they depend on the particular type of bailout schemes and strategies which will be the focus of the chapter.

The technology described above is risky because it fails to pay the creditors' dues in the bad state, but its expected NPV is positive; that is, it has a net expected value of output $e\theta_g + (1-e)\theta_b - rk > 0$ and $\theta_b < D < \theta_g$. Moreover, the current resources available in the country are neither enough for repayment of the past debt (D), nor is sufficient to undertake this new investment. The following assumptions clarify the setting of the debt renegotiation process, explaining why the involvement of a third party (a new creditor) is indispensable to the debt renegotiation process:

(a) $\theta_g > D > max.[Y_1, \theta_b]$. The current debt can be paid in full only when the risky project is successful. Neither the size of the cash flow in the bad state nor the current output is enough to repay the old debt.

(b) The existing creditors cannot raise sufficient finance to fund the risky investment project due to liquidity crunch and higher costs of financing due to its exposures on bad loans.[32]

Both conditions (a) and (b) imply that the borrowing country can undertake a positive NPV project only when it can be funded at least partially by a third party lender with lower costs of financing.[33] Thus the country has to borrow an additional amount of $k - W$ in the first period from the new lender while she contributes W on her own to finance investment. The country's ability to finance the project depends partly on the austerity programme (which resists any move to cut current consumption, an issue I will return to later) and the new creditor's willingness to join would depend on the terms of the loan contracts offered.

The timeline for the debt renegotiations is described as follows:

1. At the end of period 1, the country puts forward W for investment into the project and the new lender puts forward $k - W$.

32 That is, $eD + (1 - e\theta_b) - k(1 + r_o) < 0$ where (r_o) is the cost of capital for the old creditor.

33 The crux of the sovereign debt problem is the inability of the current lender to provide extra financing to the debt ridden country. Had she been able to, the problem of renegotiation of a new loan would have been relatively easier.

2. At the beginning of period 2, the debt renegotiations take place and the state contingent payments to both new and old creditors in both high and low states are explicitly written. The country now also decides to exert a level of effort.

3. At the end of the second period, uncertainties are resolved, cash flows are realized and all stakeholders receive contingent payments according to the contracts drawn in the earlier phase.

Date 1	Date 2	Date 3
Country puts in W and borrows $k-W$ from the new creditor and invests in the project	Debt renegotiation takes place and the country exerts a level of effort	Cash flows are realized and debts are repaid

3.3.2 Contractual agreement between Creditors and the Borrowing country:

I begin now with the second part of the time line where the country issues a state-contingent security to the new creditor which promises to pay Z_g in the event that the project yields a good outcome and Z_b in the event of a bad outcome in return of the fund $(k-W)$ advanced by her. The security must offer the new creditor the market rate of return r, so that

$$eZ_g + (1-e)Z_b = r(k-W) \tag{3.3}$$

Where r is the world risk free interest rate.

One can interpret Z_g as the face value of the new loan if the output is θ_g. The country also repays the old debt D in this scenario. However, in the event of a bad outcome $\theta_b < D + k - W$, the country defaults again as does not have enough to repay either the new loan or old the debt in full. The seniority of the debt structure agreed today in the debt renegotiation between the old and new creditors determines their respective pay-offs in the event of a bad outcome. To simplify the problem, I assume that in the case of default the output is distributed proportionally between the two creditors. The old creditor receives $(1-\alpha)\theta_b$ and the new creditor gets[34] $\alpha\theta_b$, where $\alpha = \frac{k-W}{k-W+D}$; thus equation (3.3) which captures the new creditor's zero profit condition can be written as:

$$eZ_g + (1-e)\alpha\theta_b = r(k-W) \tag{3.4}$$

Since the representative agent defaulted in the bad event, her expected second period net pay-off is given by:

$$V \equiv E\{C_2\} - m(e) = e\big(\theta_g - Z_g - D\big) - 0.5me^2 \tag{3.5}$$

[34] The structure of seniority, as we will see later, is endogenized in the section we discuss the debt equity swap.

Where the first term on the right represents the expected return on the project and the second term represents the cost of putting in effort.

3.3.3 Structure of Information and control:

The information structure surrounding the debt renegotiation process determines the contents of the bailout package, outlining especially what elements are not under its purview. The level of effort expended by the country on the new project, which determines the probability of success of the project, can neither be observed nor controlled by an outside lender and is therefore excluded from the package which contains the amount of the external fund, the face value of the loan, the priority structure of loan and the degree of debt equity swaps. There are two bailout packages; one with contingent contracts on the new loan and rollover of the old debt and one with the same properties but with an addition of debt equity swap.

Each bailout package maximizes the borrowing country's expected pay-off, subject to: (a) new creditors breaking even, (b) old creditors maintain the status quo, and (c) incentive constraints on the borrowing country's effort level gets satisfied. My purpose is to find out which of the above schemes yields a better outcome for both creditors and the country in resolving austerity and seniority problems.

3.3.4 Benchmark case:

Before I analyze the bailout packages with severe financial and incentive constraints, I will first sketch out the solution without their presence. If the old creditor has her own

fund or could raise the finance from the inter-bank loan market then the problem of seniority would disappear because she is the only creditor and her zero profit condition would be: $eZ_g + (1-e)\alpha\theta_b - r(k-W) - D = 0$. Moreover, without the incentive issues in effect, the maximization program of the underlying debt renegotiation consists of the borrowing country's pay-off subject to the zero profit condition of the creditor. This can be written as:

$$\max_{Z_g,e} \; e\left(\theta_g - Z_g\right) - 0.5me^2$$

Subject to: $eZ_g + (1-e)\alpha\theta_b - r(k-W) - D = 0$ (ZP)

Inserting eZ_g from (ZP) above into the objective function and taking the first order condition with respect to e would give rise to:

$$e^F = \frac{\theta_g - \theta_b}{m} \tag{3.6}$$

Where e^F stands for effort in the frictionless conditions and the resulting optimal expected pay-off of the country is:

$$V^f \equiv E\{C_2^f\} - m(e^f) = e^f\left(\theta_g - \theta_b\right) + \theta_b - 0.5m(e^f)^2$$
$$= \theta_b + 0.5(\frac{\theta_g - \theta_b}{m})^2 - r(k-W) - D$$

Hence, the utility of the country at the beginning of period 1 is:

$$U(C^f) \equiv C_1 + E\{C_2^f\} - m(e^f) = Y_1 - W + \theta_b + 0.5(\frac{\theta_g - \theta_b}{m})^2 - r(k-W) - D$$

Differentiating $U(C^f)$ with respect to W establishes the condition $r - 1 \leq 0$ which determines whether or not the country will put forward any current resources for

investment. If negative, the country will borrow the entire amount, and if positive she will finance the entire investment internally.

3.4 Bailout package

3.4.1 Bailout package I: Infusion of new loan and maturity extension of the old debt.

This section explores a bailout package which consists of fresh loans to the country by the new creditor and a contingent payment structure along with the extension of maturity of the old debt offered to the country when the old creditor suffers from a credit shortage and the incentive and austerity issues plague the sovereign. Thus, I introduce three frictions into the basic model: 1. For every dollar invested for the project the country incurs an additional cost (μ) associated with the austerity programme that curtails current consumption.[35] 2. The old creditor is unable to raise finance on its own and the new lender is advancing the fund $k - W$ to the country with a mutually agreed priority structure elaborated in section 3.3.2. 3. Finally, the effort put by the country belongs to her private domain which neither old nor new creditors can control, but try to influence via bailout packages which are explained as follows:

[35] Recent political unrest and turbulence surrounding austerity program suggest that maximum amount of investment out of current resources is limited.

A bailout package consists of a fresh loan $k - W$ from the new creditors, advanced in period 1, and an output contingent payment contract $\{Z_g, Z_b\}, D$ to new and old creditors respectively with the extension of maturity of the old debt by one more period. I solve the problem of designing the bailout package in two steps. First, I find out the equilibrium $\{Z_g, Z_b\}$ and e in period 2. Then I fold back the solutions into optimal pay-off functions for the country to determine whether there is an incentive for the country to make a contribution to financing of the project.

Hence, a representative citizen, for a given bailout package, will exert an effort e to maximise her expected pay-off in the second period given by (3.5). Hence, any optimal bailout package must be such satisfy the following incentive compatible condition:

$$e \in argmax\{e(\theta_g - Z_g - D) - 0.5me^2\}$$

By the first-order condition, the agent will choose e to satisfy the following constraint:

$$\theta_g - Z_g - D = me \qquad \text{(IC)}$$

This constraint, known as the incentive compatibility condition (IC), plays a key role in determining the effort put in and the probability of a successful outcome (and

thus the riskiness of the new loan) and it depends on austerity (W) as well as past debt (D) and the priority structure[36] of the debt.

In addition, the optimal bailout package must ensure the break-even condition for the new lenders. Hence, in the scenario where the old creditor extends the maturity of past loans by one period, along with the equal seniority, the optimal bailout package maximizes the borrowing country's utility, subject both to a zero profit (ZP) constraint for the new lender and incentive compatibility (IC) conditions for the borrower. The resulting optimal program is therefore given by:

$$\max_{Z_g,e} e\left(\theta_g - Z_g - D\right) - 0.5me^2$$

$$\text{Subject to: } eZ_g + (1-e)\alpha\theta_b - r(k-W) = 0 \qquad \text{(ZP)}$$

$$\theta_g - Z_g - D = me \qquad \text{(IC)}$$

In the Appendix 3.A I carry out the solution and show that both (ZP) and (IC) constraints are binding at the optimum. Thus the optimal effort e and the face value of the new creditor's loan Z_g, are determined by the zero profit and incentive compatibility conditions. Figure 3.1 presents the solution. The curve IC presents a combination of Z_g and e such that the IC condition is satisfied and the curve ZP shows the combination of the same variables for which the zero profit condition of the new

[36] The maximum pledgible wealth or priority structure of debt affects the choice of effort via their impact on (ZP)

lenders is satisfied. In Appendix 3.A I show that the optimal payments to new lenders in the good state and the effort levels exerted by the borrower are determined by their point of intersection.

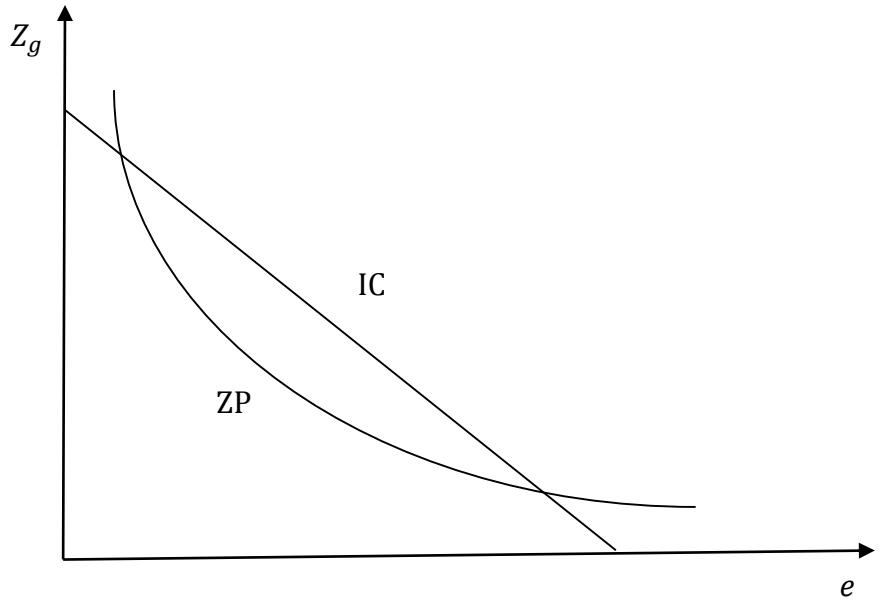

Figure 3.1 Good state contingent payments and effect levels

Given D, I can plug the optimal values of Z_g^* and e^* in the borrowing country's objective function to derive her maximum expected pay-off from the bailout package consisting of new financing and the extension of the old debt's maturity. The following propositions describe the optimal pay-off for all parties adhering to the scheme described above.

Proposition 1(i): The optimal effort level and the payment to the new creditor in the good states are given by:

$\boldsymbol{e^* = \frac{A+\sqrt{A^2-4m[r(k-W)-\alpha\theta_b]}}{2m}}$ **and** $\boldsymbol{Z_g^* = \frac{A-\sqrt{A^2-4m[r(k-W)-\alpha\theta_b]}}{2}}$ **and** $\boldsymbol{A \equiv \theta_g - D - \alpha\theta_b}$

(ii) The optimal effort e^* in the bailout case with friction is smaller than the same without any friction, given by e^F.

(iii) The optimal second period pay-off for the borrowing country and the old creditor are given by: $E\{C_2^*\} = e^*\left(\theta_g - Z_g^* - D - 0.5me^{*2}\right) = \frac{1}{2}m(e^*)^2$ and e^*D respectively where e^* is given proposition 1(i).

Proof of (i) and (iii) are presented in Appendix 3.A, and part (ii) is shown below.

Proof of (ii), the optimal value of effort without friction is e^F given by (3.6) and this shows that the incentive constraint will bind together with the zero profit condition; hence, $e^F = \frac{\theta_g-\theta_b}{m} > e^* = \frac{\theta_g-Z_g^*-D}{m}$. The last inequality follows because the total volume of debt is risky. Thus $\theta_g < Z_g^* - D$. *QED.*

Now I fold back the results into the inter-temporal expected pay-off function of the country so that it reflects the optimum solution derived in proposition 2. This optimum pay-off function of the country depends on the amount of resource that it puts into the package:

$$V(W) = Y - W\mu + E\{C_2^*\} - 0.5me^{*2}(W) = Y - W\mu + 0.5me^{*2}(W)$$

The first two terms represent current consumption with $\mu > 1$ reflecting the costs of austerity in the sense that every $ unit of consumption sacrificed today for investment

leads to political discontent and imposes extra cost on the economy. On the other hand, the third term contains the expected optimum pay-off to the borrowing country from the debt renegotiations captured in proposition 1, and depends on W.

Proposition 2, which is proven in Appendix 3.B, summarizes the condition under which the country will share the costs of funding the project with the new creditor.

Proposition 2: If $\left[-\mu + me^* \frac{de^*}{dW}\right]|_{W=0} > 0$ then the country advances an amount of resources $W = \widetilde{W}$ and $k - \widetilde{W}$ is given by the new lender. Otherwise, the country asks for full external financing for investment.

Propositions 1 and 2 together summarize the debt renegotiations under incentive and seniority issues where the old creditors simply extend the maturity of their loans and let the new creditor and the country negotiate the terms of financial contracts optimally. In the next section, I discuss whether the introduction of debt equity swap can improve matters for both the old creditor and the borrowing country while the new creditors earn the same return r. I also deal with the question of whether the swap is Pareto improving and thus an agreeable solution to all parties.

3.4.2 Comparative Static

The following comparative static, which are proven in Appendix 3.C, are useful in the analysis below.

Proposition 3: Under asymmetric information:

i) keep θ_g, θ_b, W and D unchanged. Under higher world interest rates the borrower makes a lower effort e and a higher good state-contingent payment Z_g.

ii) keep θ_g, θ_b, r and W unchanged. With a higher inherited debt level D, the borrower makes a lower effort and a higher good state-contingent payment Z_g.

The first part of the proposition characterizes the effect of the world risk free interest on the effort level and the face value of the new loan. The second part of the proposition characterizes the effect of inherited debt level on the effort level and the face value of the new loan. Under symmetric information, a change in the world risk free interest rate and inherited debt level does not affect the effort level and only has a direct effect on the face value of the new loan. When the effort is unobservable to the creditors, an increase in the world risk free interest rate and an increase in the inherited debt level could reduce the level of effort. Not only the changes of risk free interest rate and changes of inherited debt level have direct effect on the face value of the new loan though, there is also an indirect effect through the effort level because a decrease in the level of effort pushes the face value of the new bond even higher.

Under symmetric information, the world risk free interest rate and the debt level have no effect on the level of effort, but when the effort is unobservable, a higher world risk free interest rate and a higher debt level would distort incentives.

3.5 Debt Equity Swap

The proposed debt equity swap offers a new contract between the old creditor and the rest of the stakeholders in which the former gives up claims in the form of debt in exchange for an equivalent amount of equity and is therefore no worse off. Essentially, the old creditor gives up her claim of priority to the new lender in the bad state (when there is not enough to pay everyone) and is compensated by an additional amount in the good state.

The timeline for the debt equity swap is described as follows:

1. At the end of the period 1, the country puts forward W for investment into the project and the new lenders put in $k - W$.

2. At the beginning of the period 2, the debt equity swap takes place, the old creditor exchanges Δ amount of debt for t% of equity, and the state contingent payment for the new creditor and the rest of the old creditor's debt claim are explicitly written. The country also decides to exert a level of effort at the start of this period.

3. At the end of the second period, uncertainties are resolved, cash flows are realized and all stakeholders receive contingent payments according to the contracts drawn at the beginning of the period.

Date 1	Date 2	Date 3
Country puts in W and borrows $k - W$ from the new creditor and invests in the project	Debt equity swap takes place and the country exerts a level of effort	Cash flows are realized and debts are repaid

The reshuffling of financial claims induced by the debt equity swap and the corresponding pay-off structure to all stakeholders are presented in Table 3.1. The upper section presents the pay-off to individual stakeholders before the swap, and the lower section presents the same afterwards. The purpose is to establish the feasibility of the swap scheme and to ensure that the cash flow available in each state is equal to the sum of the pay-offs to all parties in that scenario:

<Insert Table 3.1 about here>

Suppose the old creditor exchanges Δ amount of debt for $t\%$ of equity, then the lower part of the payoff table can be read as follows: In the good state, the old creditor now has two components: 1. Debt claims which are equal to $D - \Delta$, and 2. an equity claim of $t(\theta_g - Z_g - D + \Delta)$, which is the residual claim shared with the borrower after she gets her dues from the remainder of the debt claim once the new creditors are paid in full. The borrowing country's pay-off in the good state is $(1-t)(\theta_g - Z_g - D + \Delta)$ and the sums of all pay-offs are equal to θ_g.

The second requirement for a successful debt equity swap is that the ex-ante expected pay-off to the old creditors from the swap must be equal to the status quo, which is the expected pay-off without the swap.

From the upper deck of the table, I can calculate the expected value of the creditors' pay-off without the swap to be $eD + (1-e)(1-\alpha)\theta_b$, where $\alpha = \frac{k-W}{k-W+D}$. After the

debt equity swap, the old creditor's expected payoff is $e(D-\Delta)+(1-e)(1-\beta)\theta_b + et(\theta_g - Z_g - D + \Delta$, where $\beta = \frac{k-W}{k-W+D-\Delta}$.

The required indifference condition for the old creditor is therefore:

$$eD + (1-e)(1-\alpha)\theta_b = e(D-\Delta) + (1-e)(1-)\theta_b + et(\theta_g - Z_g - D + \Delta)$$

The left side is the old creditor's expected pay-off without the swap. Rearranging the above expression, I find that the relationship between t, e and Δ has to satisfy:

$$t = \frac{e\Delta - (1-e)(\alpha-\beta)\theta_b}{e(\theta_g - Z_g - D + \Delta)} \tag{3.7}$$

The borrower's expected second period net pay-off after swap becomes:

$$E\{C_2\} - 0.5me^2 = e(1-t)\big(\theta_g - Z_g - D + \Delta\big) - 0.5me^2$$

Substituting t from the equation (3.7) in the borrowing country's expected pay-off, I get the incentive compatibility condition for effort, which can be written as:

$$e \in arg\,max\, E\{C_2\} = e\big(\theta_g - Z_g - D\big) + (1-e)(\alpha-\beta)\theta_b - 0.5me^2$$

The relevant first-order condition for putting in effort then becomes:

$$\big(\theta_g - Z_g - D\big) - (\alpha-\beta)\theta_b = me$$

On the other hand, the new lender's zero profit condition is:

$$eZ_g + (1-e)\beta\theta_b = r(k-W) \text{ where } \beta = \frac{k-W}{k-W+D-\Delta}$$

The maximisation problem for the borrowing country in the debt equity swap is:

$$\max_{Z_g,e}\ e\big(\theta_g - Z_g - D\big) + (1-e)(\alpha-\beta)\theta_b - 0.5me^2$$

Subject to: $eZ_g + (1-e)\beta\theta_b - r(k-W) = 0$ (ZP)

$$(\theta_g - Z_g - D) - (\alpha - \beta)\theta_b = me \quad \text{(IC)}$$

The solution shows that shows that both (ZP) and (IC) are binding;[37] Proposition 4 below sums up the optimal effort by the country and the good state contingent payment to new creditors under debt equity swap. Effort e is higher and the good state-contingent payment is lower after the debt equity swap.

Proposition 4(i): The optimal effort level and the payment to the new creditor in the good states under debt equity swap for a given value of Δ are:

$\boldsymbol{e^{**} = \frac{A+\sqrt{A^2-4m[r(k-W)-\beta\theta_b]}}{2m}}$ **and** $\boldsymbol{Z_g^{**} = \frac{A-\sqrt{A^2-4m[r(k-W)-\beta\theta_b]}}{2}}$ **and** $\boldsymbol{A \equiv \theta_g - D - \alpha\theta_b}$

(ii) The debt equity swap increases the optimal effort by the borrowing country, which also makes a lower contingent payment in the good state compared to the case without the swap.

Propositions 4(i) and 4(ii) show that a small debt equity swap improves the effort incentives and reduces the payments to the new creditor in the good state of nature, which ought to preserve incentives for the borrowing countries. However, the most important question is how the incentives and payments vary with the size of the swap

[37]See the Appendix 3.D for details

and what is the welfare implication of a larger debt equity swap for the borrowing country? Propositions 5 and 6 below show that debt equity swap unambiguously improves issues incentives, pay-off and the welfare of the borrowing country.

Proposition 5: When the debt is exchanged for equity, the cost of the new financing will be lower and the effort will be higher, in line with the increase of the size of the swap. (i) $\frac{\partial Z_g}{\partial \Delta} < 0$, (ii) $\frac{\partial e}{\partial \Delta} > 0$.

Proposition 6: The borrowing country's expected welfare, as measured by its pay-off, increases with the size of the swap.

For proof of the propositions 5 and 6, please see Appendix 3.E and Appendix 3.F.

For debt equity swap to be Pareto improving, one has to show that no pay-offs to stakeholders decline and for some there is a positive gain. I have already shown that the borrowing country benefits as it decreases the austerity problem $(\frac{\partial Z_g}{\partial \Delta} < 0)$, resulting in increased levels of consumption in the near future and the new lenders earning the market return (r) on their financing $(k - W)$ of the risky project. The fall in the face value is exactly compensated for by the increment in their pay-off in the bad state induced by the swap $(\beta'_\Delta = \frac{k-W}{(k-W+D-\Delta)^2})$, and with the increased likelihood of the good state $\frac{\partial e}{\partial \Delta} > 0$. Next, I calculate the old creditor's expected pay-off from the swap.

If the old creditor decides to exchange Δ amount of debt for t% of output, her expected payoff is:

$$P_R = e(D - \Delta) + (1 - e)(1 - \beta)\theta_b + et(\theta_g - Z_g - D + \Delta)$$

Substituting t into the payoff equation:

$$P_R = e[D - (1 - \alpha)\theta_b] + (1 - \alpha)\theta_b \quad (3.8)$$

$\frac{\partial P_R}{\partial \Delta} = \frac{\partial e}{\partial \Delta}[D - (1 - \alpha)\theta_b] > 0$ since $\frac{\partial e}{\partial \Delta} > 0$

Thus the result is that full debt equity swap is agreeable to all parties.

3.6 Role of seniority of new creditor

In this section, I consider the case that the old creditor is offered a new junior bond with a new face value; this in turn makes the new creditor senior. The proposed debt exchange offers a new contract between the old creditor and the rest of the stakeholders in which the former gives up the seniority of their claims for an equivalent amount of new junior debt so that she is not worse off. Essentially, the old creditor gives up her claim of priority to the new lender in the bad state and is compensated by an additional amount in the good state.

The timeline for the debt equity swap is described as follows:

1. At the end of the period 1, the country puts forward W for investment into the project and the new lenders put in $k - W$.

2. In the beginning of the period 2, the debt exchange takes place, the old creditor exchanges its existing debt D for a new junior debt with a face value of D_N, and the

state contingent payment for the new creditor is explicitly written. The country also decides to exert a level of effort.

3. At the end of the second period, uncertainties are resolved, cash flows are realized and all stakeholders receive contingent payments according to the contracts drawn in the earlier phase.

Date 1	Date 2	Date 3
Country puts in W and borrows $k-W$ from the new creditor and invests in the project	Debt exchange takes place and the country exerts a level of effort	Cash flows are realized and debts are repaid

The reshuffling of financial claims induced by the debt equity swap and the corresponding pay-off structure to all stakeholders are presented in Table 3.2. The upper section presents the pay-off to individual stakeholders before the swap and the lower section presents the same afterwards. The purpose is to establish the feasibility of the swap scheme ensuring the cash flow available in each state is equal to the sum of the pay-offs to all parties:

<Insert Table 3.2 about here>

Supposing the old creditor exchanges the existing debt D for a new junior debt with face value of D_N, then the lower part of the payoff table can be read as being: in the good state, the old creditor gets the face value of the new junior bond D_N. The

borrowing country's pay-off in the good state is $(\theta_g - Z_g - D_N)$ and the sum of all pay-offs is equal to θ_g. In the bad state, the old creditor gets nothing since the new lender is more senior.

The second requirement for a successful debt exchange is that the ex-ante expected pay-off to the old creditors from the exchange must be equal to the status quo, which is the expected pay-off without the exchange.

From the upper section of the table, I can calculate the expected value of the creditors' pay-off without the exchange to be $eD + (1-e)(1-\alpha)\theta_b$, where $\alpha = \frac{k-W}{k-W+D}$. After the debt exchange, the old creditor's expected pay-off is eD_N.

The required indifference condition for the old creditor between the new seniority status and the status quo is thus:

$$eD + (1-e)(1-\alpha)\theta_b = eD_N$$

The left side is the old creditor's pay-off without the debt exchange. Rearranging the above expression, I find that D_N has to satisfy:

$$D_N = \frac{eD + (1-e)(1-\alpha)\theta_b}{e} \tag{3.9}$$

The borrower's expected second period net pay-off after the debt exchange then becomes:

$$E\{C_2\} - 0.5me^2 = e\left(\theta_g - Z_g - D_N\right) - 0.5me^2$$

Substituting D_N from the equation (3.9) in the borrowing country's expected pay-off, I get the incentive compatibility condition for the effort, which can be written as:

$$e \in arg\, max\, E\{C_2\} = e\big(\theta_g - Z_g - D\big) - (1-e)(1-\alpha)\theta_b - 0.5me^2$$

The relevant first-order condition for putting effort therefore becomes

$$\big(\theta_g - Z_g - D\big) + (1-\alpha)\theta_b = me$$

And the new lender's zero profit condition is

$$eZ_g + (1-e)\theta_b = r(k-W)$$

The maximisation problem for the borrowing country in the debt exchange is:

$$\max_{Z_g, e}\ e\big(\theta_g - Z_g - D\big) - (1-e)(1-\alpha)\theta_b - 0.5me^2$$

Subject to: $eZ_g + (1-e)\theta_b - r(k-W) = 0$ (ZP)

$$(\theta_g - Z_g - D) + (1-\alpha)\theta_b = me \quad \text{(IC)}$$

The maximization here is exactly the same maximization problem as the full debt equity swap where all debt exchange to equity, so I could use the results of propositions 4 and proposition 6.

Proposition 7(i): The optimal effort level and the payment to the new creditor in the good states under debt exchange are:

$\boldsymbol{e^{**} = \frac{A+\sqrt{A^2-4m[r(k-W)-\theta_b]}}{2m}}$ **and** $\boldsymbol{Z_g^{**} = \frac{A-\sqrt{A^2-4m[r(k-W)-\theta_b]}}{2}}$ **and** $\boldsymbol{A \equiv \theta_g - D - \alpha\theta_b}$

(ii) The debt exchange increases the optimal effort by the borrowing country which also makes a lower contingent payment in the good state compared to the case without debt exchange.

(iii) The borrowing country's expected welfare is measured by its pay-off and this is increased with the debt exchange.

3.7 Conclusion

This chapter develops a simple debt restructuring framework when multiple players are involved: old creditor, new creditor and borrowing country. When the old creditor is unable to extend a new loan due to liquidity crunch and austerity, the incentive issues of the borrowing country worsen sovereign debt repayment problems. By employing a debt equity swap programme where old creditor swaps a part of the debt for an equivalent amount of equity, and at the same time, the borrowing country raise money from the new creditor, it is beneficial to all the parties. The main contribution of this chapter is that the designed debt equity swap could be Pareto improving, and it showed that it is optimum to exchange all debt for equity. I further showed that a designed new junior bond deal with the old creditor is Pareto improving and yields the same equilibrium as the full debt equity swap where all the debt is exchanged for equity. The exchange of old debt into equity or junior debt makes the new debt automatically more senior. The enhanced priority of the new debt increases the pay-off of for new lenders in the bad state and makes this debt relatively safer if they charge lower interest rates.

This fall in the face value of new loan (payments in the good state) leaves an increased surplus to the borrowing country, which creates an incentive to make extra effort to make the risky project successful, which further lowers the probability of second time default and therefore making everyone gain ex ante.

It is necessary to point out some practical issues of debt equity swap have not been considered in this model. For example, political consideration of giving out the control right to the foreigner of the domestic resources. The information asymmetry problem where some attributes of the borrowing country are unknown to the creditors.

Table 3.1 Pay-off structure to all stakeholders of debt equity swap

Without debt equity swap	Good State	Bad State
New creditor	Z_g	$\frac{k-W}{k-W+D}\theta_b$
Old creditor's debt	D	$\frac{D}{k-W+D}\theta_b$
Old creditor's equity	0	0
Borrower	$\theta_g - Z_g - D$	0
Partial debt equity swap	Good State	Bad State
New creditor	Z_g	$\frac{k-W}{k-W+D}\theta_b$
Old creditor's debt	$D-\Delta$	$\frac{D-\Delta}{k-W+D-\Delta}\theta_b$
Old creditor's equity	$t(\theta_g - Z_g - D + \Delta)$	0
Borrower	$(1-t)(\theta_g - Z_g - D + \Delta)$	0

Table 3.2 Pay-off structure to all stakeholders for debt exchange

Without debt exchange	Good State	Bad State
New creditor	Z_g	$\frac{k-W}{k-W+D}\theta_b$
Old creditor's debt	D	$\frac{D}{k-W+D}\theta_b$
Old creditor's equity	0	0
Borrower	$\theta_g - Z_g - D$	0
After debt exchange	Good State	Bad State
New creditor	Z_g	θ_b
Old creditor's debt	D_N	0
Old creditor's equity	0	0
Borrower	$\theta_g - Z_g - D_N$	0

Appendix 3.A Proof of proposition 1

The relevant maximization problem is given by the following:

$$\max_{Z_g,e} e\left(\theta_g - Z_g - D\right) - 0.5me^2$$

$$\text{Subject to: } eZ_g + (1-e)\alpha\theta_b - r(k-W) = 0 \qquad \text{(ZP)}$$

$$\theta_g - Z_g - D = me \qquad \text{(IC)}$$

The Lagrangian is given by the following expression:

$$L = e\left(\theta_g - Z_g - D\right) - 0.5me^2 + \lambda_1\left[eZ_g + (1-e)\alpha\theta_b - r(k-W)\right] + \lambda_2\left[\left(\theta_g - Z_g - D\right) - me\right]$$

The first-order conditions are:

$$\frac{\partial L}{\partial e} = \lambda_1\left(eZ_g - \alpha\theta_b\right) - \lambda_2 m = 0 \qquad \text{(3A1)}$$

$$\frac{\partial L}{\partial Z_g} = -e + e\lambda_1 - \lambda_2 = 0 \qquad \text{(3A2)}$$

Lemma: $\lambda_1 > 0$ and $\lambda_2 > 0$.

Proof: Suppose that $\lambda_1 = 0$, Then (3A1) implies $\lambda_2 = 0$. Plugging this result in (3A2), I get $\lambda_1 = 1$ which contradicts the assertion. On the other hand, if I assume $\lambda_2 = 0$, (3A1) implies that $\lambda_1 = 0$. From (3A2). I get $\lambda_1 = -e$. Since $e > 0$, it contradicts the assertion. Hence, both λ_1 and λ_2 have to be bigger than 0; hence, (IC) and (ZP) are binding. In that case (3A2) shows that $\lambda_2 = -e + e\lambda_1$. Substituting the result into (3A1), I get: $\lambda_1 = \frac{e}{me - Z_g + \alpha\theta_b}$

The binding (IC) and Zero profit constraints imply respectively $\theta_g - Z_g - D - me = 0$ and $eZ_g + (1-e)\alpha\theta_b - r(k-W) = 0$. Using these expressions it shows that $me - Z_g + \alpha\theta_b > 0$, implying that $\lambda_1 = \frac{e}{me - Z_g + \alpha\theta_b} > 0$ and from (3A1), it follows that $\lambda_2 > 0$,

Hence, $eZ_g + (1-e)\alpha\theta_b - r(k-W) = 0$ (ZP) and $(\theta_g - Z_g - D) = me$ (IC) jointly determine the optimal effort and payment to investors in the good state. Solving the two equations, I get:

$$e^* = \frac{\theta_g - D - \alpha\theta_b + \sqrt{(\theta_g - D - \alpha\theta_b)^2 - 4m[r(k-W) - \alpha\theta_b]}}{2m}$$

and

$$Z_g^* = \frac{\theta_g - D + \alpha\theta_b - \sqrt{(\theta_g - D - \alpha\theta_b)^2 - 4m[r(k-W) - \alpha\theta_b]}}{2}$$

Appendix 3.B Proof of proposition 2

From proposition 1(ii), I know that the maximum expected utility that the borrowing country could obtain from the bailout package is:

$$V = C_1 + E\{C_2^*\} = Y - W\mu + e^*\left(\theta_g - Z_g^* - D\right) - 0.5me^{*2}$$

$$= Y - W\mu + 0.5me^{*2}$$

The first order condition is: $\frac{dV}{dW} = -\mu + me^* \frac{de^*}{dW} \leq 0$, if $\frac{dV}{dW}$<0, then $W^* = 0$

To evaluate the sign of $\frac{\mathrm{de}^*}{\mathrm{dW}}$, I perform the comparative statics using the implicit function theorem using both zero profit and incentive compatibility conditions reproduced below:

$$eZ_g + (1-e)\alpha\theta_b - r(k - W) = 0 \qquad \text{(ZP)}$$

$$(\theta_g - Z_g - D) = me \qquad \text{(IC)}$$

Where $\alpha = \frac{k-W}{k-W+D}$

By totally differentiating the (ZP) and (IC) with respect to W, r and D, I get the following set of simultaneous equations:

$$(Z_g - \alpha\theta_b)de + edZ_g$$

$$= [-(1-e)\alpha'(W)\theta_b - r]dW + kdr - [(1-e)\alpha'(D)\theta_b]dD$$

$$-mde - dZ_g = dD$$

The Jacobian determinant below is positive due to second order condition:

$$|\mathrm{J}| = \begin{vmatrix} \mathrm{Z_g} - \alpha\theta_\mathrm{b} & \mathrm{e} \\ -\mathrm{m} & -1 \end{vmatrix} = -(\mathrm{Z_g} - \alpha\theta_\mathrm{b}) + \mathrm{me} > 0$$

Taking the partial differentiation of the (ZP) and (IC) conditions with respect to W, I get:

$$\frac{\partial e}{\partial W} = \frac{|A_1|}{|J|} = \frac{\begin{vmatrix} -(1-e)\alpha'(D)\theta_b - r & e \\ 0 & -1 \end{vmatrix}}{-(Z_g - \alpha\theta_b) + me} = \frac{(1-e)\alpha'(D)\theta_b + r}{-(Z_g - \alpha\theta_b) + me}$$

It follows that if $(1-e)\alpha'(D)\theta_b + r > 0$, then $|A_1|$ and $\frac{\partial \mathrm{e}}{\partial \mathrm{W}} > 0$

Since both the first and second derivative of α with respect to W are negative, there exists a critical point W, such that below this point $(1-e)\alpha'(W)\theta_b + r > 0$ and beyond that point $(1-e)\alpha'(W)\theta_b + r < 0$. This in turn means that there exists a critical point W such that below this point $\frac{dV}{dW} > 0$ and beyond that point $\frac{dV}{dW} < 0$. Since $\alpha = \frac{k-W}{k-W+D}$ and $\frac{\partial \alpha}{\partial W} = \frac{-D}{(k-W+D)^2} < 0$, evaluating $\frac{dV}{dW}$ at $W = 0$, I get $-\mu + me^* \frac{(1-e^*)\frac{-D}{(k+D)^2}\theta_b + r}{-(Z_g - \alpha\theta_b) + me} > 0$ to be the condition where the borrowing country makes a contribution towards financing of the risky project.

Appendix 3.C Proof of proposition 3

By using the implicit function theorem, I can discover comparative statics. Considering the incentive compatibility condition and the zero profit condition

$$eZ_g + (1-e)\alpha\theta_b - r(k-W) = 0 \qquad \text{(ZP)}$$

$$(\theta_g - Z_g - D) = me \qquad \text{(IC)}$$

Where $\alpha = \frac{k-W}{k-W+D}$

By totally differentiating the (ZP) and (IC) with respect to W, r and D, I get the following set of simultaneous equations:

$$(Z_g - \alpha\theta_b)de + edZ_g$$

$$= [-(1-e)\alpha'(W)\theta_b - r]dW + kdr - [(1-e)\alpha'(D)\theta_b]dD$$

$$-mde - dZ_g = dD$$

The Jacobian determinant below is positive due to second order condition:

$$|J| = \begin{vmatrix} Z_g - \alpha\theta_b & e \\ -m & -1 \end{vmatrix} = -(Z_g - \alpha\theta_b) + me > 0$$

Taking the partial differentiation of the (ZP) and (IC) conditions with respect to r, I get:

$$\frac{\partial e}{\partial r} = \frac{|B_1|}{|J|} = \frac{\begin{vmatrix} k & e \\ 0 & -1 \end{vmatrix}}{-(Z_g - \alpha\theta_b) + me} = \frac{-k}{-(Z_g - \alpha\theta_b) + me} < 0$$

$$\frac{\partial Z_g}{\partial r} = \frac{|B_2|}{|J|} = \frac{\begin{vmatrix} Z_g - \alpha\theta_b & k \\ -m & 0 \end{vmatrix}}{-(Z_g - \alpha\theta_b) + me} = \frac{km}{-(Z_g - \alpha\theta_b) + me} > 0$$

Taking the partial differentiation of the (ZP) and (IC) conditions with respect to D, I get:

$$\frac{\partial e}{\partial D} = \frac{|C_1|}{|J|} = \frac{\begin{vmatrix} -(1-e)\alpha'(D)\theta_b & e \\ 1 & -1 \end{vmatrix}}{-(Z_g - \alpha\theta_b) + me} = \frac{(1-e)\alpha'(D)\theta_b - e}{-(Z_g - \alpha\theta_b) + me} < 0$$

$$\frac{\partial Z_g}{\partial D} = \frac{|C_2|}{|J|} = \frac{\begin{vmatrix} Z_g - \alpha\theta_b & -(1-e)\alpha'(D)\theta_b \\ -m & 1 \end{vmatrix}}{-(Z_g - \alpha\theta_b) + me}$$

$$= \frac{Z_g - \alpha\theta_b - m[(1-e)\alpha'(D)\theta_b]}{-(Z_g - \alpha\theta_b) + me} > 0$$

Appendix 3.D Proof of proposition 4

The maximization programme can be written as follows:

$$\max_{Z_g,e} \; e\left(\theta_g - Z_g - D\right) + (1-e)(\alpha-\beta)\theta_b - 0.5me^2$$

Subject to: $eZ_g + (1-e)\beta\theta_b - r(k-W) = 0$ (ZP)

$$(\theta_g - Z_g - D) - (\alpha-\beta)\theta_b - me = 0 \quad \text{(IC)}$$

I obtain the Lagrangian:

$$L = e\left(\theta_g - Z_g - D\right) + (1-e)(\alpha-\beta)\theta_b - 0.5me^2 + \lambda_1\left[eZ_g + (1-e)\beta\theta_b - r(k-W)\right] + \lambda_2[(\theta_g - Z_g - D) - (\alpha-\beta)\theta_b - me]$$

By first order condition:

$$\frac{\partial L}{\partial e} = \lambda_1\left(Z_g - \beta\theta_b\right) - \lambda_2 m = 0 \quad \text{(3B1)}$$

$$\frac{\partial L}{\partial Z_g} = -e + \lambda_1 e - \lambda_2 = 0 \quad \text{(3B2)}$$

Following the method of the proof used in proposition 1, one can similarly demonstrate that $\lambda_1 = \frac{-em}{Z_g - \beta\theta_b - em} = \frac{em}{-(Z_g - \beta\theta_b) + em} > 1 > 0$. Plugging this value into (3B2), I find $\lambda_2 = -e + \lambda_1 e = e(\lambda_1 - 1) > 0$

Hence, the incentive compatibility condition and the zero profit condition bind at the optimum:

$$eZ_g + (1-e)\beta\theta_b - r(k-W) = 0 \quad \text{(ZP)}$$

$$(\theta_g - Z_g - D) - (\alpha - \beta)\theta_b - me = 0 \qquad \text{(IC)}$$

Where $\alpha = \frac{k-W}{k-W+D}$ and $\beta = \frac{k-W}{k-W+D-\Delta}$

The optimal effort and contingent payment in the good state can then be found by solving the (ZP) and (IC) conditions:

$$e^{**} = \frac{A + \sqrt{A^2 - 4m[r(k-W) - \beta\theta_b]}}{2m}$$

Substituting e^{**} into (IC)

$$Z_g^{**} = \beta\theta_b + \frac{A - \sqrt{(\theta_g - D - \alpha\theta_b)^2 - 4m[r(k-W) - \beta\theta_b]}}{2}$$

Since $\beta = \frac{k-W}{k-W+D-\Delta} > \alpha = \frac{k-W}{k-W+D}$, it follows from directly comparing the expressions in proposition 1) that $e^{**} > e^{*}$. Hence, from (ZP), I find that $Z_g^{**} < Z_g^{*}$

Appendix 3.E Proof of proposition 5

By differentiating the (ZP) and (IC) conditions from the debt equity swap section above with respect to Δ, I get:

$$(Z_g - \beta\theta_b)de + edZ_g = -(1-e)\beta'\theta_b d\Delta$$

$$-mde - dZ_g = -\beta'\theta_b d\Delta$$

The Jocobian determinant below is positive due to the second-order condition of maximum:

$$|J| = \begin{vmatrix} Z_g - \beta\theta_b & e \\ -m & -1 \end{vmatrix} = -(Z_g - \beta\theta_b) + me > 0$$

$$\frac{\partial e}{\partial \Delta} = \frac{|D_1|}{|J|} = \frac{\begin{vmatrix} -(1-e)\beta'\theta_b & e \\ -\beta'\theta_b & -1 \end{vmatrix}}{-(Z_g - \beta\theta_b) + me} = \frac{(1-e)\beta'\theta_b}{-(Z_g - \beta\theta_b) + me} > 0$$

$$\frac{\partial Z_g}{\partial \Delta} = \frac{|D_2|}{|J|} = \frac{\begin{vmatrix} Z_g - \beta\theta_b & -(1-e)\beta'\theta_b \\ -m & -\beta'\theta_b \end{vmatrix}}{-(Z_g - \beta\theta_b) + me}$$

$$= \frac{-\beta'\theta_b(Z_g - \beta\theta_b) - (1-e)\beta'\theta_b m}{-(Z_g - \beta\theta_b) + me} < 0$$

Since $\beta' = \frac{\partial \beta}{\partial \Delta} = \beta'_\Delta = \frac{k-W}{(k-W+D-\Delta)^2} > 0$

Appendix 3.F Proof of proposition 6

Regarding to the borrower's utility, if I differentiate the borrower's utility respect to Δ, I get:

$$\frac{\partial U(e^*, Z_g^*, \Delta)}{\partial \Delta} = \frac{\partial e^*}{\partial \Delta}\left[\theta_g - Z_g - D - (\alpha - \beta)\theta_b - me\right] - e\frac{\partial Z_g^*}{\partial \Delta} - (1-e)\frac{\partial \beta}{\partial \Delta}\theta_b$$

Since I am evaluating the borrower's utility at the optimum, the first term vanishes as $\theta_g - Z_g - D - (\alpha - \beta)\theta_b - me = 0$ due to the incentive compatibility condition, which reduces the above expression to:

$$\frac{\partial U(e^*, Z_g^*, \Delta)}{\partial \Delta} = -e\frac{\partial Z_g^*}{\partial \Delta} - (1-e)\frac{\partial \beta}{\partial \Delta}\theta_b$$

In order to evaluate the expression, I differentiate the (ZP) condition with respect to Δ at the optimum, and get:

$$e\frac{\partial Z_g^*}{\partial \Delta} + (1-e)\frac{\partial \beta}{\partial \Delta}\theta_b + \frac{\partial e^*}{\partial \Delta}\left(Z_g - \beta\theta_b\right) = 0$$

Thus $-e\frac{\partial Z_g^*}{\partial \Delta} - (1-e)\frac{\partial \beta}{\partial \Delta}\theta_b = \frac{\partial e^*}{\partial \Delta}\left(Z_g - \beta\theta_b\right) > 0$ since $\frac{\partial e^*}{\partial \Delta} > 0$ as shown in the earlier proposition and the zero profit condition implies that $Z_g - \beta\theta_b > 0$. Hence $\frac{\partial U(e^*, Z_g^*, \Delta)}{\partial \Delta} > 0$

4 THE IMPACT OF IMF INTERVENTION ON SOVEREIGN DEBT RESCHEDULING

4.1 Introduction

The recent European sovereign debt crisis which happened during 2010-2012, started with Greece, Portugal and Spain and spread to the neighboring countries. The main problem for these countries is their large budget deficits and their inability to pay back their debt. When the debt is large enough, it creates a debt overhang effect where the debtors are reluctant to invest and generate income to repay the debt because most of their income goes to their creditors. Because of the debt overhang effect, it could be a lose-lose situation for both debtors and creditors (Krugman, 1988). A possible solution

could be debt rescheduling, which can be defined as an exchange of outstanding sovereign debt instruments for new debt instruments through a legal process. Debt rescheduling implies debt relief, because it usually involves a reduction of the repayment (Trebesch, Papaioannou and Das, 2012). By rescheduling the debt, a creditor could reduce the debt overhang effect and boost the debtor's incentive to invest and eventually repay the debt. While Krugman (1988) shows that debt rescheduling could be a Pareto improving strategy when the debtor is experiencing a debt overhang effect, the problem is when there is asymmetric information between the creditor and debtor regarding the attribute of the debtor because the creditor cannot observe whether or not the debtor is experiencing a debt overhang effect. Thus, without perfect knowledge regarding the attribute of the debtor, debt rescheduling could only benefit the debtor and reduce the welfare for the creditor. In order to discriminate between different types of countries when the debtor's attribute is unobservable, Marchesi and Thomas (1999) show that IMF program participation could be used for the purpose of signaling because only a debtor who is willing to resolve the debt overhang effect and reform the economy would participate in an IMF program. Since IMF programs incur a short term cost which is associated with the economic reform, when the cost is large enough, the debtor who has no debt overhang effect will not be willing to participate the program and incur such cost. Thus, only a country with a debt overhang effect participates in an IMF program and should therefore be offered subsequent debt rescheduling. While Marchesi

and Thomas (1999) show the relationship between IMF intervention and sovereign debt rescheduling in theory, the focal points of this study are to shed light on (i) the empirical relationship between the IMF program and the subsequent debt rescheduling with official and private creditors, (ii) The effectiveness of signaling by participating and complying with different IMF programs, and (iii) whether and how these relationships change for debtors at different income levels.

The most relevant study to this chapter is Marchesi (2003). Her research focuses on the effect of IMF programs on the probability of 93 countries' sovereign debt rescheduling with private creditors during the period 1983-1995. She shows that IMF intervention increases the probability of subsequent debt rescheduling with private creditors, because participating in an IMF program can be used as a signaling tool to show the country's willingness to reform and the recipient country is rewarded with debt rescheduling. This chapter differs from and extends Marchesi (2003) in several ways. Firstly, with the recent European debt crisis and a series of debt rescheduling, it is possible to re-evaluate the impact of IMF programs on debt rescheduling at a larger scale and across a longer time frame. Compared to Marchesi (2003), I have employed a dataset which includes sovereign debt rescheduling for 115 countries with official and private creditors from 1970 to 2012 so as to include the recent European debt crisis period. Secondly, although Marchesi (2003) finds a positive relationship between IMF intervention and debt rescheduling, there is no consideration given to the size of the

relationship. In this chapter I empirically examine the size of the marginal effect of the IMF intervention on sovereign debt rescheduling. This provides an important measure because not only do I then know the actual size of the IMF program participation effect, but the marginal effect is comparable with different regressions, especially when I compare the marginal effect for countries with different level of income. Thirdly, Marchesi (2003) models IMF program participation and sovereign debt rescheduling with private creditors as dummy variables. Hence she considers neither the quantity of debt rescheduling nor the amount of IMF disbursed loan separately in her study. Instead, this chapter models explicitly the effect of the amount of IMF disbursed loan on the probability and quantity of sovereign debt rescheduling. Fourthly, recognizing that IMF program participation should have different impacts on countries at different income levels, especially from creditors' point of view, this study also investigates the effect of IMF intervention on sovereign debt rescheduling by dividing the sample countries into three sub-samples according to their income levels. Last but not the least, The IMF has varieties of programs when helping sovereign debtors and each program has different conditions and consequences, which in turn affect the ability to repay debt of the country in the future. The study would be misleading or incomplete if such differences in IMF programs were ignored. Hence, in this study I investigate the separate effect of different IMF programs on sovereign debt rescheduling. To do this, IMF programs are

classified into two categories: concessional and non-concessional according to their conditions and consequences.

Overall, this chapter contributes to the literature by considering a much richer dataset covering the recent European debt crisis period and investigates the relationship between IMF intervention and sovereign debt rescheduling in depth and from different perspectives. The findings should have important implications for both policy makers and private investors. From a policy makers point of view, depending on the country's characteristics, the results could suggest the most effective signaling tool to use to reach agreement on their country's debt rescheduling and the optimum amount of borrowing from IMF beforehand. For the investors, the results could provide some guidance on the information conveyed by various IMF program related factors when they price the sovereign debt and consider the subsequent debt rescheduling.

My main results indicate that participating in a non-concessional IMF program increases the probability of subsequent debt rescheduling, but the probability and the quantity of debt rescheduling are negatively correlated with the amount of non-concessional IMF disbursed loan in the short term. The participation effect of IMF program on sovereign debt rescheduling is larger for countries with lower income. Furthermore, compliance with IMF conditionality could increase the probability and quantity of subsequent debt rescheduling, especially for low income countries. The results may indicate that participation in a non-concessional IMF program could signal

a country's willingness to reform and the recipient country is rewarded with subsequent debt rescheduling, the effectiveness of signaling is negatively linked with the country's level of income, so compliance with IMF conditionality could enhance such a signaling effect.

The remaining of the chapter is organized as follows: Section 4.2 reviews the empirical literature. Section 4.3 reviews the theoretical framework that links IMF program participation and sovereign debt rescheduling. Section 4.4 explains the empirical methodology and data. Section 4.5 presents the results and a robustness check is included in section 4.6. Finally, section 4.7 concludes.

4.2 Literature Review

Marchesi and Thomas (1999) develop a theoretical model to explain the relationship between the adoption of an IMF program and sovereign debt rescheduling. When the type of the country is unobservable to the creditors, adoption of an IMF program could be used for the purpose of signaling. The creditor is willing to reduce the debt for the highly productive country in order to resolve the country's debt overhang effect, which in turn boosts the country's incentive to invest and eventually repay the debt. A highly productive country could signal its productivity level by adopting an IMF program (which creates the short term costs associated with economic reform) because the costs of economic reform could be too large for a country with low productivity to adopt. Thus the adoption of an IMF program can be used as a screening mechanism that allows

creditors to distinguish between the productivity level of countries in that only highly productive countries will be willing to adopt an IMF program and indicate that they are suitable candidates for subsequent debt reduction.

Marchesi (2003) empirically tested the effect of the adoption of an IMF program on the subsequent commercial debt rescheduling [38]. The author defined debt rescheduling and adoption of an IMF program as dummy variables by using a bivariate probit model on a sample of 93 countries during the period 1983-1995. She found that debt rescheduling with a private creditor was more likely if the country had adopted an IMF program. This result confirms the theory (Marchesi and Thomas, 1999) that the adoption of an IMF program could signal the country's type and show its willingness to reform, thus be a good candidate for subsequent debt rescheduling as a reward.

To my knowledge, the investigation of the effects of participation in an IMF program on sovereign debt rescheduling has only been undertaken by Marchesi (2003). My research will build on the literature on the determinants of sovereign debt rescheduling and the economic consequences of IMF programs. The literature on the determinants of sovereign debt rescheduling could guide us the choice of control variables. The literature on the economic consequences of IMF programs suggests that

[38] Rescheduling bank loans which are not guaranteed by creditor governments nor by the official agencies of creditor countries.

the adoption of an IMF program could be endogenous, thus in order to study the effect of the adoption of an IMF program on sovereign debt rescheduling, the literature could guide us in the methodology and variables to resolve the endogeneity problem.

4.2.1 Debt Rescheduling Literature

The existing empirical literature on sovereign debt rescheduling has mainly focused on identifying the main determinants of sovereign debt rescheduling. There are mainly four approaches for choosing variables: the balance sheet approach, the macro approach, the willingness to pay approach, and the structural approach.

According to the balance sheet approach, Lloyd-Ellis *et al*. (1989) employ a set of balance sheet variables and global attitudes towards debt rescheduling variables to identify the determinants of the probability of debt rescheduling. With both annual sample estimations of 27 countries over the period 1977-1981 and semiannual sample estimations of 59 countries over the period 1977-1985, they find that an increase in banks' loans relative to assets, short-, long- and medium-term bank debt to total bank debt lending leads to a rise in the probability of rescheduling, while increases in unallocated credit and in foreign exchange reserves leads to a fall in this probability. Lloyd-Ellis *et al*. (1990) extend the work of Lloyd-Ellis *et al*. (1989) by identifying the determinants of the quantity of debt rescheduling, with the same data set. By employing a type 2 Tobit estimation on both annual data and semiannual data, the common significant determinant over the two sets of samples was found to be the short term debt

to total debt ratio, they found that the quantity of debt rescheduling was higher if the country had a higher short term debt to total debt ratio.

Backer (1992) also extended the work of Lloyd-Ellis *et al*.'s (1989) by including a set of macroeconomic fundamental variables, and this is regarded as a macro approach. He used a logit model to estimate the debt rescheduling probability for 68 debtor countries with semi-annual data from 1981 to 1988, he also applied different lags to the explanatory variables because he considered 6 months lag (1 period lag) periods to be insufficient . His results suggest that as the lag is lengthened, the significance of macroeconomic fundamental variables improves relative to the balance sheet variables. This suggests that macroeconomic fundamental variables are proxies for more fundamental, longer-term determinants of a country's solvency while financial variables only provide information about the country's current liquidity.

By using a similar macro approach to Backer (1992), two studies on countries in a specific continent have been performed. Rahnama-Moghadam, Samavati and Haber (1991) investigated the determinants of debt rescheduling in Latin American countries over the period 1980-1987. By using a probit model, they found that the probability of rescheduling was positively correlated with total debt service to GNP ratio and percentage of debt held as variable interest rate loans, but negatively correlated with reserve to debt ratio. Laušev, Stojanović and Todorović (2011) used panel logit models on a set of macroeconomic, financial and political variables to estimate the debt

rescheduling probabilities of 15 Eastern European countries during period 1990-2005. Their results suggest that reduced government expenditure, attracting foreign direct investment, increasing export revenues and keeping a good repayment record result in lower debt rescheduling probabilities.

The willingness to pay model was developed by Eaton and Gersovitz (1981). Rather than considering the borrower's ability to repay the debt, this model considers the borrower's *willingness* to repay. At each payment period, the borrower compares the expected value of his discounted utility of consumption with repayment against the expected value of his discounted utility of consumption with either default or rescheduling. The borrower chooses default or repayment based on the comparison and the decision is irrelevant to the borrower's repayment ability. Lee (1991) tested a model whose explanatory variable depended on a country's 'willingness to pay' using a sample of 75 countries within a period from 1970-1985. His results showed that the probability of debt rescheduling depended positively on the interest rate on international lending, total foreign debt (relative to GNP) and the ratio of government debt that is held domestically to GDP. It depends negatively on the growth rate of per capital GDP. Moreover, Lee (1991) separately considered 'official rescheduling' (rescheduling payments on public and private debt that are guaranteed by creditor countries' government or official agencies) as distinct from 'commercial rescheduling' (rescheduling bank loans which are not guaranteed where the loan is held by private

creditors). He found that both official and commercial rescheduling decisions depend on the economic performance of borrowers, the level of indebtedness and the level of interest rates. Commercial rescheduling also depended on access to international credit markets.

Finally, the structural approach relates the specific structural characteristics of a country to the probability of debt rescheduling. Chauvin and Karray (2007) investigated the allocation of debt relief by using a sample of 62 low-income countries over three five-year periods 1989-1993, 1994-1998 and 1999-2003. In their study, in addition to those macro and financial variables, they include a variable which measures the quality of domestic policy and institutions. They further separated the provider of debt relief from bilateral creditors operating through the Paris Club; multilateral creditors operating through the Heavily Indebted Poor Countries Initiative (HIPC); a small donor-funded debt-buyback facility for low-income countries operated by the World Bank; and bilateral debt relief provided by Russia. Their results suggest that debt relief, particularly from multilateral creditors, has been allocated to countries with better policies in recent years.

Another structural approach is investigating the relationship between debt relief and the government's quality. This was used by Freytag and Pehnelt (2009). The quality of governance was measured in several dimensions, including voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality,

rule of law and control of corruption. Using data from 123 developing countries over the three sub-periods 1990-94, 1995-99 and 2000-04 by adopting the Tobit estimation technique, they find that governance quality did not play a role in debt relief in the 1990s, but did play an important role in debt relief in the early 21st century.

4.2.2 Economic consequences of IMF program literature

There are various papers dealing with the economic consequences of IMF participation. Typically, the literature investigates the impact of IMF participation on domestic policy, macroeconomic fundamentals and financial crisis

Dreher and Vaubel (2004) investigated how monetary and fiscal policies were affected by IMF and International Bank for Reconstruction and Development (IBRD) lending. Using panel data for 94 countries between 1975-1997, their results suggest that new net lending from the Bank (relative to GDP) raised monetary expansion but lowered the budget deficits of the recipient countries, while new net credit from the IMF was associated with less monetary expansion and lower budget deficits. The endogeneity problem of IMF and IBRD loans was taken account by using the Two Stage Least Square (2SLS) and General Method of Moment (GMM) estimations. They concluded the country's borrowing potential from the IMF was larger with a higher government budget deficit and a higher rate of monetary expansion. Dreher (2005) investigated the effect of different IMF programs on fiscal and monetary policy. He examines four kinds of IMF program, including Stand-by Arrangements (SBA),

Extended Fund Facilities (EFF), Structural Adjustment Facilities (ESAF) and Poverty Reduction and Growth Facilities (PRGF). Using panel data for 98 countries over the period 1975-2000, his results suggested that only SBA and EFF programs could reduce fiscal deficits. The endogeneity problem of IMF loans was taken into account by using the Three Stage Least Square (3SLS) estimation and he showed that participation was more likely with higher government consumption, lower monetary expansion and a less fictionalized government. New IMF loans rose significantly with low GDP growth and lagged IMF loans.

The above studies show signs of moral hazard in IMF lending. First of all, since IMF loans are likely to be granted to countries with higher budget deficits and higher rates of monetary expansion, countries are encouraged to run budget deficits and monetary expansion. Secondly, IMF loans and conditionality seem ineffective in inducing a country's policy improvement; only SBA and EFF programs were shown to reduce the fiscal deficits and IMF programs did not affect monetary policies. Furthermore, the amount of disbursed IMF loan does not have any influence. The moral hazard problem with IMF lending is in line with Evrensel (2002) who uses a before-after analysis to show that although budget deficits and monetary expansion were lower during program periods, policies did not improve in the long-run, but rather deteriorated.

Barro and Lee (2005) investigated the effect of IMF loans on economic growth. Using panel data for 130 countries from 1975-1999, their results suggest that a higher

IMF loan participation rate reduces economic growth and the size of IMF loan does not have an impact on economic growth. In order to take account of the endogeneity problem of IMF loans, IMF lending decision is instrumented by a set of political-economy variables. The participation in an IMF program and the size of IMF loans were estimated by probit and Tobit regressions respectively. The results suggest that the probability of receiving and the size of IMF loans were larger when a country had a larger quota (IMF voting power), more nationals working on the professional staff, and more political proximity to the United States and the Major Western European countries. The authors further used these political factors as an instrument for IMF lending when estimating the effect of IMF loan on economic growth. The results show that a higher IMF loan participation rate reduces economic growth. Dreher (2006) extended the work of Barro and Lee (2005) by investigating how compliance with IMF conditionality affected economic growth. Using panel data for 98 countries from 1970-2000, they investigated the effect of IMF participation rate, IMF loan size and three different compliance proxies on economic growth by using SUR estimation first and then 3SLS estimation by instrument IMF participation rate, IMF loan size and compliance proxies. The results were consistent with Barro and Lee's (2005) study: IMF programs have a negative effect on growth rates, but compliance with IMF conditionality reduces this negative effect.

Butkiewicz and Yanikkaya (2005) assessed the impact of IMF and World Bank lending on economic growth by analyzing 100 developing countries over the period from 1970 to 1999, applying Seemingly Unrelated Regression (SUR) and 3SLS estimation on the full sample and a sub-sample which was divided according to per capita income and level of democracy. Their results suggest that World Bank lending stimulates growth in some cases, primarily by increasing public investment. IMF lending was found to be either neutral or detrimental to growth. The channel for this effect was a negative impact of IMF lending on public as well as private investment.

Focusing on the results regarding the impact of IMF loans for countries with different levels of income, IMF lending reduced GDP growth for both low-income and middle-income countries. In particular, the channel of affecting low-income countries was the negative impact of IMF lending on both public and private investment. Other studies have also confirmed the negative effect of IMF lending on economic growth (see Goldstein and Montiel, 1986; Haque and Khan, 1998; Bird, 2001 p.1961; Bordo and James, 2000; Przeworski and Vreeland, 2000; Bird and Rowlands, 2003).

Instead of investigating the impact of IMF intervention on economic growth, Van der Veer and de Jong (2013) investigated the effect of IMF loans on private capital inflow in middle-income countries. Using a sample of 49 middle-income countries over the period from 1984 to 2004 the results suggested that participation in an IMF program had a positive effect on private capital inflow as long as the country did not restructure

its debt. The explanation was that the IMF program helped a country signal its willingness to reform and repay debts to private creditors because the signal gives foreign private investors confidence and thus generates private capital inflows to that country. This is consistent with Marchesi and Thomas's (1999) theory. Since the participation in an IMF program is sufficient for the purpose of signaling, the size of the IMF lending is not important. In general, IMF programs do more harm than good for the recipient country's macroeconomic fundamentals except as a signal to potential creditors.

Finally, the relationship between economic crisis and IMF programs has been studied. Dreher and Walter (2010) investigated how IMF programs, disbursed loans, and compliance with conditionality affects the risk of currency crisis. The endogeneity problem of the IMF loans was taken account by using 3SLS and GMM estimation and the country's voting behavior in the UN General Assembly was employed as instrument. Their analysis covered 68 countries from 1975-2002 and they found that IMF involvement reduces the probability of a currency crisis. The amount of the loans and compliance with IMF conditionality had no impact. These results suggest that the effect of IMF programs seems to be indirect, such as IMF advice and IMF's function as scapegoat (Vreeland, 1999).

Jorra (2012) explored how the adoption of an IMF program affects sovereign risk over the medium term. Using a sample of 57 developing and emerging economies with

annual data from 1975 to 2008, the results suggested that IMF programs significantly increase the probability of subsequent sovereign defaults by approximately 1.5-2 percentage points and compliance with IMF conditionality had no impact. This could be explained by the theory associated with the debtor's moral hazard problem with IMF lending (Vauble, 1983; Meltzer Commision, 2000; Corsetti *et al*., 2006; Morris and Shin, 2006).

To summarize the literature above; sovereign debt rescheduling is determined by balance sheet variables, macroeconomic variables, willingness to pay factors and some characteristics of the debtor country. IMF programs are harmful for the recipient's economy, but on the other hand, IMF programs can be used for the purpose of signaling since it shows the country's willingness to participate in economic reform. In terms of estimation methodology; probit and logit estimations are used if the dependent variables are the probability of debt rescheduling, whereas Tobit estimation is used if the dependent variable is the quantity of debt rescheduling. Regarding the economic consequences of IMF programs; since the participation in an IMF program could be endogenous, the literature has taken care of the endogeneity problem by employing 2SLS, 3SLS and GMM estimations because these three methodologies can be used if the dependent variable is continuous and uncensored. When the dependent variable is binary, in order to take care of both the binary nature of dependent variable and the

binary nature of endogenous variable, a simultaneous equation estimation has to be used (Merchesi, 2003; Jorra, 2012).

4.3 The theoretical framework

Marchesi and Thomas (1999) show that the adoption of an IMF program can be used as a screening mechanism to distinguish between debtor countries which are willing to use debt relief as an incentive to invest and later pay and countries which are not. The idea is that there are two types of country; high productivity and low productivity countries, differentiated by the return of the investment and the type of the country is unobservable to the creditors. Because of the debt overhang effect, the high productivity country is not willing to invest, even though it is socially efficient to do so. On the other hand, the low productivity country does not want to invest anyway. In this case, the creditor is willing to offer the high productivity country some debt relief, so that the high productivity country has the incentive to invest and repay the debt eventually. But since the creditor does not know the type of the country, the creditor could mistakenly reduce the debt for a low productivity country, this will result a loss for the creditor.

Marchesi and Thomas (1999) introduced IMF programs as being able to improve the productivity of the country, but on the other hand, reducing the current consumption because of the conditionality. Since low productivity countries do not invest anyway, increasing productivity does not increase their utility, but it will definitely reduce due to the conditionality, so the low productivity country is not willing to take the IMF

program. For the high productivity country, since the increase in productivity could increase her utility, although the program decreases the current consumption, the increase in productivity and the reduction of existing debt could make up the losses and even generate profit, thus the high productivity country is willing to take the IMF program.

In order to find the factors which can influence the probability of a debt rescheduling, Marchesi and Thomas (1999) focus on the moral hazard aspect of the model, in other words, the creditor is trying to solve the debt overhang effect by reducing debt for the high productivity country. According to the model setup from Marchesi and Thomas, the high productivity country receives an investment of mI in period two by investing I. At period one, the high productivity country has an endowment $Q(1)$. At period two, the high productivity country could have a high endowment $Q(2)$ with probability q_H and a low endowment $\underline{Q}(2)$ with probability $1 - q_H$. By taking an IMF program, the country incurs a short term cost S at period one, but receives benefit bS at period two $(0 \leq b < 1)$. The debtor country has a total amount of external debt D and the creditor chooses the amount of debt forgiveness *R*. In case of default, the creditor could seize portion α of the country's income. By making an investment, the income of the high productivity country at period two is:

$$Q(1) - S + q_H[Q(2) + mI + bS - (D - R)] + (1 - q_H)[\underline{Q}(2) + mI + bS - (D - R)]$$

By not making investment, the income of the high productivity country at period two is:

$$Q(1) - S + q_H[Q(2) + bS - (D - R)] + (1 - q_H)(1 - \alpha)(\underline{Q}(2) + bS)$$

Thus the high productivity country will make investment if the following condition is satisfied:

$$\begin{aligned} Q(1) - S + q_H[Q(2) + mI + bS - (D - R)] \\ + (1 - q_H)\left[\underline{Q}(2) + mI + bS - (D - R)\right] \\ \geq Q(1) - S + q_H[Q(2) + bS - (D - R)] + (1 - q_H)(1 \\ - \alpha)(\underline{Q}(2) + bS) \end{aligned}$$

When simplified, this becomes:

$$D - \frac{I(m-1)}{1 - q_H} - \alpha(\underline{Q}(2) + bS) \leq R \qquad (4.1)$$

The main purpose of debt rescheduling is resolving the debt overhang problem. Consider the case where $R = 0$. If $D - \frac{I(m-1)}{1-q_H} - \alpha\left(\underline{Q}(2) + bS\right) < 0$, then equation (4.1) is satisfied, this indicates that in case of no debt rescheduling, the country is still making an investment, thus there is no debt overhang effect. On the other hand, if $D - \frac{I(m-1)}{1-q_H} - \alpha\left(\underline{Q}(2) + bS\right) > 0$, R has to be greater than 0 in order to satisfy equation (4.1), thus there is debt overhang effect and the country will only make an investment if there is a sufficient amount of debt rescheduling. To conclude, the larger the left hand side of equation (4.1), the larger the debt overhang effect and the higher the probability

and the quantity of debt rescheduling. In Section 4.4 I will discuss in greater detail how these variables will become the control variables of the empirical model.

Several hypothesis could be formed by the above theory. Since debt reduction is a reward for a country which has taken an IMF program, the above theory assumes that by taking IMF program, the country will comply with the IMF conditionality, thus I could form the following hypotheses:

(H1) Debt rescheduling becomes more likely if the country has been involved in an IMF program.

(H2) Debt rescheduling becomes more likely if the country has complied with IMF conditionality.

(H3) The quantity of debt rescheduling increases if the country has complied with IMF conditionality.

Regarding the amount of the IMF disbursed loan; first of all, IMF programs are associated with a certain amount of money and the direct effect of the IMF credit is to boost the reserve of the recipient country and improve its short term financial position, thus the larger the amount of IMF disbursed loan, the better the short term financial position and the less likely the country is to default and reschedule its debt. Secondly, according to Marchesi and Thomas (1999) the IMF credit should be used for investment rather than consumption. From equation (4.1) it shows that an increase in investment will lead to a decrease in the debt overhang effect; thus the probability and the quantity

of debt rescheduling will decrease. From above two arguments, I could form the following hypotheses:

(H4) The probability of debt rescheduling and the amount of IMF disbursed loan are negatively correlated.

(H5) The quantity of debt rescheduling and the amount of the IMF disbursed loan are negatively correlated.

4.4 Empirical Framework and data

4.4.1 Empirical framework

The goal of this section is to analyze the effects of participation in an IMF program on sovereign debt rescheduling from different perspectives. When I estimate the impact of the participation in an IMF program on debt rescheduling, the participation in an IMF program could be endogenous, since the IMF program is designed to avert macroeconomic crises. The participation in an IMF program could be affected by the macroeconomic fundamental variables, but even if I include several macroeconomic variables as control variables, the participation in an IMF program could still be correlated with the error term. In order to take account of the endogeneity problem of participation in an IMF program, 2SLS, 3SLS and GMM estimations could be used if the dependent variable is continuous or uncensored. In this section, the dependent variable is either binary (in the case of debt rescheduling) or censored (the quantity of

the debt rescheduling) and the endogenous variable is either binary (debt rescheduling) or censored (the amount of the IMF disbursed loan), so 2SLS, 3SLS or GMM estimations are not appropriate in this case. In this eventuality, the literature (Merchesi, 2003; Jorra, 2012) has suggested a simultaneous equation estimation approach; therefore, the models of this chapter are designed as follows:

Model A - Bivariate Probit Model

In order to test hypotheses (H1) and (H2), I model the impact of the participation of an IMF program on the probability of debt rescheduling. Participation in an IMF program and the case of debt rescheduling are indicated by dummy variables, the model can be estimated by a bivariate probit model where two probit equations estimate simultaneously. The model can be written as:

$$C_{it} = \beta x_{it} + \gamma IMF3_{it} + \varepsilon_{it} \quad (4.A1)$$

$$IMF3_{it} = \delta z_{it} + v_{it} \quad (4.A2)$$

With the disturbances following a bivariate normal distribution being:

$$\begin{pmatrix} \varepsilon_{it} \\ v_{it} \end{pmatrix} = N \begin{pmatrix} 0 & 1 & \rho \\ 0 & \rho & 1 \end{pmatrix}$$

C_{it} is the dummy variable indicating sovereign debt rescheduling and $IMF3_{it}$ is the dummy variable indicating any participation in an IMF program during the previous 3 years. Equation (4.A1) describes the probability of debt rescheduling as a function of previous IMF program participation and control variables are summarized in the

vectors x_{it}. The coefficient γ is my main object of interest. Equation (4.A2) describes the participation in an IMF program as a function of the determinants summarized in the vector z_{it}.

As I mentioned earlier, I would like to examine the marginal effect of IMF program participation on debt rescheduling, The marginal effect of bivariate probit estimation can be calculated by:

$$Prob[D_{it} = 1|IMF3_{it} = 1, x_{it}, z_{it}] - Prob[D_{it} = 1|IMF3_{it} = 0, x_{it}, z_{it}] \quad (4.2)$$

Equation (4.2) can be computed as:

$$\frac{\Phi_2(x'_{it}\hat{\beta} + \hat{\gamma}IMF3_{it}, z'_{it}\hat{\delta}, \hat{\rho})}{\Phi(z'_{it}\hat{\delta})} - \frac{\Phi_2(x'_{it}\hat{\beta}, -z'_{it}\hat{\delta}, -\hat{\rho})}{1 - \Phi(z'_{it}\hat{\delta})} \quad (4.3)$$

Where Φ and Φ_2 denote the cumulative density function of the standard and bivariate normal distribution (Green, 2008).

Evaluating equation (4.3) at the means of covariates, I obtain the marginal effect of participating in an IMF program. In order to examine the size of the marginal effect, I divide this by the probability of debt rescheduling, conditional on not participating IMF program, expressed by:

$$\frac{Prob[D_{it} = 1|IMF3_{it} = 1, x_{it}, z_{it}] - Prob[D_{it} = 1|IMF3_{it} = 0, x_{it}, z_{it}]}{Prob[D_{it} = 1|IMF3_{it} = 0, x_{it}, z_{it}]} \quad (4.4)$$

Evaluating equation (4.4) at the means of covariates, I obtain the relative size of the marginal effect. It measures how large is the marginal effect is relative to the base

probability of debt rescheduling (the probability of debt rescheduling without participating in an IMF program).

Model B- Probit-Tobit Model

In order to test hypotheses (H2) and (H4), I model the impact of the amount of the IMF disbursed loan on the probability of debt rescheduling. The amount of the IMF disbursed loan is censored data, thus the IMF disbursed loan equation must be estimated by Tobit regression. The model can be written as follows:

$$C_{it} = \beta f_{it} + \gamma IMF\_GDP3_{it} + \varepsilon_{it} \quad (4.B1)$$

$$IMF\_GDP3_{it} = \delta g_{it} + v_{it} \quad (4.B2)$$

With the disturbances following a bivariate normal distribution:

$$\begin{pmatrix} \varepsilon_{it} \\ v_{it} \end{pmatrix} = N \begin{pmatrix} 0 & 1 & \rho\sigma_2 \\ 0 & \rho\sigma_2 & \sigma_2^2 \end{pmatrix}$$

C_{it} denotes the dummy variable indicating sovereign debt rescheduling and IMF_GDP3_{it} denotes the average of the amount of IMF disbursed loan to GDP ratio during the previous 3 years[39]. Equation (4.B1) describes the probability of debt rescheduling as a function of the amount of IMF disbursed loan, and other control

[39] The average of the amount of IMF disbursed loan to GDP ratio during the previous 3 years = the sum of the ratios (the amount of IMF disbursed loan to GDP ratio) during the previous 2 years / the number of years that the country participated in an IMF program during the previous 3 years.

variables are summarized in the vectors f_{it}. The coefficient γ is my main object of interest. Equation (4.B2) describes the amount of the IMF disbursed loan as a function of determinants summarized in the vector g_{it}. Equation (4.B1) is estimated by probit regression and equation (4.B2) is estimated by Tobit regression. Both equations are estimated simultaneously.

Model C- Bivariate Tobit Model

Model C - bivariate Tobit regression: in order to test hypotheses (H3) and (H5), I model the impact of the amount of the IMF disbursed loan on the quantity of debt rescheduling. Since both the quantity of debt rescheduling and the amount of IMF disbursed loan are censored data, the model can be estimated by a bivariate Tobit model where two Tobit equations are estimated simultaneously. The model can be written as:

$$CA_{it} = \beta k_{it} + \gamma IMF\_GDP3_{it} + \varepsilon_{it} \quad (4.C1)$$

$$IMF\_GDP3_{it} = \delta y_{it} + v_{it} \quad (4.C2)$$

With the disturbances following a bivariate normal distribution:

$$\binom{\varepsilon_{it}}{v_{it}} = N\begin{pmatrix} 0 & \sigma_1^2 & \rho\sigma_1\sigma_2 \\ 0 & \rho\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}$$

CA_{it} denotes the quantity of sovereign debt rescheduling to total external debt ratio[40] and IMF_GDP3_{it} denotes the average of the amount of IMF disbursed loan to GDP ratio during the previous 3 years. Equation (4.C1) describes the quantity of debt rescheduling as a function of the amount of IMF disbursed loan and control variables are summarized in the vectors k_{it}. The coefficient γ is my main object of interest. Equation (4.C2) describes the amount of IMF disbursed loan as a function of the determinants summarized in the vector y_{it}.

Models A, B and C can be estimated if the structural form of the model is identified, which means that there must be at least one variable that is in the first equation but not in the second equation for model A, B and C. In other words, the extra variables do not affect the probability and quantity of debt rescheduling directly, but are only able to influence them through their impact on the probability and amount of the IMF disbursed loan. In order to solve the parameter identification problem for the simultaneous equation I include an additional political variable in the second equation of each model as an instrument variable; more specifically, I employ a variable that measures the percentage of the vote that the country *i* coincides with one of the G7 counties in United Nations (UN) General Assembly within one year. This variable has been suggested to be a significant determinant of participating in an IMF program (Dreher and Walter,

[40] The quantity of debt rescheduling to total debt ratio = the face value of the debt rescheduling effected / country's total external debt

2010). Regarding the validity of the instruments; the relationship between the instrument and IMF programs has to be significant, and this can be shown by the regression output. On the other hand, there should be no relationship between the instrument and sovereign debt rescheduling; this condition is not testable and I can only justify this based on the literature and economic theory. To my knowledge, there is no literature or economic theory suggests that there is a relationship between voting coinciding with G7 countries in the UN General Assembly and sovereign debt rescheduling.

The endogenous nature of IMF interventions is reflected in the correlation between the two error terms ε and v. Because IMF intervention is correlated with v, if v and ε are correlated, then IMF intervention is correlated with ε as well, this indicates the endogenous nature of IMF interventions. Thus I would expect the correlation coefficient ρ to be significant because this confirms the necessity of using simultaneous equation models.

4.4.2 Sub-sample estimation

4.4.2.1 Official debt rescheduling versus commercial debt rescheduling

As mentioned in the literature review, there are two types of debt rescheduling: official rescheduling and commercial rescheduling. Because an official loan is guaranteed and a commercial loan is not, Lee (1991) suggests that the attitude and perception of borrowers and creditors may be different for each type of loan. I follow Lee (1991) to

perform separate tests for official and private rescheduling cases. Debt rescheduling cases are therefore categorized into three groups. These are denoted as:

(a) OFFICIAL: official rescheduling cases;

(b) COMMERCIAL: commercial rescheduling cases;

(c) BOTH: includes both official and commercial rescheduling cases.

When I am estimating models (A), (B) and (C), each model is estimated three times since there are three different dependent variables that take account of debt rescheduling from the BOTH, OFFICIAL or COMMERCIAL groups.

4.4.2.2 Countries with different income levels.

Developing countries differ in the level of their income, stage of economic development, economic information transparency, and institution and policy environments. Due to the differences between developing countries, the effectiveness of signaling may differ, the effect of IMF credit could be different, and the attitude of the creditors towards debt rescheduling could be different. Thus I divide my sample by following the World Bank categories: low income, lower-middle income and upper-middle income. Using the World Bank Atlas method I can convert GNI per capita into US Dollars. The World Bank groups countries according their GNI per capita; for example, in the year 2012, a country belongs to the low-income group if its GNI per capita is $1025 or less; to the lower-middle income if its GNI per capita is between $1036 and $4085, and to the

upper-middle income if its GNI per capita is between $4086 and $12615[41]. The threshold for each GNI per capita group is changing every year according to the World Bank.

The method of separating countries into income bands is as follows: the classification is separated into 5-year intervals, thus the classification of each country can change every five years. The classification is calculated by comparing the average of five years of GNI per capita of that country with the average of the five years threshold GNI per capita[42]. If the classification is missing due to the missing GNI per capita data, I fill the missing classification in as the same as the first available category the country has.

4.4.2.3 Concessional IMF program versus non-concessional IMF program

To capture the impact of IMF intervention I employ four different IMF programs: Stand-by Arrangements (SBA), Extended Fund Facilities (EFF), Structural Adjustment Facilities (ESAF) and Poverty Reduction and Growth Facilities (PRGF). The feature of each program is: Stand-by Arrangements (SBA) are designed to provide short term balance of payment assistance to member countries in order to avert crises and restore sustainable growth. The typical Stand-By Arrangement covers a period of 1–2 years,

[41] Data source: World Bank

[42] GNI per capita is calculated by the World Bank Atlas method

with repayments scheduled between 3.25 and 5 years from the date of the borrowing. Extended Fund Facilities (EFF) are designed for countries who face serious medium-term balance of payment problems because of structural weaknesses. Compared with SBA, EFF provides longer term financing with larger amounts. The EFF arrangement typically lasts up to 3 years, with repayments scheduled over a period of 4.5–10 years. The lending rates for SBA and EFF are not concessional; it depends on the basic rate of charge, amount, and duration of the loan. Structural Adjustment Facilities (ESAF) are designed to providing long-term loans at subsidized interest rates for poor countries. The interest rate charged is 0.5% and repayments are scheduled over 5–10 years after a 5-year grace period. In 1999 the ESAF was replaced by the Poverty Reduction and Growth Facility (PRGF) and the interest rate and repayment schedule are the same.[43]

I follow Dreher and Strum (2011) and categorize IMF programs into two groups: Non-concessional IMF programs including SBA and EFF and Concessional IMF program including ESAF and PRGF programs. Marchesi and Thomas (1999) concluded that under asymmetric information, countries could signal their willingness to undertake economic reform by adopting an IMF program, in other words, by taking an IMF program, the country conveys some information to the market and the creditor, but it is not clear to us which kind of IMF program could convey more information to

[43] Information regarding SBA, EFF, ESAF and PRGF is from IMF website.

the creditor in the case of the debt rescheduling decision, hence it suggests that I should separate IMF programs in the empirical analysis instead of using one variable to capture all of them.

When I am estimating models (A), (B) and (C), each model is estimated two times since there are two different independent variables that take account of IMF program belonging to either the concessional or non-concessional group.

4.3 Data and Variables

My empirical analysis is based on an unbalanced panel of 115 developing countries with annual data from 1970 to 2012. Although the country coverage is dictated by the availability of data on my main variable of interest, the sample countries listed in Appendix 4.A seem to be representative of the broader spread of developing countries[44]. I followed Lee (1991) in starting start my sample in 1970.

For the dependent variables, I use C to indicate a dummy variable for debt rescheduling cases in the BOTH group, $C_{official}$ indicates a dummy variable for debt rescheduling cases in the OFFICIAL group and $C_{commerical}$ indicates a dummy variable for debt rescheduling cases in the COMMERCIAL group. Variable CA indicates the quantity of debt rescheduling to total debt ratio in the BOTH group,

[44] The number of developing countries in 2012 was 150 (IMF Economic Outlook, 2012)

$CA_{official}$ indicates the quantity of debt rescheduling to total debt ratio in the OFFICIAL group and $CA_{commerical}$ indicates the quantity of debt rescheduling to total debt ratio in the COMMERCIAL group. Since the quantity of debt rescheduling to total debt ratio is a very small number, I scale it up by 10000. Table 4.1 shows the number of debt rescheduling cases and the average of the quantity of debt rescheduling to total external debt ratio over a sub-sample periods (in the parentheses). My sample includes 348 official debt rescheduling cases and 129 private debt rescheduling cases in the period from 1970 to 2012. These represent all the debt rescheduling data available. There are very few cases during the 1970s and since the 1980s the average of the quantity of debt rescheduling to total external debt ratio has increased with time.

<Insert Table 4.1 about here>

The main explanatory variable of interest - the participation in an IMF program - is a dummy variable which takes a value of 1 if the country has participated in an IMF program during the previous 3 years (IMF3) in model A. For models B and C, the amount of IMF disbursed loan is measured by the average of the amount of IMF disbursed loan to GDP ratio during the previous 3 years (IMF_GDP3). SBA_EFF3 indicates a dummy variable which takes a value of 1 if the country has participated an IMF non-concessional program during the previous 3 years, ESAF_PRFG3 indicates dummy variable which takes a value of 1 if the country has participated an IMF concessional program during the previous 3 years, SBA_EFF_GDP3 indicates the

average of the amount of IMF non-concessional disbursed loan to GDP ratio during the previous 3 years[45], and ESAF_PRFG_GDP3 indicates the average of the amount of IMF concessional disbursed loan to GDP ratio during the previous 3 years[46].

Another variable of interest is compliance with IMF conditionality. When a country borrows from the IMF, its government has to agree to adjust its economic policies; these loan conditions are called the IMF conditionality. Theoretically, the country has complied with IMF conditionality if it meets all the economic policy adjustment conditions. I follow the method proposed by Dreher (2003) to formulate the proxy for the compliance with IMF conditionality. It is a dummy variable which takes value of 1 (compliance) if at most 25% of the agreed amount of IMF loan remains undrawn. If the undrawn amount is greater than 25%, then the dummy variable takes value of 0 (non-compliance). IMF3COMP indicates a dummy variable which takes the value of 1 if the country has complied with IMF conditionality during the previous 3 years, SBA_EFF3COMP indicates a dummy variable which takes value of 1 if the

[45] The average of the amount of IMF non-concessional disbursed loan to GDP ratio during the previous 3 years = sum of the ratios (the amount of IMF non-concessional disbursed loan to GDP ratio) during the previous 3 years / the number of years that the country has participated in a non-concessional IMF program during the previous 3 years.

[46] The average of the amount of IMF concessional disbursed loan to GDP ratio during the previous 3 years = sum of the ratios (the amount of IMF concessional disbursed loan to GDP ratio) during the previous 3 years / the number of years that the country has participated in a concessional IMF program during the previous 3 years.

country has complied with IMF non-concessional program conditionality during the previous 3 years, and ESAF_PRGF3COMP indicates a dummy variable which takes value of 1 if the country has complied with IMF concessional program conditionality during the previous 3 years. Table 4.2 shows the number of IMF programs, average of the amount of IMF disbursed loan to GDP and compliance rates by sub-periods. The number of IMF interventions during the 1970s was much lower than sub-periods from 1980 to 2012. The average of the amount of disbursed loan to GDP is steady within range between 0.16-0.19 across all sub-periods. Compliance rate increases during the period from 1980-2012, and in the last sub-period from 2000-2012 the compliance rate reaches to 82.49%.

<Insert Table 4.2 about here>

Table 4.3 shows the average number of countries in each income category by sub-period[47]. The total sample for upper-middle income countries is much smaller than that of lower-middle and low income countries. Focusing on each income category; the number of upper-middle income countries increases with time, whereas the number of low income countries decrease with time and the number of lower-middle income

[47] The average number of countries in each income category by sub-periods = the total sample size in the category over the sub-period / the number of years in the sub-period

countries is steady across time. Thus, in general, there is a trend that countries moves to a higher income category with time.

<Insert Table 4.3 about here>

For the determinants of debt rescheduling, my choice of control variables is guided by the theory of Marchesi and Thomas (1999) and the empirical literature on the determinants of sovereign debt rescheduling. The total amount of external debt D is captured by the total external debt to GDP ratio (TED) and the interest arrears on long term debt to export ratio (ILTD) while the amount of investment I is captured by the gross domestic investment to GDP ratio (GDI). $\underline{Q}(2)$ is the country's endowment (in the low endowment case), since it is the future income (other than investment returns) plus reserve. In the empirical model, I assume that it captures the GDP per capita growth rate (GDPPC) and the reserve to GDP ratio (RES). q_H is the probability of getting a high endowment for high productivity country and I follow Marchesi (2003) in that q_H is captured by total value of the country's export (EXP).

From equation (4.1), the higher the D and q_H, the larger the debt overhang effect will be and the higher the probability and the quantity of debt rescheduling will be. Thus an increase in TED, ILTD or EXP should lead to an increase in the probability and quantity of debt rescheduling. Lee (1991) and Marchesi (2003) show expected signs for TED and ILTD respectively and the coefficients are significant. Regarding EXP; although the sign is positive from Marchesi (2003) it is not significant. From

equation (1), The higher the I and $\underline{Q}(2)$, the smaller the debt overhang effect and the lower the probability and quantity of debt rescheduling. Thus an increase in GDI, GDPPC or RES should lead to a decrease in the probability and quantity of debt rescheduling. Lee (1991) and Marchesi (2003) show expected signs for GDPPC and GDI respectively and the coefficients are significant. Regarding RES; although Marchesi (2003) shows that RES is insignificant, Jorra (2012) shows that an increase in reserve could lead to a decrease in the probability of default. I further include the yield of 10 year US Treasury notes (US_notes) to capture the global economic condition. I assume US_note is the world risk free rate and the higher the risk free rate, the less likely the country will be to invest. The larger the debt overhang effect, the higher the probability and quantity of debt rescheduling will be. All the control variables except US_note take one lag and this is to ensure that debt rescheduling is explained solely by already realized values of the explanatory variables.

For the determinants of IMF intervention, my choice of control variable is guided by the literature on IMF interventions and is especially close to the specification of Marchesi (2003). I expect that a country with low exports (EXP), low GDP per capita growth rate (GDPPC), lower investments (GDI) and reserves (RES) to ask for help from IMF. The seeking of an IMF fund is also expected for countries with a high external debt (TED). Since IMF prefers not to grant new loans to a country which is already in arrears with its payments, IMF intervention is less likely for country with a

high arrears in interest payment. Regarding my instrument variable, which is measured as the percentage of the vote of that country coincides with one of the G7 countries in UN General Assembly (VOTE); I expect IMF intervention to be more likely if the country is more politically linked with G7 countries. All the control variables take sufficient lags to ensure that the IMF intervention is explained solely by already realized values of the explanatory variables.

The definition of the variables are presented in Table 4.4 and the source of the data is presented in Appendix 4.B.

The summary statistics are presented in Table 4.5 and the difference in the number of observation is due to the difference in the data availability of each variable.

<Insert Table 4.4 about here>

<Insert Table 4.5 about here>

4.5 Empirical Results

4.5.1 The impact of participation of an IMF program on the probability of debt rescheduling

The results of the bivariate probit regression are summarized in Table 4.6. Panel A presents the estimation results of equation (4.A1), whereas panel B represents the estimation results of equation (4.A2). Column (1) represents the results for all debt rescheduling cases whereas column (2) includes only official rescheduling cases and

column (3) includes only commercial rescheduling cases. All the regression results show that debt rescheduling is more likely to occur in the three years following an IMF program at a significance level of 0.01. These results support hypothesis (H1). Columns (4), (5) and (6) include the compliance with IMF conditionality proxy variable when estimating equation (4.A1). The participation in an IMF program (IMF3) still shows positive and significant results for all three regressions, compliance with IMF conditionality (IMF3COMP) shows positive and significant results for the BOTH and OFFICIAL groups, at the 0.1 level. These results indicate that debt rescheduling becomes more likely if the country complied with IMF conditionality during the three years prior to the debt rescheduling. Regarding the COMMERCIAL group; compliance with IMF conditionality was not significant so this suggests that there is no relationship between the commercial rescheduling and compliance with IMF conditionality. A possible explanation for this could be that participation in an IMF program is used as a signaling tool according to the theory of Marchesi and Thomas (1999), the debtor country should then be rewarded by the rescheduling its debt if the country has participated in an IMF program and complied with the conditionality. In reality, it may be difficult for private creditors to gauge the degree of compliance of the debtor country. The reason comes in two parts, firstly, private creditors have less access to the debtor country's information compared to official creditors, and secondly, each private creditor usually holds a small portion of the country's total debt so the information

searching cost could be high for individual creditors. The idea is similar to the theory of Diamond (1984) who states that if the lenders can appoint a third party financial intermediation to monitor the borrowers, it has a gross cost advantage in collecting information because the alternative is a duplication of effort for each lender to collect the information directly. The estimation results from the BOTH group which includes all the debt rescheduling cases supports hypothesis (H2), thus I can conclude that debt rescheduling becomes more likely if the country has complied with IMF conditionality.

Focusing on the control variables for equation (4.A1); the results show a similar pattern for the BOTH and OFFCIAL groups. Debt rescheduling become more likely with a higher total external debt (TED) and a lower gross domestic investment (GDI), at least at the significance level of 0.1. The positive relationship between debt rescheduling and total external debt is in line with Lee (1991). Debt rescheduling become more likely with a higher interest arrears on long term debt (ILTD) and a higher yield of 10 year US Treasury note (US_note) for all groups, at the significance level of 0.1 and 0.01 respectively. The positive relationship between debt rescheduling and ILTD is in line with Marchesi (2003). In the COMMERCIAL group, I find that some variables (TED, GDPPC and GDI) relate to the country's long term solvency are not significant. On the other hand, only variables relating to short term liquidity are significant. Commercial debt rescheduling become more likely with higher interest arrears on long term debt (ILTD), higher exports (EXP) and higher yield of 10 year US

Treasury note (US_note), at least at the significance level of 0.1. The signs of all the coefficients are in line with my theoretical prediction. From the above discussion I can conclude that the decision of commercial rescheduling depends on the liquidity condition rather than the solvency condition of the debtor country, whereas the decision of official rescheduling depends on both the liquidity and solvency conditions of the debtor country.

The results of the estimation of equation (4.A2) are reported in Panel B. Participation in an IMF program becomes more likely with higher total external debt (TED), lower gross domestic investment (GDI), lower reserve (RES), lower interest arrears on long-term debt (ILTD) and lower exports (EXP) for all the estimations, at least at the significance level of 0.1. The results of TED, GDI, ILTD and EXP are in line with Marchesi (2003), whereas the result of RES is in line with Jorra (2012). The signs of all the coefficients are in line with my expectations. Regarding my instrument variable; VOTE is positive and significant at the 0.01 level for all the estimations and this indicates that it becomes easier for countries to get IMF funding if they are politically aligned with one of the G7 countries.

The estimated correlation coefficient ρ is significant except in columns (2) and (4) and this suggests that a bivariate probit estimation is appropriate in this case.

<Insert Table 4.6 about here>

Table 4.7 summarizes the magnitude of the IMF participation effect. The first row (participation effect) is calculated by equation (4.3) and the second row (relative size) is calculated by equation (4.4). The results for the BOTH group suggest that participation in an IMF program could increase the probability of debt rescheduling by 14.43% and that *ceteris paribus* the chance of having debt rescheduled is 10.43 times higher for a country that has participated in an IMF program. Participation in an IMF program can also increase the probability of official rescheduling by 12.80% and *ceteris paribus* the chance of having debt rescheduled is 26.53 times higher for the country that has participated in an IMF program. Participation of an IMF program could also increase the probability of commercial rescheduling by 3.37% and *ceteris paribus* the chance of having debt rescheduled is 3.66 times higher for the country that has participated in an IMF program. The magnitude of the IMF participation effect on official rescheduling is much larger than on commercial rescheduling. This is because most of the official rescheduling went through the Paris Club[48] and participation in an IMF program is essential to start debt negotiation in the Paris Club (Trebesch, Papaioannou and Das, 2012). Thus in addition to the signaling purpose of an IMF program, participation of an IMF program could help debtor country to settle official rescheduling through the Paris Club.

[48] The Paris Club is an informal group of officials from creditor countries whose role is to find coordinated and sustainable solutions to the payment difficulties experienced by debtor countries.

Although the IMF participation effect on commercial rescheduling is small, the relative size is not small. This suggests that participating in an IMF program could help a country to settle debt rescheduling deals with private creditors.

<Insert Table 4.7 about here>

Table 4.8 summarizes the results when I divide the countries investigated into three categories according their level of income: Upper-middle income (UM), lower-middle income (LM) and low income (L)[49]. Columns (1), (2) and (3) shows the estimation for upper-middle income countries, lower-middle income countries and low income countries respectively. The results suggest that debt rescheduling is more likely if the country has participated in an IMF program during the previous 3 years for both lower-middle income and low income countries, whereas compliance with IMF conditionality only increases the probability of debt rescheduling for the low income countries. Countries with a high income are generally more transparent than those with low income[50]. The asymmetric information problem between the debtor country and the creditor is therefore more severe for low income countries, thus signaling is more effective for countries with a lower income and more signaling is required for countries

[49]Only the estimation of equation (4.A1) is reported in Table 4.8, other results are available on request.

[50] Drabeck and Payne (2002) list 52 countries with their ranking of transparency, it shows the trend that more developed countries have better ranking.

with lower income. This explains two outcomes in my results; firstly, it explains why participation of an IMF program is useful for lower-middle income and low income counties. Secondly, it explains why compliance with IMF conditionality is only useful for low income countries.

Focusing on the control variables; debt rescheduling for upper-middle income countries becomes more likely with higher total external debt (TED), higher interest arrears on long term debt (ILTD), higher yield of 10 year US Treasury note, lower reserve (RES) and lower exports (EXP). The results indicate that the decision of debt rescheduling for upper-middle income countries is based on the financial position of the country. Debt rescheduling for lower-middle income countries becomes more likely with lower GDP per capita growth rate (GDPPC), lower gross domestic investment (GDI), higher interest arrears on long term debt (ILTD) and higher yield of 10 year US Treasury note. GDPPC and GDI are the variables which indicate the country's long term economic growth, thus the decision of debt rescheduling for lower-middle income countries is based on the country's long term growth factors. Debt rescheduling for low income countries becomes more likely with higher total external debt (TED) and lower gross domestic investment (GDI). Thus the decision of debt rescheduling for low income countries is based on the country's debt sustainability. The signs of all the coefficients are in line with my theoretical predictions.

<Insert Table 4.8 about here>

Table 4.9 summarizes the magnitude of the IMF participation effect. For upper-middle income countries, participating in an IMF program could increase the probability of debt rescheduling by 1.04% and *ceteris paribus* the chance of getting debt rescheduled is 0.33 times higher for the country that has participated in an IMF program. For lower-middle income countries, participating in an IMF program could increase the probability of debt rescheduling by 14.59% and *ceteris paribus* the chance of getting debt rescheduled is 33.77 times higher for the country that has participated in an IMF program. For low income countries, participating in an IMF program could increase the probability of debt rescheduling by 17.13% and *ceteris paribus* the chance of getting debt rescheduled is 6.72 times higher for the country that has participated in an IMF program. The participation effect results show that the lower the income of the country, the larger the participation effect; this is because signaling is more effective for a country with a lower income, as explained earlier. For the relative size, participation in an IMF program is more important for lower-middle income countries than low income countries. This is because the base probability of debt rescheduling for low income country is high. In other words, even without IMF program participation, the probability of debt rescheduling for low income countries is already very high due to their weak economic fundamentals and their financial position.

<Insert Table 4.9 about here>

Table 4.10 summarizes the effect of different IMF programs on debt rescheduling[51]. Column (1) shows the estimation of non-concessional IMF programs whereas column (2) shows the estimation of concessional IMF programs. The results suggest that only participating in a non-concessional IMF program increases the probability of debt rescheduling. Regarding the compliance variable; compliance with IMF conditionality for a concessional program shows a positive and significant sign. Again, the explanation is likely to be due to signaling. A concessional IMF program is more like an aid to the country, thus participation in such a program does not send a strong signal to creditors about its willingness to reform unless the country has complied with IMF conditionality. The control variables for both estimations show the same pattern and the signs of all the coefficients are in line with my theoretical predictions.

<Insert Table 4.10 about here>

4.5.2 The impact of the amount of IMF loan on the probability of debt rescheduling.

Table 4.11 summarizes the results of the Probit-Tobit estimation. Panel A represents the estimation results of equation (4.B1) whereas panel B represents the estimation results of equation (4.B2). Column (1) represents the results for all debt rescheduling cases whereas column (2) includes only official rescheduling cases and column (3)

[51]Only the estimation of equation (4.A1) is reported in Table 4.10, other results are available on request.

includes only commercial rescheduling cases. Columns (4), (5) and (6) include the compliance with IMF conditionality proxy variable when estimating equation (4.B1). IMF_GDP3 is not significant for all regressions and this result does not support hypothesis (H4). In the robustness check section, I will change the time horizon employed in the measurement of the IMF program to check whether there is any evidence to support hypothesis (H4), in particular, I will check whether the amount of the IMF disbursed loan during the previous 2 years or 1 year affects the probability of debt rescheduling. Compliance with IMF conditionality shows positive and significant signs for both the BOTH and OFFICIAL groups at a significance level of at least 0.05. These results are the same as those in section 4.5.1 which support hypothesis (H2). This indicates that compliance with IMF conditionality during the past three years could significantly increase the probability of debt rescheduling.

Focusing on the control variables for equation (4.B1); the results are similar for all three groups. Debt rescheduling becomes more likely with a higher total external debt (TED), lower gross domestic investment (GDI), lower reserve (RES), higher exports (EXP) and higher yield of 10 year US Treasury note for all three groups, at a significance level of at least 0.1. Furthermore, for the BOTH group, debt rescheduling become more likely with less GDP per capita growth rate (GDPPC), at a significance level of 0.1. The signs of all the coefficients are in line with my theoretical predictions.

Turning to the estimation of equation (4.B2); the amount of IMF disbursed loan is significantly increased with higher total external debt (TED), lower reserve (RES) and interest arrears on long-term debt, at a significance level of at least 0.1. VOTE is positive and significant at the 0.1 level for all three groups and this indicates that a country will be granted a larger IMF loan if they are politically aligned with one of the G7 countries. The signs of all the coefficients are in line with my theoretical predictions.

The estimated correlation coefficient ρ is significant for all the estimations and this suggests that a Probit-Tobit estimation is appropriate in this case.

<Insert Table 4.11 about here>

Table 4.12 summarizes the results when I divide the countries into three categories according their level of income: upper-middle income (UM), lower-middle income (LM) and low income (L)[52]. Columns (1), (2) and (3) show the estimation for upper-middle income countries, lower-middle income countries and low income countries respectively. The results suggest that the probability of debt rescheduling and the amount of IMF disbursed loan during the previous 3 years are negatively correlated for lower-middle income countries. The sign of the relationship is in line with my prediction but the relationship is ambiguous for upper-middle income and low income

[52]Only the estimation of equation (4.B1) is reported in Table 4.12, other results are available on request.

countries. As I mentioned earlier, the IMF credit is directly associated with country's reserve and investment and these two variables are significant determinants of the probability of debt rescheduling for lower-middle income countries. This explain why the amount of IMF disbursed loan (IMF_GDP3) only matters for lower-middle income countries. The results for the compliance and control variables are the same as in Section 4.5.1.

<Insert Table 4.12 about here>

Table 4.13 summarizes the effect of the amount of disbursed IMF loan from different IMF programs on debt rescheduling[53]. Column (1) shows the estimation of non-concessional IMF programs whereas column (2) shows the estimation of concessional IMF programs. The results show that the probability of debt rescheduling and the amount of the non-concessional IMF disbursed loan are negatively correlated, but there is no relationship between the probability of debt rescheduling and the amount of the concessional IMF disbursed loan. Most of the concessional IMF loans go to the poor countries and Butkiewicz and Yanikkaya (2005) show that lagged IMF credit is positively linked to the investment in middle income countries and is negatively linked to the investment in low income countries. This might be due to the misallocation of the credit. Burnside and Dollar (2000) show that the impact of international aid depends

[53]Only the estimation of equation (4.B1) is reported in Table 4.13, other results are available on request.

on the quality of state institutions and policies because if these are in a bad state, the IMF credit going to poor countries might not be used for investment, thus it might not improve the economic fundamentals and reduce the probability of debt rescheduling. The results for compliance and control variables are the same as in Section 4.5.1.

<Insert Table 4.13 about here>

4.5.3 How does the amount of IMF loan affect the quantity of debt rescheduling

Table 4.14 summarizes the results of the Probit-Tobit estimation. Panel A represents the estimation results of equation (4.C1) whereas panel B represents the estimation results of equation (4.C2). Column (1) represents the results for all debt rescheduling cases whereas column (2) includes only official rescheduling cases and column (3) includes only commercial rescheduling cases. Columns (4), (5) and (6) include the compliance with IMF conditionality proxy variable when estimating equation (4.C1). IMF_GDP3 is not significant for all regressions and this result does not support my hypothesis (H5). In the robustness check section, I will change the time horizon employed in the measurement of the IMF program to check whether there is evidence to support hypothesis (H5), in particular I will check whether the amount of IMF disbursed loan during the previous 2 years or 1 year affects the quantity of debt rescheduling. Compliance with IMF conditionality is positive and significant at the 0.01 level for the BOTH and OFFICIAL groups and these results support hypothesis (H5). This indicates that compliance with IMF conditionality during the past three years could

significantly increase the quantity of debt rescheduling. Compliance with IMF conditionality is not significant for the COMMERCIAL group and the explanation for this is the same as in section 4.5.1.

Focusing on the control variables in equation (4.C1); the results are similar for all three groups. The quantity of debt rescheduling increases with a higher total external debt (TED), lower gross domestic investment (GDI) and lower reserve (RES), at a significance level of at least 0.1. Furthermore, the quantity of debt rescheduling increases with a higher yield of 10 year US Treasury note at a significance level of at least 0.05 except for the OFFICIAL group. The signs of all the coefficients are in line with my theoretical predictions.

Turning to the estimation of equation (4.C2). The amount of the IMF disbursed loan will be significantly increased with a higher total external debt (TED), lower reserve (RES) and interest arrears on long-term debt (ILTD), at a significance level of at least 0.1. VOTE is positive and significant at a level of 0.1 for all three groups and this indicates that a country will be granted a larger IMF loan if they are politically aligned with one of the G7 countries.

The estimated correlation coefficient ρ is significant except in column (6) and this suggests that a bivariate Tobit estimation is appropriate in this case.

<Insert Table 4.14 about here>

Table 4.15 summarizes the results when I divide the countries into three categories according their level of income: upper-middle income (UM), lower-middle income (LM) and low income (L)[54]. Columns (1), (2) and (3) shows the estimation for upper-middle income countries, lower-middle income countries and low income countries respectively. The results suggest that the quantity of debt rescheduling is negatively correlated with the amount of IMF disbursed loan for lower-middle income countries only. Compliance with IMF conditionality during the previous 3 years increases the quantity of debt rescheduling for low income countries. The explanations for this are the same as in section 4.5.1 and 4.5.2.

Focusing on the control variables; the pattern is similar to the case where the dependent variable is the probability of debt rescheduling. The quantity of debt rescheduling for upper-middle income countries, lower-middle income countries and low income countries depends on the country's financial position, long term economic growth factors and debt sustainability respectively. The signs of the coefficients are in line with the theoretical predictions.

<Insert Table 4.15 about here>

[54]Only the estimation of equation (4.C1) is reported in Table 4.15, other results are available on request.

Table 4.16 summarizes the effect of the amount of the disbursed IMF loan from different IMF programs on debt rescheduling[55]. Column (1) shows the estimation of non-concessional IMF programs whereas column (2) shows the estimation of concessional IMF programs. The results show that the quantity of debt rescheduling and the amount of non-concessional IMF disbursed loan are negatively correlated, but there is no relationship between the quantity of debt rescheduling and the amount of concessional IMF disbursed loan. Compliance with IMF conditionality for concessional programs shows a positive and significant sign. The explanations for this are the same as in sections 4.5.1 and 4.5.2.

<Insert Table 4.16 about here>

4.6 Robustness Check

In order to test the sensitivity of my results on the choice of the time horizon employed in the measurement of IMF program I now adjust the time horizon to the previous 2 years and 1 year and retest all the estimations in section 4.5[56].

[55]Only the estimation of equation (4.C1) is reported in Table 4.16, other results are available on request

[56] I only report the coefficient of the variables of my main interest, other results are available on request.

Table 4.17 summarizes the results of the bivariate probit estimation. IMF2 and IMF1 indicate participation in an IMF program during the previous 2 and 1 years respectively. IMF2COMP, and IMF1COMP indicate compliance with IMF conditionality during previous 2 and 1 years respectively. The results are in line with my estimations in section 4.5.1 in that participating in an IMF program increases the probability of debt rescheduling and compliance with IMF conditionality increases the probability of debt rescheduling.

<Insert Table 4.17 about here>

Table 4.18 summarizes the results of the bivariate probit estimation for countries with different levels of income and the results for lower-middle income and low income countries are in line with my estimations in section 4.5.1. Regarding the upper-middle income countries; participating in an IMF program becomes positive and significant when I adjust the time horizon to the previous 2 years or 1 year. Even though this is only significant at the 0.1 level (compared with 0.01 for lower-middle and low income countries) I can still conclude that participation in an IMF program is more important for lower-middle income and low income countries in order to get their debt rescheduled.

<Insert Table 4.18 about here>

Table 4.19 summarizes the results of the bivariate probit estimation for different IMF programs. SBA_EFF2 and SBA_EFF1 indicate participation in a non-

concessional IMF program during the previous 2 and 1 years respectively. SBA_EFF2COMP and SBA_EFF1COP indicate compliance with IMF conditionality for non-concessional programs during the previous 2 and 1 years respectively. SAF_PRGF2 and SAF_PRGF1 indicate participation in a concessional IMF program during the previous 2 and 1 years respectively. SAF_PRGF2COMP and SAF_PRGF1COMP indicate compliance with IMF conditionality for concessional programs during the previous 2 and 1 years respectively. The results for non-concessional IMF programs are in line with my estimations in section 4.5.1. Regarding the results for concessional IMF programs; compliance with IMF conditionality for concessional IMF programs becomes insignificant when I adjust the time horizon to the previous 2 years or 1 year. As I mentioned earlier in section 4.5.1, participation in a concessional IMF program could not signal the country's willingness to reform unless the country has complied with the IMF conditionality. Combining the results from Table 4.10 and Table 4.19, I can conclude that even compliance with concessional IMF conditionality is not an effective signaling tool unless the country had a long history of compliance, for example for 3 years.

<Insert Table 4.19 about here>

Table 4.20 summarizes the results of the Probit-Tobit estimation. IMF_GDP2 and IMF_GDP1 indicate the IMF disbursed loan during the previous 2 and 1 years. The results for the compliance variable are in line with estimation in section 4.5.2. In

contrast with the results from section 4.5.2, the amount of IMF disbursed loan becomes negative and significant for all three groups when I adjust the time horizon to the previous 2 and 1 years. This result supports my hypothesis (H4), thus the probability of debt rescheduling and the amount of IMF loan in the short term is negatively correlated. Theoretically, a larger amount of IMF credit is associated with an increase in reserve and investment and increase in reserve could prevent a country from default in short term, whereas an increase in investment could prevent country from default in long term. Empirically, Butkiewicz and Yanikkaya (2005) show that the amount of IMF credit could lead to a decrease in investment. This explains why the amount of IMF credit only has short term effect on the probability of debt rescheduling.

<Insert Table 4.20 about here>

Table 4.21 summarizes the results of the Probit-Tobit estimation for countries with different levels of income. The results are in line with the estimation in section 4.5.2.

<Insert Table 4.21 about here>

Table 4.22 summarizes the results of the Probit-Tobit estimation for different IMF programs. SBA_EFF_GDP2 and SBA_EFF_GDP1 indicate the amount of non-concessional IMF program disbursed loan during the previous 2 and 1 years respectively. SAF_PRGF_GDP2 and SAF_PRGF_GDP1 indicate the amount of concessional IMF program disbursed loan during the previous 2 and 1 years respectively. The results are in line with estimation in section 4.5.2.

<Insert Table 4.22 about here>

Table 4.23 summarizes the results of the bivariate Tobit estimation. In contrast with the estimation in section 4.5.3, compliance with IMF conditionality become positive and significant for the COMMERICAL group when I adjust the time horizon to the previous 2 and 1 years. Regarding the amount of IMF disbursed loan; when the time horizon adjusts to the previous 1 year, the amount of IMF disbursed loan becomes negative and significant for all three groups. This evidence supports my hypothesis (H5) and indicates that the quantity of debt rescheduling is less with a higher amount of IMF disbursed loan during the previous 1 year. The reason why the amount of IMF loan only has a short term effect is explained earlier in Table 4.20.

<Insert Table 4.23 about here>

Table 4.24 summarizes the results of the bivariate tobit estimation for countries with different levels of income. The results are in line with the estimation in section 4.5.3.

<Insert Table 4.24 about here>

Table 4.25 summarizes the results of the bivariate tobit estimation for different IMF programs. The results for non-concessional IMF programs are in line with my estimations in section 4.5.3. Regarding the results for concessional IMF program; compliance with IMF conditionality for concessional IMF programs becomes insignificant when I adjust the time horizon to the previous 2 or 1 years. The

explanation for this phenomenon is the same as the explanation for the results in Table 4.19.

<Insert Table 4.25 about here>

4.7 Conclusion

To evaluate the effect of IMF intervention on sovereign debt rescheduling I applied simultaneous equation estimations for 115 countries from 1970 to 2013. My results suggest that participating in an IMF program during the previous 3 years increases the probability of subsequent debt rescheduling by 14.43%. The probability and quantity of debt rescheduling is negatively correlated with the amount of IMF disbursed loan in the short term. Debt rescheduling is more likely if the country has complied with IMF conditionality.

The results regarding countries with different levels of income suggest that participating in an IMF program increases the probability of subsequent debt rescheduling for all types of countries and the participation effect is larger for countries with lower income. The probability and quantity of debt rescheduling is negatively correlated with the amount of IMF disbursed loan for lower-middle income countries only. Creditors only pay attention to the degree of compliance for low income countries and the probability and the quantity of debt rescheduling is larger if the low income country has complied with IMF conditionality.

The results regarding different IMF programs suggest that participating in a non-concessional IMF program could increase the probability of debt rescheduling, but the probability and the quantity of debt rescheduling are negatively correlated with the amount of non-concessional IMF loan.

My results have several implications: from the policy maker's point of view, if they would like to signal willingness to reform and reschedule debt, only participating in a non-concessional IMF program could satisfy this purpose, and it is more effective for lower-middle and low income countries. Compliance with the IMF conditionality could enhance the signal, especially for low income countries. Furthermore, the government of the recipient country should keep the amount of IMF loan as low as possible. From the investor's point of view, the risk of a country's sovereign bond would be different if the country had participated in an IMF program and the investor has to consider the IMF factor when they pricing the sovereign bond. Under debt rescheduling, the recovery rate should be higher than the default and this can be derived from the debt overhang argument (Krugman, 1988), since participating in an IMF program could increase the probability of debt rescheduling. This in turn means that adopting an IMF program could affect the expected recovery rate of the sovereign bond, thus it effects the price of the sovereign bond.

One may argue that the effectiveness of IMF interventions may vary across different time periods, especially the particularly volatile time during various crises. In

order to capture the potential impacts during financial crisis periods, I included dummy variables to indicate major financial crisis periods[57], but none of the dummies were statistically significant. Another possible way to investigate the potential time effect is to divide the sample period into sub-sample periods. However this is limited by the available number of rescheduling cases during sub-periods, hence it is not feasible for the method used here.

Although this chapter has shown that country could benefit from participating an IMF program through increasing in the probability of debt rescheduling, other studies (Barro and Lee, 2005; Dreher, 2006; Prezeworski and Vreeland, 2000) show the negative effect of IMF lending on the economic growth. Future research could analyze the overall effect of IMF lending by considering both positive and negative effect, I speculate that, whether the positive effect dominates depends on the attribute of the country.

[57] Including the Latin American crisis (1981-1990), Tequila crisis (1994), Asian crisis (1997-1998), dotcom bubble (1999-2000), global financial crisis (2007-2008) and European debt crisis (2010-2012).

Table 4.1 Number of debt rescheduling cases by sub-period

Year	BOTH	OFFICAL	COMERCIAL
1970-1979	11	9	3
	(2.84)	(3.14)	(1.00)
1980-1989	149	117	62
	(1.04)	(0.61)	(1.33)
1990-1999	154	120	46
	(1.30)	(0.97)	(1.84)
2000-2012	118	102	18
	(1.87)	(1.76)	(2.29)
Total	432	348	129

Note: Figures in parentheses are the average of the quantity of debt rescheduling to total external debt ratio. Average of the quantity of debt rescheduling to total external debt ratio = Sum of the ratios (quantity of debt rescheduling to total external debt ratio) / number of rescheduling cases

Table 4.2 Number of IMF programs and number of cases compliant with IMF conditionality by sub-period.

Year	IMF	Compliance	Compliance Rate
1970-1979	135	51	37.78%
	(0.04)		
1980-1989	315	97	30.79%
	(0.16)		
1990-1999	454	263	57.93%
	(0.19)		
2000-2012	417	344	82.49%
	(0.16)		

Note: Figures in parentheses are the average of the amount of IMF disbursed loan to GDP.
The average of the amount of IMF disbursed loan to GDP = sum of the ratios (the amount of IMF disbursed loan to GDP) / number of IMF programs

Table 4.3 Average number of countries in each income category by sub-period

Year	Upper-middle income	Lower-middle income	Low income
1970-1979	10	53	52
1980-1989	10	53	52
1990-1999	14.5	44.5	56
2000-2012	32.5	44.5	38

Note: The average number of countries in each income category by sub-periods = Total sample size in the category over the sub-period / number of years in the sub-period

Table 4.4 Variable definitions and expected signs

Variable	Definition	Sign for C	Sign for IMF
C	Debt rescheduling (dummy)		
CA	Quantity of debt rescheduling		
$C_{official}$	Official debt rescheduling (dummy)		
$CA_{official}$	Quantity of official debt rescheduling		
$C_{commerical}$	Commercial debt rescheduling (dummy)		
$CA_{commerical}$	Quantity of commercial debt Rescheduling		
IMF3	IMF program during previous 3 years	+	NA
IMF_GDP3	Average amount of IMF loan to GDP during previous 3 years	-	NA
IMF3COMP	Compliance with IMF conditionality during previous 3 years (dummy)	+	NA
SBA_EFF3	Non-concessional IMF program during previous 3 years	+	NA
SBA_EFF_GDP3	Average amount of Non-concessional IMF loan to GDP during previous 3 years	-	NA
SBA_EFF3COMP	Compliance with non-concessional IMF conditionality during previous 3 years (dummy)	+	NA
SAF_PRGF3	Concessional IMF intervention during previous 3 years	+	NA
SAF_PRGF_GDP3	Average amount of concessional IMF loan to GDP during previous 3 years	-	NA
SAF_PRGF3_COMP	Compliance with concessional IMF conditionality during previous 3 years (dummy)	+	NA
TED	Total external debt to GDP ratio	+	+
GDPPC	GDP per capita growth rate	-	-
GDI	Gross domestic investment to GDP ratio	-	-
RES	Reserve to GDP ratio	-	-
ILTD	Interest arrears on long term debt to export ratio	+	-
EXP	Export to GDP ratio	+	-
US_note	10 year US Treasury note yield	+	NA

(Continued)

VOTE	Percentage of the vote of that country coincides with one of the G7 country in UN General Assembly	NA	+

Note: Column 3 shows the expected sign for the determinants of debt rescheduling. Column 4 shows the expected sign for the determinants of IMF intervention.

Data source: detail of data source is shown in Appendix 4.B

Table 4.5 Summary statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
C	0.09	0.28	0.00	1.00	4945
CA	0.12	0.81	0.00	32.61	4945
$C_{official}$	0.07	0.26	0.00	1.00	4945
$CA_{official}$	0.08	0.70	0.00	32.61	4945
$C_{commerical}$	0.03	0.16	0.00	1.00	4945
$CA_{commerical}$	0.04	0.41	0.00	10.92	4945
IMF3	0.45	0.50	0.00	1.00	4945
IMF_GDP3	0.07	0.18	0.00	3.19	4945
IMF3COMP	0.10	0.30	0.00	1.00	4945
SBA_EFF3	0.29	0.45	0.00	1.00	4945
SBA_EFF_GDP3	0.03	0.09	0.00	1.22	4945
SBA_EFF3COMP	0.04	0.20	0.00	1.00	4945
SAF_PRGF3	0.20	0.40	0.00	1.00	4945
SAF_PRGF_GDP3	0.04	0.16	0.00	3.19	4945
SAF_PRGF_GDP3COMP	0.06	0.24	0.00	1.00	4945
TED	61.62	85.94	0.00	1829.49	4055
GDPPC	6.88	15.18	-65.39	114.79	4166
GDI	21.68	8.76	-2.42	154.80	3744
RES	13.42	14.36	-0.48	170.57	3922
ILTD	1.41	19.58	0.00	448.31	3606
EXP	31.61	19.97	2.52	166.36	4065
US_note	6.98	2.74	1.80	13.92	4945
VOTE	0.38	0.15	0.00	0.91	3930

Note: C = Dummy variable for debt rescheduling. CA = Quantity of debt rescheduling.

$C_{official}$ = Dummy variable for official debt rescheduling. $CA_{official}$ = Quantity of official debt rescheduling. $C_{commerical}$ = Dummy variable for commercial debt rescheduling. $CA_{commerical}$ = Quantity of commercial debt rescheduling. IMF3 = Dummy variable for IMF program during the previous 3 years. IMF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. IMF3COMP = Dummy variable for compliance with IMF compliance with IMF conditionality during the previous 3 years. SBA_EFF3 = Dummy variable for non-concessional IMF program during the previous 3 years. SBA_EFF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. SBA_EFF3COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 3 years. SAF_PRGF3 = Dummy variable for concessional IMF program during the previous 3 years. SAF_PRGF_GDP3 = Average of the amount of concessional IMF loan to GDP during the previous 3 years. SAF_PRGF3COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 3 years. TED = Total external debt to GDP ratio. GDPPC = GDP per capita growth rate. GDI = Gross domestic investment to GDP ratio. RES = Reserve to GDP ratio. ILTD = Interest arrears on long term debt to export ratio. US_note = 10 year US Treasury note yield. VOTE = The percentage of the vote that coincides with G7 countries in UN General Assembly.

Data source: detail of data source is shown in Appendix 4.B

Table 4.6 Bivariate probit model estimations

Panel A: Estimation of equation (4.A1)

	(1)	(2)	(3)	(4)	(5)	(6)
	BOTH	OFFICIAL	COMMERICAL	BOTH	OFFICIAL	COMMERICAL
Dependent Variable:						
The probability of debt rescheduling						
IMF3	1.971***	2.020***	1.711***	1.925***	1.963***	1.703***
	(8.47)	(4.06)	(4.78)	(8.15)	(3.95)	(4.74)
IMF3COMP				0.150*	0.148*	0.030
				(1.85)	(1.82)	(0.27)
L.TED	0.002**	0.002*	-0.001	0.002**	0.002**	-0.001
	(2.20)	(1.93)	(-0.86)	(2.21)	(1.98)	(-0.86)
L.GDPPC	-0.003	-0.002	-0.004	-0.003	-0.002	-0.004
	(-1.38)	(-0.80)	(-1.10)	(-1.34)	(-0.75)	(-1.09)
L.GDI	-0.012*	-0.013*	-0.010	-0.013**	-0.014*	-0.010
	(-1.95)	(-1.87)	(-1.17)	(-2.04)	(-1.95)	(-1.18)
L.RES	-0.006	-0.008	-0.006	-0.007	-0.008	-0.006
	(-1.10)	(-1.17)	(-0.72)	(-1.17)	(-1.25)	(-0.73)
L.ILTD	0.003*	0.003*	0.003*	0.003*	0.003*	0.003*
	(1.65)	(1.65)	(1.85)	(1.68)	(1.67)	(1.85)
L.EXP	0.003	-0.000	0.009***	0.003	0.000	0.010***
	(1.15)	(-0.15)	(3.39)	(1.37)	(0.03)	(3.39)
US_note	0.079***	0.059***	0.116***	0.081***	0.061***	0.116***
	(4.45)	(3.57)	(4.79)	(4.51)	(3.62)	(4.87)
_cons	-2.903***	-2.993***	-3.506***	-2.912***	-2.993***	-3.509***
	(-14.66)	(-8.14)	(-15.51)	(-14.64)	(-8.14)	(-15.66)

(Continued)

Panel B: Estimation of equation (4.A2)

	(1) BOTH	(2) OFFICIAL	(3) COMMERICAL	(4) BOTH	(5) OFFICIAL	(6) COMMERCIAL
Dependent Variable:						
IMF3						
L4.TED	0.006**	0.006**	0.006**	0.006**	0.006**	0.006**
	(2.44)	(2.42)	(2.48)	(2.44)	(2.42)	(2.48)
L4.GDPPC	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(-1.40)	(-1.21)	(-1.36)	(-1.39)	(-1.20)	(-1.36)
L4.GDI	-0.013*	-0.013*	-0.013*	-0.013*	-0.013*	-0.013*
	(-1.70)	(-1.72)	(-1.70)	(-1.71)	(-1.72)	(-1.70)
L4.RES	-0.028***	-0.028***	-0.029***	-0.028***	-0.028***	-0.029***
	(-3.97)	(-3.88)	(-4.05)	(-3.96)	(-3.89)	(-4.05)
L4.ILTD	-0.011***	-0.012**	-0.012***	-0.011***	-0.012**	-0.012***
	(-3.07)	(-2.41)	(-2.59)	(-3.13)	(-2.45)	(-2.59)
L4.EXP	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(-2.80)	(-2.82)	(-2.73)	(-2.80)	(-2.82)	(-2.73)
L4.VOTE	1.231***	1.239***	1.241***	1.236***	1.243***	1.242***
	(3.21)	(3.14)	(3.20)	(3.23)	(3.16)	(3.21)
_cons	0.381*	0.378*	0.392*	0.380*	0.378*	0.392*
	(1.73)	(1.69)	(1.76)	(1.72)	(1.68)	(1.76)
ρ	-0.573**	-0.391	-0.821**	-0.563**	-0.375	-0.820**
	(-2.23)	(-0.96)	(-2.50)	(-2.24)	(-0.94)	(-2.50)
N	2547	2547	2547	2547	2547	2547

Note: IMF3 = Dummy variable for IMF program during the previous 3 years. IMF3COMP = Dummy variable for compliance with IMF conditionality during the previous 3 years. TED = Total external debt to GDP ratio. GDPPC = GDP per capita growth rate. GDI = Gross domestic investment to GDP ratio. RES = Reserve to GDP ratio. ILTD = Interest arrears on long term debt to export ratio. US_note = 10 year US Treasury note yield. VOTE = The percentage of the vote that coincides with G7 countries in UN General Assembly. L indicates lags.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main Results: IMF3 is significant for all regression with positive sign. IMF3COMP is significant for BOTH and OFFICIAL group with positive sign.

Table 4.7 Magnitude of IMF participation effect

	BOTH	OFFICIAL	COMMERICAL
Participation effect	14.43%	12.80%	3.37%
Relative size	10.43	26.53	3.66

Note: Participation effect is calculated by estimating equation (4.3). Relative size is calculated by estimating equation (4.4)

Table 4.8 Bivariate-Probit estimations for countries with different levels of income

	(1)	(2)	(3)
	UM	LM	L
Dependent Variable:			
The probability of debt rescheduling			
IMF3	0.405	2.527***	2.296***
	(0.94)	(6.33)	(7.82)
IMF3COMP	-0.145	0.085	0.118*
	(-0.48)	(0.66)	(1.88)
L.TED	0.017***	0.004	0.001**
	(3.04)	(1.53)	(2.02)
L.GDPPC	0.004	-0.009**	-0.000
	(0.57)	(-2.49)	(-0.06)
L.GDI	0.000	-0.019*	-0.012***
	(0.03)	(-1.77)	(-5.70)
L.RES	-0.033**	-0.018	0.002
	(-2.29)	(-1.58)	(0.36)
L.ILTD	0.520***	0.003*	0.003
	(5.02)	(1.81)	(1.42)
L.EXP	-0.015*	-0.000	0.001
	(-1.72)	(-0.07)	(0.33)
US_note	0.141***	0.075***	0.035
	(3.41)	(3.37)	(1.52)
_cons	-2.703***	-2.990***	-2.778***
	(-3.69)	(-7.54)	(-9.45)
N	488	1050	1009

Note: Same as Table 4.6

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: IMF3 is significant for lower-middle income and low income countries with positive sign. IMF3COMP is significant for low income countries with positive sign.

Table 4.9 Magnitude of IMF participation effect for countries with different levels of income

	UM	LM	L
Participation effect	1.04%	14.59%	17.13%
Relative size	0.33	33.77	6.72

Note: Participation effect is calculated by estimating equation (3). Relative size is calculated by estimating equation (4)

Table 4.10 Bivariate-Probit estimations for different IMF programs

	(1) Non-concessional	(2) Concessional
Dependent Variable:		
The probability of debt rescheduling		
SBA_EFF3	0.939***	
	(3.05)	
SBA_EFF3COMP	-0.011	
	(-0.06)	
SAF_PRGF3		0.288
		(0.78)
SAF_PRGF3COMP		0.179*
		(1.72)
L.TED	0.004***	0.003***
	(3.75)	(3.91)
L.GDPPC2	-0.003	-0.004
	(-1.57)	(-1.44)
L.GDI	-0.016**	-0.018***
	(-2.31)	(-2.89)
L.RES	-0.009*	-0.016**
	(-1.66)	(-2.38)
L.ILTD	-0.001	-0.000
	(-0.53)	(-0.23)
L.EXP	-0.003	0.000
	(-1.36)	(0.06)
US_note	0.041**	0.103***
	(2.43)	(5.22)
_cons	-1.472***	-1.669***
	(-9.51)	(-6.04)
N	2547	2547

Note: SBA_EFF3 = Dummy variable for non-concessional IMF program during the previous 3 years. SBA_EFF3COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 3 years. SAF_PRGF3 = Dummy variable for concessional IMF program during the previous 3 years. SAF_PRGF3COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 3 years. Other variables definition– same as Table 4.6.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: SBA_EFF3 is significant with positive sign. SAF_PRGF3COMP is significant with positive sign.

Table 4.11 Probit-Tobit model estimations

Panel A: Estimation of equation (4.B1)

	(1) BOTH	(2) OFFICIAL	(3) COMMERICAL	(4) BOTH	(5) OFFICIAL	(6) COMMERICL
Dependent Variable:						
The probability of debt rescheduling						
IMF_GDP3	-0.127	-0.168	-0.031	-0.258	-0.296	-0.100
	(-0.47)	(-0.60)	(-0.13)	(-0.85)	(-0.92)	(-0.39)
IMF3COMP				0.330***	0.332***	0.134
				(3.89)	(4.03)	(1.08)
L.TED	0.004***	0.004***	0.002***	0.004***	0.004***	0.002***
	(3.26)	(3.34)	(2.98)	(3.25)	(3.34)	(2.99)
L.GDPPC	-0.004*	-0.003	-0.004	-0.003*	-0.003	-0.004
	(-1.91)	(-1.51)	(-1.14)	(-1.75)	(-1.35)	(-1.10)
L.GDI	-0.019***	-0.018***	-0.020***	-0.019***	-0.018***	-0.020***
	(-3.28)	(-2.83)	(-3.17)	(-3.31)	(-2.83)	(-3.17)
L.RES	-0.019***	-0.018**	-0.016*	-0.019***	-0.018**	-0.016*
	(-2.83)	(-2.43)	(-1.96)	(-2.80)	(-2.42)	(-1.92)
L.ILTD	-0.003	-0.004*	0.002	-0.002	-0.003	0.003
	(-1.20)	(-1.82)	(0.87)	(-0.79)	(-1.40)	(0.99)
L.EXP	0.036**	0.024	0.082***	0.041**	0.029*	0.084***
	(2.26)	(1.46)	(4.24)	(2.54)	(1.75)	(4.37)
US_note	0.004***	0.004***	0.002***	0.004***	0.004***	0.002***
	(3.26)	(3.34)	(2.98)	(3.25)	(3.34)	(2.99)
_cons	-1.006***	-1.042***	-2.019***	-1.108***	-1.148***	-2.058***
	(-6.94)	(-6.54)	(-11.61)	(-7.89)	(-7.47)	(-11.72)

(Continued)

Panel B: Estimation of equation (4.B2)

	(1) BOTH	(2) OFFICIAL	(3) COMMERICAL	(4) BOTH	(5) OFFICIAL	(6) COMMERICL
Dependent Variable:						
IMF_GDP3						
L4.TED	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(3.29)	(3.26)	(3.30)	(3.29)	(3.26)	(3.30)
L4.GDPPC	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.02)	(-0.15)	(-0.22)	(-0.04)	(-0.17)	(-0.22)
L4.GDI	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(-1.25)	(-1.24)	(-1.28)	(-1.25)	(-1.24)	(-1.28)
L4.RES	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
	(-3.79)	(-3.83)	(-3.80)	(-3.79)	(-3.84)	(-3.80)
L4.ILTD	-0.021*	-0.021*	-0.020	-0.021*	-0.021*	-0.020*
	(-1.76)	(-1.69)	(-1.64)	(-1.77)	(-1.70)	(-1.65)
L4.EXP	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.96)	(-0.95)	(-0.97)	(-0.97)	(-0.96)	(-0.97)
L4.VOTE	0.191*	0.196*	0.195*	0.190*	0.195*	0.195*
	(1.82)	(1.84)	(1.84)	(1.80)	(1.83)	(1.83)
_cons	-0.056	-0.057	-0.053	-0.055	-0.056	-0.053
	(-0.65)	(-0.66)	(-0.61)	(-0.64)	(-0.65)	(-0.61)
P	0.300***	0.297***	0.131*	0.292***	0.289***	0.132*
	(5.15)	(4.77)	(1.68)	(4.94)	(4.51)	(1.66)
N	3427	3427	3427	3427	3427	3427

*Note:*IMF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. Other variables definition – same as Table 4.6.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main Results: IMF_GDP3 is insignificant for all regression. IMF3COMP is significant for BOTH and OFFICIAL group with positive sign.

Table 4.12 Probit-Tobit estimations for countries with different levels of income

	(1)	(2)	(3)
	UM	LM	L
Dependent Variable:			
The probability of debt rescheduling			
IMF_GDP3	-0.186	-1.443**	-0.061
	(-0.21)	(-2.22)	(-0.15)
IMF3COMP	-0.138	0.217	0.404***
	(-0.59)	(1.50)	(3.65)
L.TEDG	0.018***	0.011***	0.002**
	(3.23)	(4.55)	(2.29)
L.GDPPC2	0.006	-0.005	-0.001
	(0.69)	(-1.51)	(-0.55)
L.GDI	-0.015	-0.023***	-0.019**
	(-0.60)	(-2.78)	(-2.03)
L.RES	-0.042**	-0.025**	-0.007
	(-2.50)	(-2.34)	(-0.84)
L.ILTD	0.422***	-0.003	-0.009
	(3.14)	(-1.36)	(-0.39)
L.EXP	-0.016**	-0.005	0.004
	(-2.44)	(-0.94)	(0.84)
US_note	0.132***	0.013	0.040
	(4.04)	(0.57)	(1.35)
_cons	-1.982***	-0.910***	-1.200***
	(-2.99)	(-3.59)	(-5.66)
N	552	1243	1198

Note: IMF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. Other variables definition – same as Table 4.6.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: IMF_GDP3 is significant for lower-middle income countries with negative sign. IMF3COMP is significant for low income countries with positive sign.

Table 4.13 Probit-Tobit estimations for different IMF programs

	(1) Non-concessional	(2) Concessional
Dependent Variable:		
The probability of debt rescheduling		
SBA_EFF_GDP3	-1.038*	
	(-1.79)	
SBA_EFF3COMP	0.055	
	(0.33)	
SAF_PRGF_GDP3		0.008
		(0.03)
SAF_PRGF3COMP		0.343***
		(3.19)
L.TED	0.003***	0.003***
	(2.94)	(2.99)
L.GDPPC2	-0.004*	-0.004
	(-1.69)	(-1.44)
L.GDI	-0.017***	-0.019***
	(-2.85)	(-3.04)
L.RES	-0.018***	-0.016**
	(-2.89)	(-2.57)
L.ILTD	-0.003	-0.002
	(-1.49)	(-0.96)
L.EXP	-0.002	-0.001
	(-0.84)	(-0.61)
US_note	0.032**	0.072***
	(1.96)	(4.10)
_cons	-0.921***	-1.292***
	(-6.32)	(-9.19)
N	2993	2993

Note: SBA_EFF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. SBA_EFF3COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 3 years. SAF_PRGF_GDP3 = Average of the amount of concessional IMF loan to GDP during the previous 3 years. SAF_PRGF3COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 3 years. Other variables definition – same as Table 4.6

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: SBA_EFF_GDP3 is significant with negative sign. SAF_PRGF3COMP is significant with positive sign.

Table 4.14 Bivariate Tobit model estimations

Panel A: Estimation of equation (4.C1)

	(1)	(2)	(3)	(4)	(5)	(6)
	BOTH	OFFICIAL	COMMERICAL	BOTH	OFFICIAL	COMMERICL
Dependent Variable:						
The quantity of debt rescheduling						
IMF_GDP3	0.246	0.633	-0.896	0.083	0.492	-1.247
	(0.12)	(0.34)	(-0.64)	(0.04)	(0.25)	(-0.85)
IMF3COMP				0.822***	0.699***	0.815
				(2.94)	(2.82)	(1.39)
L.TED	0.011***	0.010***	0.007**	0.010***	0.010***	0.007**
	(3.20)	(3.77)	(2.36)	(3.21)	(3.81)	(2.37)
L.GDPPC	-0.005	-0.002	-0.013	-0.004	-0.001	-0.012
	(-0.59)	(-0.28)	(-0.69)	(-0.49)	(-0.17)	(-0.66)
L.GDI	-0.077***	-0.069***	-0.079**	-0.078***	-0.070***	-0.080**
	(-3.34)	(-2.65)	(-2.43)	(-3.37)	(-2.66)	(-2.46)
L.RES	-0.042**	-0.033*	-0.067*	-0.041**	-0.032*	-0.065*
	(-2.34)	(-1.84)	(-1.88)	(-2.31)	(-1.82)	(-1.83)
L.ILTD	-0.007	-0.007	-0.003	-0.006	-0.006	-0.002
	(-1.06)	(-1.23)	(-0.35)	(-0.93)	(-1.10)	(-0.25)
L.EXP	-0.010	-0.015	0.012	-0.008	-0.012	0.015
	(-1.02)	(-1.42)	(0.96)	(-0.74)	(-1.18)	(1.15)
US_note	0.137**	0.066	0.405***	0.150**	0.076	0.418***
	(2.21)	(1.10)	(4.38)	(2.45)	(1.29)	(4.46)
_cons	-3.898***	-3.656***	-9.503***	-4.192***	-3.912***	-9.750***
	(-4.27)	(-3.39)	(-6.53)	(-4.63)	(-3.62)	(-6.43)

(Continued)

Panel B: Estimations of equation (4.C2)

	(1) BOTH	(2) OFFICIAL	(3) COMMERICAL	(4) BOTH	(5) OFFICIAL	(6) COMMERICL
Dependent Variable:						
IMF_GDP3						
L4.TED	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
	(3.20)	(3.17)	(3.30)	(3.20)	(3.18)	(3.30)
L4.GDPPC	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-0.14)	(-0.26)	(-0.20)	(-0.16)	(-0.27)	(-0.20)
L4.GDI	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(-1.31)	(-1.30)	(-1.28)	(-1.31)	(-1.30)	(-1.28)
L4.RES	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***
	(-3.77)	(-3.82)	(-3.80)	(-3.77)	(-3.82)	(-3.80)
L4.ILTD	-0.021*	-0.020*	-0.020*	-0.021*	-0.020*	-0.020*
	(-1.75)	(-1.65)	(-1.67)	(-1.75)	(-1.66)	(-1.67)
L4.EXP	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(-0.97)	(-0.96)	(-0.97)	(-0.97)	(-0.96)	(-0.97)
L4.VOTE	0.193*	0.197*	0.194*	0.193*	0.197*	0.194*
	(1.80)	(1.84)	(1.83)	(1.80)	(1.83)	(1.83)
_cons	-0.050	-0.051	-0.052	-0.050	-0.051	-0.052
	(-0.58)	(-0.59)	(-0.60)	(-0.58)	(-0.59)	(-0.60)
ρ	0.223**	0.197**	0.157*	0.210**	0.187*	0.152
	(2.22)	(1.99)	(1.66)	(2.06)	(1.85)	(1.58)
N	2993	2993	2993	2993	2993	2993

Note: IMF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. Other variables definition– same as Table 4.6.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: IMF_GDP3 is insignificant for all regression. IMF3COMP is significant for BOTH and OFFICIAL group with positive sign.

Table 4.15 Bivariate Tobit estimations for countries with different levels of income

	(1)	(2)	(3)
	UM	LM	L
Dependent Variable:			
The quantity of debt rescheduling			
IMF_GDP3	-1.612	-6.204**	2.207
	(-0.46)	(-2.11)	(0.95)
IMF3COMP	0.012	0.796	0.773**
	(0.01)	(1.52)	(2.28)
L.TEDG	0.099***	0.040***	0.004**
	(3.60)	(4.68)	(2.24)
L.GDPPC2	0.018	-0.011	0.001
	(0.55)	(-0.79)	(0.19)
L.GDI	-0.064	-0.104**	-0.064**
	(-0.51)	(-2.34)	(-2.13)
L.RES	-0.207***	-0.060*	-0.004
	(-2.85)	(-1.93)	(-0.12)
L.ILTD	0.974***	-0.010	-0.012**
	(3.49)	(-1.34)	(-2.07)
L.EXP	-0.074**	-0.020	0.001
	(-2.24)	(-1.06)	(0.04)
US_note	0.586***	0.018	0.083
	(2.79)	(0.25)	(0.88)
_cons	-10.461***	-3.257***	-3.870***
	(-2.72)	(-3.21)	(-2.67)
N	552	1243	1198

Note: IMF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. Other variables definition – same as Table 4.6.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: IMF_GDP3 is significant for lower-middle income countries with negative sign. IMF3COMP is significant for low income countries with positive sign.

Table 4.16 Bivariate Tobit estimations for different IMF programs

	(1)	(2)
	Non-concessional	Concessional
Dependent Variable:		
The quantity of debt rescheduling		
SBA_EFF_GDP3	-3.718*	
	(-1.86)	
SBA_EFF3COMP	0.353	
	(0.62)	
SAF_PRGF_GDP3		1.587
		(0.79)
SAF_PRGF3COMP		0.747**
		(2.13)
L.TED	0.011***	0.009***
	(4.10)	(2.96)
L.GDPPC2	-0.007	-0.008
	(-0.90)	(-0.94)
L.GDI	-0.072***	-0.074***
	(-3.22)	(-3.15)
L.RES	-0.044**	-0.039**
	(-2.52)	(-2.29)
L.ILTD	-0.009	-0.005
	(-1.28)	(-0.76)
L.EXP	-0.008	-0.006
	(-0.72)	(-0.64)
US_note	0.091	0.212***
	(1.60)	(3.15)
_cons	0.011***	0.009***
	(4.10)	(2.96)
N	2993	2993

Note: SBA_EFF_GDP3 = Average of the amount of IMF loan to GDP during the previous 3 years. SBA_EFF3COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 3 years. SAF_PRGF_GDP3 = Average of the amount of concessional IMF loan to GDP during the previous 3 years. SAF_PRGF3COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 3 years. Other variables definition – same as Table 4.6

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Main results: SBA_EFF_GDP3 is significant with negative sign. SAF_PRGF3COMP is significant with positive sign.

Table 4.17 Robustness check for bivariate probit estimation

	(1) BOTH	(2) BOTH	(3) OFFICIAL	(4) OFFICIAL	(5) COMMERICAL	(6) COMMERICAL
Dependent Variable:						
The probability of debt rescheduling						
IMF2	1.946***		1.987***		1.642***	
	(9.30)		(4.87)		(6.32)	
IMF2COMP	0.180**		0.146*		0.029	
	(2.24)		(1.78)		(0.23)	
IMF1		1.991***		2.116***		1.600***
		(5.91)		(3.81)		(5.10)
IMF1COMP		0.175**		0.115		0.090
		(1.98)		(1.28)		(0.80)

Note: IMF2 = Dummy variable for IMF program during the previous 2 years. IMF2COMP = Dummy variable for compliance with IMF conditionality during the previous 2 years. IMF1 = Dummy variable for IMF program during the previous 1 year. IMF1COMP = Dummy variable for compliance with IMF conditionality during the previous 1 year.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.18 Robustness check for bivariate probit estimations for countries with different levels of income

	(1)	(2)	(3)	(4)	(5)	(6)
	UM	UM	LM	LM	L	L
Dependent Variable:						
The probability of debt rescheduling						
IMF2	0.834*		2.128***		2.050***	
	(1.89)		(5.44)		(6.26)	
IMF2COMP	-0.077		0.074		0.272**	
	(-0.25)		(0.51)		(2.56)	
IMF1		0.741*		2.142***		2.173***
		(1.71)		(3.91)		(5.43)
IMF1COMP		-0.071		0.131		0.200
		(-0.23)		(0.81)		(1.62)

Note: same as Table 4.17

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.19 Robustness check for bivariate probit estimations for different IMF programs

	(1) Non-concessional	(2) Non-concessional	(3) Concessional	(4) Concessional
Dependent Variable:				
The probability of debt rescheduling				
SBA_EFF2	1.022***			
	(2.95)			
SBA_EFF2COMP	0.158			
	(0.96)			
SBA_EFF1		0.875*		
		(1.77)		
SBA_EFF1COMP		0.253		
		(1.59)		
SAF_PRGF2			0.100	
			(0.23)	
SAF_PRGF2COMP			0.162	
			(1.57)	
SAF_PRGF1				0.033
				(0.06)
SAF_PRGF1COMP				0.109
				(0.99)

Note: SBA_EFF2 = Dummy variable for non-concessional IMF program during the previous 2 years. SBA_EFF2COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 2 years. SBA_EFF1 = Dummy variable for non-concessional IMF program during the previous 1 year. SBA_EFF1COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 1 year. SAF_PRGF2 = Dummy variable for concessional IMF program during the previous 2 years. SAF_PRGF2COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 2 years. SAF_PRGF1 = Dummy variable for concessional IMF program during the previous 1 year. SAF_PRGF1COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 1 year.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.20 Robustness check for Probit-Tobit estimations

	(1) BOTH	(2) BOTH	(3) OFFICIAL	(4) OFFICIAL	(5) COMMERICAL	(6) COMMERICAL
Dependent Variable:						
The probability of debt rescheduling						
IMF_GDP2	-0.878**		-0.952**		-0.512*	
	(-2.36)		(-2.43)		(-1.85)	
IMF2COMP	0.322***		0.286***		0.164	
	(4.10)		(3.80)		(1.21)	
IMF_GDP1		-1.338***		-1.415***		-0.921***
		(-3.52)		(-3.83)		(-3.35)
IMF1COMP		0.309***		0.255***		0.267**
		(3.77)		(3.20)		(2.09)

Note: IMF_GDP2 = Average of the amount of IMF loan to GDP during the previous 2 years. IMF2COMP = Dummy variable for compliance with IMF compliance with IMF conditionality during the previous 2 years. IMF_GDP1 = Average of the amount of IMF loan to GDP during the previous 1 year. IMF1COMP = Dummy variable for compliance with IMF compliance with IMF conditionality during the previous 1 year.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.21 Robustness check for Probit-Tobit estimations for countries with different levels of income

	(1) UM	(2) UM	(3) LM	(4) LM	(5) L	(6) L
Dependent Variable:						
The probability of debt rescheduling						
IMF2	0.176		-1.874***		-0.349	
	(0.28)		(-3.08)		(-0.78)	
IMF2COMP	-0.003		0.167		0.469***	
	(-0.01)		(1.14)		(4.28)	
IMF1		0.320		-2.210***		-0.629
		(0.48)		(-2.92)		(-1.08)
IMF1COMP		-0.020		0.288**		0.423***
		(-0.06)		(2.10)		(3.30)

Note: same as Table 4.20

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.22 Robustness check for Probit-Tobit estimations for different IMF programs

	(1) Non-concessional	(2) Non-concessional	(3) Concessional	(4) Concessional
Dependent Variable:				
The probability of debt rescheduling				
SBA_EFF_GDP2	-1.673***			
	(-2.65)			
SBA_EFF2COMP	0.270			
	(1.48)			
SBA_EFF_GDP1		-2.038***		
		(-3.27)		
SBA_EFF1COMP		0.316*		
		(1.93)		
SAF_PRGF_GDP2			-0.201	
			(-0.64)	
SAF_PRGF2COMP			0.315***	
			(2.85)	
SAF_PRGF_GDP1				-0.419
				(-1.20)
SAF_PRGF1COMP				0.251**
				(2.17)

Note: SBA_EFF_GDP2 = Average of the amount of IMF loan to GDP during the previous 2 years. SBA_EFF2COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 2 years. SBA_EFF_GDP1 = Average of the amount of IMF loan to GDP during the previous 1 year. SBA_EFF1COMP = Dummy variable for compliance with non-concessional IMF conditionality during the previous 1 year. SAF_PRGF_GDP2 = Average of the amount of concessional IMF loan to GDP during the previous 2 years. SAF_PRGF2COMP = Dummy variable for compliance with concessional IMF conditionality during previous 2 years. SAF_PRGF_GDP1 = Average of the amount of concessional IMF loan to GDP during the previous 1 year. SAF_PRGF1COMP = Dummy variable for compliance with concessional IMF conditionality during the previous 1 year.

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.23 Robustness check for bivariate Tobit estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	BOTH	BOTH	OFFICIAL	OFFICIAL	COMMERICAL	COMMERCIAL
Dependent Variable:						
The quantity of debt rescheduling						
IMF_GDP2	-1.735		-0.647		-2.166**	
	(-0.93)		(-0.45)		(-2.37)	
IMF2COMP	0.812***		0.575**		0.518***	
	(2.75)		(2.57)		(3.20)	
IMF_GDP1		-4.321**		-2.698**		-2.941***
		(-2.41)		(-2.01)		(-3.36)
IMF1COMP		0.894***		0.588**		0.611***
		(2.93)		(2.57)		(3.40)

Note: same as Table 4.20

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.24 Robustness check for bivariate Tobit estimations for countries with different levels of income

	(1) UM	(2) UM	(3) LM	(4) LM	(5) L	(6) L
Dependent Variable:						
The quantity of debt rescheduling						
IMF2	-0.145		-7.858***		0.708	
	(-0.05)		(-2.60)		(0.35)	
IMF2COMP	0.597		0.456		0.807**	
	(0.45)		(0.84)		(2.37)	
IMF1		0.078		-9.167**		-0.736
		(0.03)		(-2.33)		(-0.33)
IMF1COMP		0.473		0.924*		0.725*
		(0.32)		(1.89)		(1.95)

Note: same as Table 4.20

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Table 4.25 Robustness check for bivariate Tobit estimations for different IMF programs

	(1) Non-concessional	(2) Non-concessional	(3) Concessional	(4) Concessional
Dependent Variable:				
The quantity of debt rescheduling				
SBA_EFF_GDP2	-5.977***			
	(-2.69)			
SBA_EFF2COMP	0.844			
	(1.39)			
SBA_EFF_GDP1		-6.661***		
		(-3.06)		
SBA_EFF1COMP		1.144**		
		(2.03)		
SAF_PRGF_GDP2			0.700	
			(0.36)	
SAF_PRGF2COMP			0.471	
			(1.23)	
SAF_PRGF_GDP1				-0.726
				(-0.37)
SAF_PRGF1COMP				0.244
				(0.61)

Note: same as Table 4.22

t statistics in parentheses: * p<0.10, ** p<0.05, *** p<0.01

Appendix 4.A Country Coverage (classifications are based on year 2012)

UM		LM		L
Albania	Montenegro	Armenia	Papua New Guinea	Afghanistan
Algeria	Panama	Bhutan	Paraguay	Bangladesh
Angola	Peru	Bolivia	Philippines	Benin
Argentina	Romania	Cabo Verde	Sao Tome and Principe	Burkina Faso
Azerbaijan	Serbia	Cameroon	Solomon Islands	Burundi
Belarus	Seychelles	Congo, Rep.	Sri Lanka	Cambodia
Belize	St. Lucia	Cote d'Ivoire	Sudan	Central African Republic
Bosnia and Herzegovina	St. Vincent and the Grenadines	Djibouti	Swaziland	Chad
Botswana	Thailand	Egypt, Arab Rep.	Syrian Arab Republic	Comoros
Brazil	Tonga	El Salvador	Ukraine	Eritrea
Bulgaria	Tunisia	Fiji	Uzbekistan	Ethiopia
China	Turkey	Georgia		Gambia, The
Colombia	Turkmenistan	Ghana		Guinea
Costa Rica	Venezuela, RB	Guatemala		Guinea-Bissau
Dominica	Montenegro	Guyana		Haiti
Dominican Republic	Panama	Honduras		Liberia
Ecuador	Peru	India		Madagascar
Gabon	Romania	Indonesia		Malawi
Grenada	Serbia	Kenya		Mali
Hungary	Seychelles	Kosovo		Mozambique
Iran, Islamic Rep.	St. Lucia	Kyrgyz Republic		Nepal
Jamaica	St. Vincent and the Grenadines	Lao PDR		Niger
Jordan	Thailand	Lesotho		Rwanda
Kazakhstan	Tonga	Mauritania		Senegal
Lebanon	Tunisia	Moldova		Sierra Leone
Macedonia, FYR	Turkey	Mongolia		Somalia
Malaysia	Turkmenistan	Morocco		Tajikistan
Maldives	Venezuela, RB	Nicaragua		Tanzania
Mauritius		Nigeria		Togo
Mexico		Pakistan		Uganda

Appendix 4.B Data sources

Name	Source	Definition
Dependent variable		
Debt rescheduling	Trebesch, Papaioannou and Das (2012)	Dummy variable coded as 1 for the year of sovereign debt rescheduling
Quantity of debt rescheduling	Dreher (2006) - Extended time covering from web site	Face value of the debt that is rescheduled
IMF variable		
IMF program	Dreher (2006) - Extended time covering from web site	IMF program agreed, dummy variable
SBA/EFF program	Dreher (2006) - Extended time covering from web site	SBA or EFF program agreed, dummy variable
SAF/PRGF program	Dreher (2006) - Extended time covering from web site	SAF or PRGF program agreed, dummy variable
Compliance with IMF	Dreher (2010) - Extended time covering from web site	dummy variable which takes value of 1if at most 25% of the agreed amount of IMF loan remain undrawn, if the undrawn amount is greater than 25%, then the dummy variable takes value of 0
Control variable		
GDP growth per capita	World bank website	Growth rate of GDP per capita
Total external debt to GDP	World bank website	Total external debt / GDP
Gross domestic Investment to GDP	World bank website	Gross domestic investment / GDP
Reserve to GDP	World bank website	Reserve / GDP
Interest arrears on long-term debt to export	World bank website	Interest arrears on long-term debt / Export
Export to GDP	World bank website	Export / GDP
10 year US treasury note yield	Bloomberg	
UN voting	Dreher and Sturm (2011)	the percentage of the vote of that country coincides with one of the G7 country in UN General Assembly

5 CONCLUSION

This thesis focuses on the issue of sovereign debt from different perspectives. Chapter 2 analyzes the determinants of the variation of the sovereign bond spread in emerging economics, in particular, the relative importance of global factors and country-specific factors. I show that variations in sovereign bond spread are mainly driven by global shocks, with the term structure of US interest rates and the global risk aversion of international investors having the most important role. The findings also indicate that shocks from the US have an indirect effect on sovereign bond spread via country-specific macroeconomic fundamentals. Since an increase in sovereign bond spreads is typically seen as key predictor of default and restructuring risk and thus serves an early indicator of the crisis (Trebesch, Papaioannou and Das, 2012). Debt restructuring may benefit both creditor and debtor (Krugman, 1988), but under different circumstances some structuring strategies might be more effective. Chapter 3 analyzes the financial aspects of different sovereign debt restructuring strategies when the debtor faces debt repayment problems. I find that a designed debt equity swap could be Pareto improving and benefits all stakeholders. Although debt restructuring could potentially benefit both debtor and creditor, it may fail due to the conflict of interest rate among different parties. A co-ordination body such as the IMF could play an important role in facilitating

sovereign debt restructuring. Chapter 4 analyzes the effect of participating in an IMF program on subsequent sovereign debt rescheduling. I find that the participating in a non-concessional IMF program increases the probability of subsequent debt rescheduling, especially for low income countries. The finding also shows that compliance with IMF conditionality could increase the probability of subsequent debt rescheduling. The results may indicate that participation in a non-concessional IMF program could signal a country's willingness to reform and the recipient country is rewarded with subsequent debt rescheduling. The effectiveness of signaling is negatively linked to the country's level of income and compliance with IMF conditionality could enhance such signaling effects.

Since this thesis deals with different aspects of sovereign debt, each one could be extended further for future research. Future research based on Chapter 2 could focus on the role of debt sustainability on the sensitivity of sovereign bond spread to global shocks, in another word, how the sensitivity of sovereign bond spread to global shocks under different level of debt sustainability. Chapter 3 could be extended upon by analyzing how adverse selection or information asymmetry affects the outcome of debt equity swap; for example, when the costs of effort or austerity are unknown to the lenders. The purpose of this would be investigating the possible reasons that debt equity swap is not used in practice. Chapter 4 could be extended upon by investigating different channels of the effects of IMF interventions on sovereign debt rescheduling.

Although I showed signaling could be one of the channels, IMF interventions could negatively affect economic growth and hence affect sovereign debt rescheduling, future research could analyze the relative importance of each channel.

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