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Impact of Financial Fragility on Sovereign Bond Spreads: An Empirical Analysis for BRICs Region

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Abstract
The paper investigates the impact of financial fragility on the sovereign bond spreads of the four rapidly rising emerging economies Brazil, Russia, India and China (BRICs). Using fixed effect model, a comparison is being made among different models after including and excluding Financial Stress Index (FSI) from the base line model. The results suggest that financial fragility is a major determinant of sovereign bond spreads than other macroeconomic factors as it appears to be highly significant in all estimations. Moreover it has been observed that by adding FSI, the explanatory power of the model has increased quite prominently. The significance of FSI depicts the importance of idiosyncratic financial environment in financing conditions of BRICs by showing the transmission of financial stress through financial and economic linkages. The results also indicate the importance of local factors in explaining the sovereign bond spreads of BRICs economies that is in conforming to past studies.
Keywords: Fragility, Bonds, Trade, Public Debt, Financial markets, Interest Rates

1: INTRODUCTION:

"Markets can remain irrational longer than you can remain solvent" —

(J. M. Keynes)

Due to current global financial and economic crisis, as stock markets of all over the world, irrespective of the advanced or emerging economies, tumbled, but this effect was brutal in the emerging regions, while at the same time, spreads on sovereign debt widened and exchange markets came under extreme pressure. Most of the emerging market economies had large debt burden, unpredictability with higher bond spreads that eventually led to default like the Mexican crisis (1995), the Asian financial crisis (1997), the Russian Ruble crisis (1998) and the Argentine default (2001). In recent times interest rises due to the economic sub-prime crisis that began in 2007. An understanding of sovereign bond spreads is essential given the rising trend of investing capital into emerging economies. With the awareness of emerging market sovereign bonds, governments of these countries rapidly learned how to take advantage of this vast source of financing for required foreign currency. Movements in sovereign bond spreads have important consequences in the economies as affecting both investment and consumption decisions. Higher sovereign bond yield spreads tend to be accompanied by higher debt-servicing and funding costs which ultimately results into higher rollover risk. Sovereign bond spreads of emerging market economies are important indicators of financial vulnerability for country surveillance purposes and used to determine the external financing conditions of emerging market economies. The risks related with investing in sovereign bonds depend on different variables like issuer's financial condition, economic performance and the capability to pay back obligations. As the crisis unfolded, several factors might have affected the valuations of sovereign bonds. First, the global market price for risk went up, as investors sought higher compensation for risk. Deleveraging and balance sheet-constrained investors developed a systemically stronger preference for a few selected assets vis-à-vis riskier instruments. This behavior not only benefited sovereign securities as an asset class at the expense of corporate bonds and other riskier assets, but also introduced a higher degree of differentiation within the sovereign spectrum itself. Second, as the crisis spread to the public sector and policy authorities stepped in to support troubled financial institutions, probabilities of distress went up across sovereigns. Ebner (2009) identifies considerable variation in government bond spreads in Central and Eastern Europe during crisis and non-crisis periods.

In view of the emergence of BRIC countries as a major economic force in the global market with rapidly rising external investment inflow and the significant number of bond issuance from these countries, this study sheds light on determinants of sovereign bond spreads by employing financial fragility measure for BRIC countries. By inclusion of this measure of financial stress, the aim is to clarify the movements of emerging market sovereign bond spreads relating to financial vulnerabilities. Financial Stress Index (FSI) captures price changes in BRIC markets comparative to past trends as this index is the indicator of strain in financial markets. The research conducted indicates that FSI is highly significant and positively correlated with the sovereign bond spreads of BRIC countries. The results also show the importance of fundamental factors in explaining disparity in sovereign bond spreads. These fundamental factors are reflective of historical country specific economic, political and regulatory events. Hence, this study is consistent with the view that the ability of BRIC countries to service their debt is largely influenced by financial crisis and premium of BRICs bond yields also reflect this.

Today, with heightened financial sector stress, markets have anticipated the rise in public debt and the spreads on sovereign debt have, therefore, risen. Thus there is a need to find the factors (determinants) that influence the sovereign bond spreads. The existing literature on determinants of sovereign bond spreads shows that the many studies have examined the correlation between sovereign bond spreads and different macroeconomic and financial variables. They find some empirical pattern but

this debate did not find significant determinants. So the research problem can be defined as "to identify the determinants of sovereign bond spreads by adding the impact of financial fragility during the period of 2001-2009 using fixed effect method". This study divides determinants into two categories;
(i) Fundamental (macroeconomic) factors of sovereign bond spreads.
(ii) Financial market (financial fragility) factors of sovereign bond spreads.
Due to the drastic impact of the widened sovereign bond spreads, this area has grabbed a lot of attention to work with. This study presents broad and timely empirical evidence of the determinants of changes in sovereign bond yield spreads in the BRICs. Sovereign bond spreads are usually used to assess the market's perception of the sovereign risk of default. The contribution of this paper is to track how this process has unfolded in the current context with special reference to BRIC nations. The existing literature on determinants of sovereign bond spreads shows that the present study will be the first study that use Financial Stress Index (FSI) for BRICs in order to capture the financial health of BRICs. By making comparison with FSI and without FSI, the importance of financial fragility is described in order to explain sovereign bond yield spreads.

1.2 Objectives of the study

The study intends to develop a theoretical and empirical framework for establishing the relationship of sovereign bond spreads with fundamental and temporary factors. Its objectives are:

- To analyze the effects of fundamental (macroeconomic) factors on sovereign bond spreads.
- The factor of changes in sovereign bond spreads as indicator of sovereign risk in the BRICs.
- The impact of adding the Financial Stress Index (FSI) as a determinant of sovereign bond spreads for BRIC economies.

Thus the main objective of this study is to identify the impact of financial fragility which can play an important part in variation in sovereign bond spreads.

1.3 Hypotheses

Hypothesis 1: There is a significant relationship between the macroeconomic factors and sovereign bond spreads.
Hypothesis 2: There is a significant relationship between financial fragility and sovereign bond spreads.

2: LITERATURE REVIEW

This chapter is dedicated to investigate the past and current states of sovereign bond spreads by looking at its history and assessing the theoretical and empirical literature. Public lending is used for consumption smoothing and to boost public investment such as infrastructure (Barro (1979, 1995)), and encouraging growth and welfare (Eaton 1993). From this sight of the neoclassical growth theory, sovereign bonds are one tool among many to smooth the progress of capital flows, evading the "original sin" problem by borrowing in foreign currency (Eichengreen, Hausmann and Panizza (2003), Ozmen and Arinsoy (2005)). An abundant literature has sought to identify the economic (fundamentals) and financial determinants of sovereign bond spreads but it varies with respect to choice of variables, time span, techniques employed as well as selection of countries.

2.1 Primary market spreads

Eichengreen and Mody (1998), Kamin and von Kleist (1999) both employed primary market spreads for two reasons.

- Primary market spreads are used as a measure of credit risk.
- They include a time series element for emerging market bonds.

A common feature of all these studies is that they use primary yields which may result in sample selection biases.

- **Eichengreen and Mody (1998a, 1998b)**

Eichengreen and Mody (1998a, 1998b)[3] found that in case of poor market conditions when secondary yields rise, primary yields do not rise proportionally and in some cases they fall. In several situations, factors that increase the perceived risk of emerging market debt may result in raising secondary market spreads. Nevertheless, this may have an opposite impact on launch spreads as riskier borrowers are rationed out of the market and leaving only those borrowers that bears low risk. So this may result in biased estimations that are based on primary yields. This bias can be corrected by simultaneously using primary yields with a binary choice to issue or not to issue. They examined 1000 emerging market bonds which were taken from East Asia, Latin America, and East Europe for the time period 1991 – 1996. By using maximum likelihood estimation, he established that market sentiment plays a major role in explaining country risk premiums on new-issue bond spreads (launch spreads).This is the most striking findings as it showed the shift of economic fundamental towards market sentiment particularly in unpredictable epoch (Asian crises).

- **Kamin and von Kleist (1999)**

Kamin and von Kleist (1999) examined issue spreads on bonds and bank loans. The results demonstrate that emerging market spreads are strongly related with credit ratings and consequently with borrower creditworthiness. They also find that Latin American and Eastern Europe spreads are higher than the Middle East and Asian spreads for similar credit rating while spreads on bonds are systematically higher than spreads on bank loans. Further they did not find any statistically significant relationship between emerging market launch bond spreads and industrial country interest rates. In the era of 2000's emerging markets offered additional beneficial investment opportunity for international investors as enormous capital inflows and outflows has noticed as compared to last decade. In the beginning most studies considered economic fundamentals as major drivers of sovereign spread while with the passage of time external variables e.g international interest rates, global liquidity conditions and investors' risk tolerance got considerable attention.

- **Budina and Mantchev (2000)**

Budina and Mantchev (2000) used the monthly data from Jul 1994 to Jul 1998 of bond price for a single country Bulgaria as the dependent variable rather than the spread. By employing the cointegration framework they found that foreign reserves and exports had a positive (+) impact on bond prices while the real exchange rate (REER) and Mexico's nominal exchange rate depreciation had a negative (-) impact. If a variable is positively associated with bond price it means that it has negative relationship with spread and vice versa.

2.2 Secondary market spreads

- **Goldman Sachs (2000)**
  To use secondary market spreads is another way to solve selectivity bias. Goldman Sachs (2000) study is among those studies which employed pool mean group (PMG) estimation technique in order to find out the determinants of sovereign bond spreads using secondary market yields. This study concluded that a number of variables (like international interest rates, total external amortizations/Reserves, fiscal balance, real exchange rate (REER) misalignment, exports/GDP) have a significant impact on the sovereign bond spreads.
- **Ferrucci (2003)**
  Ferrucci (2003) also used PMG technique in order to develop an empirical model relating secondary market sovereign bond spreads to a set of macroeconomic variables. This paper explained the long-run and short run determinants of emerging market bond spreads. The estimation results show that country's fundamentals and external liquidity conditions are significant determinants of market spreads for emerging market economies as market do take into account the macro fundamentals when pricing sovereign risk.
- **McGuire and Schrijvers (2003)**
  McGuire and Schrijvers (2003) studied the response of emerging market sovereign bond spreads by using global factors. They used daily data of 15 emerging markets for the period of 1997 to 2003. With the help of factor analysis they concluded that total movement of sovereign bond spreads can be explained by common factors of international markets. They further point out that the single common factor plays a significant role in explaining the common disparity while the primary factor better justified the investors' behavior toward investment decision
- **Hartelius, Kashiwase, and Kodres (2008)**
  Hartelius, Kashiwase, and Kodres (2008) demonstrate that external global factors (including interest rate expectations and volatility) account for over half of spread dynamics. In their study they explained the significant impact of fundamentals and liquidity in determining EMBI spreads. In contrast to other studies like (Goldman Sachs (2000)), they constructed credit rating outlook index as a proxy for macroeconomic variables. This index measures the non-linear relation between spreads and rating.
- **Baldacci, Gupta, and Mati (2008)**
  Baldacci, Gupta, and Mati (2008) studied the determinants of country risk premiums as measured by sovereign bond spreads by using a panel of 30 emerging countries[5] that are drawn from the Emerging Market Bond Index Global (EMBIG) for the period of 1997-2007. Their findings indicate the significance of fiscal variables and political risk factors in emerging economies. Lower levels of political risk are related with tighter spreads while political instability results in rising sovereign bond spreads as financial markets demand an extra premium for high levels of political risk. Moreover the results show that fiscal variables matter and have a greater impact on sovereign bond spreads especially for those countries that experienced previous defaults.
- **Ciarlone et al. (2009)**
  Ciarlone et al. (2009) used factor analysis to find the pattern among the common variables. By using this technique their purpose is to get more information regarding common factors so that they become able to capture the international capital market conditions. The data set for the estimation consists of monthly data from 1998 to 2006. This study found that a common factor plays a significant role in explaining the correlation between the emerging markets spreads with the conditions of the international capital markets.
- **Mody (2009)**
  Many researchers have also investigated financial fragility and crisis-related determinants of sovereign bond spreads. Mody (2009) analyzed the impact of financial vulnerability (measured by the ratio of the financial sector equity index of the country over the overall equity index) on sovereign bond spreads in 10 eurozone countries from January 2006 to January 2009. Their results indicate that financial fragility is highly associated with changes in sovereign bond spreads. After the introduction of the euro[6] and before the beginning of subprime crisis in 2007, spreads movement were effectively random with no obvious determinants as negligible chances of default by eurozone sovereigns. Following the onset of the crisis and through to the rescue of Bear Stearns, the global factors became more important determinants of sovereign spreads changes. After the Bear Stearns rescue, domestic financial sector played a significant role in explaining changes in sovereign bond spreads that led to a differentiation in spreads across countries. Moreover after the failure of Lehman Brothers, these differences further widened as countries with the largest decline in competitiveness paid an increased penalty for high public debt to GDP ratios.
- **Ebner (2009)**
  Ebner (2009) studied the Eastern and Central European government bond spreads at the time of crisis and non-crisis. This paper revealed that there is a significant difference in government bond spreads during both the periods.
  He found that during crisis period macroeconomic factors become less significant explanatory variables as the measured countries pursued the more stable economic policy while other factors like political uncertainty, market instability, and global factors play an important role in explaining the rise in spreads.
- **Balakrishnan et. al (2009)**
  Balakrishnan et. al (2009) developed Financial Stress Index (FSI) for 26 emerging economies. Emerging Markets Financial Stress Index (EM-FSI) is the first empirical estimation of the intensity of financial stress and its transmission to emerging economies. It is constructed by using same methodologies which are proposed by Cardarelli, Elekdag, and Lall (2009) in building financial stress index for advanced economies (AE-FSI). According to their work, financial stress transmitted rapidly to emerging economies but differences in the degree of stress transmission are generally connected with the strength of financial linkages (stock of foreign liabilities) to advanced economies.
- **Bellas et al. (2010)**

Bellas et al. (2010) examined the short run and long run determinants of emerging market sovereign bond spreads by using fixed-effects model and the PMG estimation technique. They extended the Ferrucci (2003) model by incorporating a financial stress index. By including FSI their aim is to capture the state of a country's financial health. The dataset covers 14 countries from first quarter 1997 to second quarter of 2009 and the bond spreads included data from Emerging Market Bond Index (EMBI) developed by J.P. Morgan. They concluded that in the long run, fundamentals are significant determinants of emerging market sovereign bond spreads, while in the short run financial volatility is a major determinant of spreads than fundamental variables. They further confirmed that political instability plays a significant part as a long-term determinant of sovereign bond spreads.

2.3 Contagion & Spillovers

Contagion is essential in the sense that investors want to be acquainted with issuers on the basis of similar characteristics which means that an increase in the spread of one cause spread increase of the others. So it is not a mere correlation rather it can be explained as a causal comovement. There is extensive debate in the literature regarding how to define and measure contagion (Pericoli and Sbracia, 2001, and Rigobon, 2001).A generally accepted, however not undisputed definition by Edwards (2000) ''contagion reflects a situation where the effect of an external shock is larger than what was expected by experts and analysts''.

Claessens, Dornsbush and Park (2001) defined contagion as "a significant increase in cross-market asset linkages after a shock to an individual country or group of countries". It is the widely renowned definition of contagion as cross-market asset linkages can be investigated for numerous markets in a different possible means.

While in accordance with contagion in sovereign bond markets it can be defined as a response of sovereign yield premia in one country to distress in another country's sovereign bond market, once prospective interconnection channels and common shocks have been controlled for.

3: Why BRICs

Wilson and Purushothaman (2003) identify Brazil, Russia, India and China, the BRIC economies, as the larger force in the world economy with the greatest economic potential. The world economy has changed a lot over the last 50 years and these variations could be at least as dramatic over the next 50 years. They argue that if things go right then by 2050 the BRIC economies will together become larger than the G6 in US dollar terms. The key assumption underlying this projection is that the BRIC countries developing and maintaining a regulatory environment that are supportive of growth. In financial terms, the BRIC economies lead the emerging market of today (Jensen and Larsen, 2004) like their share in international investment portfolios has been growing in the past decade.

The BRICs share some characteristics like large populations, high levels of natural resources, rapidly increasing incomes and speedily developing economies which results into ample business opportunities. The process of financial liberalization was initiated in BRICs in the early 1990s. Bekaert, Harvey and Lundblad (2003) describe the liberalisation as "the date of formal regulatory change after which foreign investors officially have the opportunity to invest in domestic equity securities and domestic investors have the right to transact in foreign equity securities abroad".

Bekaert and Harvey (2000) recognize the liberalisation dates for the BRICs as

- For Brazil May 1991,
- For Russia January 1994,
- For India February 1992,
- For China July 1993.

Table 1 shows that BRIC countries are among those countries which have world top 10 FX reserves.

Table 1: World Top10 FX Reserves

Country	**Total FX Reserves* (US $bn)**	**Current Account** (% of GDP)**
China	1,434	9.4
Japan	911	3.9
Russia	407	9.7
Taiwan	263	6.8
Korea	257	0.7
India	222	-1.1
Euro system	201	0.0
Brazil	161	1.6
Singapore	147	27.5
Hong Kong	141	10.8

Source: IMF, National Sources
*As of September 2007
**As of December 2006

3.1 Financial fragility

This study employs Financial Stress Index (FSI) as developed by staff of the International Monetary Fund (Balakrishnan et. al (2009) in order to capture the financial health of the country because sovereign bond spreads cannot fully explained by macroeconomic indicators. Many researchers like (Mody 2009) used zero-one binary variables to measure intensity of stress but it is not a good measure as it frequently ignores the ambiguity of "near-miss" (A "near-miss" is an event which indicates a system weakness that if not remedied could result in significant consequences in the future. As such it is also an opportunity to improve system structure and to reduce risk exposure to potential catastrophe.) events like sell-off in emerging markets (2006) reflects a rise in risk premiums but not a re-evaluation of emerging market fundamentals. The aim of using FSI is to clarify the movements of emerging market sovereign bond spreads relating to financial vulnerabilities as it provide a high frequency measure of stress in emerging economies.

The FSI consists of five variables, which tend to capture three financial market segments

- Banking
- Securities markets
- Exchange markets
- The five components of the FSI are given below
- Banking-sector beta denoted as β
- Stock market returns
- Time-varying stock market returns volatility
- Sovereign debt spreads
- Exchange market pressure index (EMPI)

The five components are summed up to yield the aggregate financial stress.

EM-FSI = β + Stock market returns + Stock market volatility + EMPI + Sovereign debt Spreads

The index depends mainly on market data and therefore is accessible at a high frequency and with a short time lag. The FSI is robust to other weighting methods. Different values and its meaning are given below:

Zero:

A value of zero means on average neutral financial market conditions across the sub-indices.

Positive Value:

Positive values show financial strain which indicates that on average prices are above means or trends.

One:

A value of 1 implies that a one-standard deviation from average conditions across sub-indices.

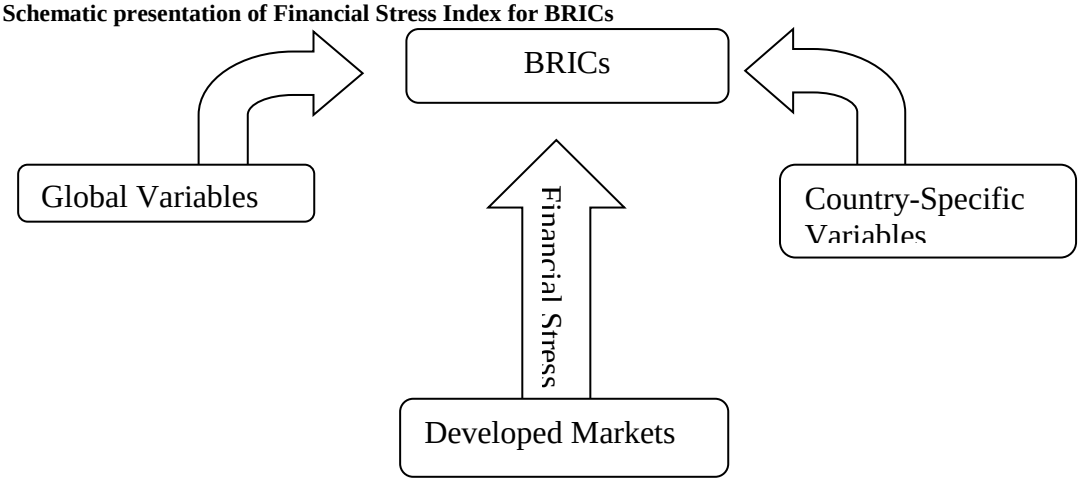
A value of 1.5 or greater than 1.5:

In the past these values have been related with a crisis.

3.2 The Financial Stress Index for BRICs

Balakrishnan et. al (2009) defined episodes of financial stress as "periods when the financial system is under strain and its ability to intermediate is impaired".

Figure 1: Schematic presentation of Financial Stress Index for BRICs



Here this schematic presentation shows how global and country specific variables interact and influence BRICs. Global variables can be global shifts in market sentiment or risk aversion in order to increase financial integration while country-specific variables facilitate the transmission of financial stress through financial and economic linkages. Financial stress can rise due to losses of BRICs incurred as a result of those assets that are invested in advanced countries experiencing a crisis or due to financial shock that are initiated by investors in advanced countries.

3.3: Financial Stress Index (BRICs)

Figure 2: Financial Stress Index for BRIC Economies (2001-2009)

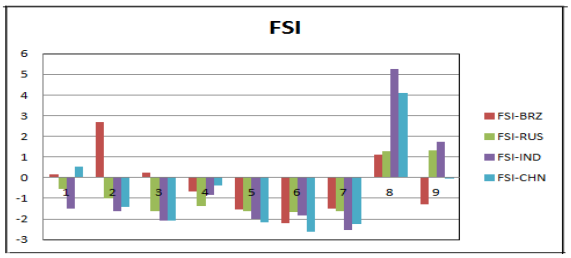


Figure 2 demonstrates the financial stress index for BRIC economies. The figure clearly indicates that under normal conditions BRICs facing low (negative) financial stress while sharp increase in financial stress index correspond to economic slump in 2008. This also helps in identifying distinctive financial environment and conditions of BRIC countries.

3.4: Credit ratings

Credit rating contains information regarding the financial health of a country. By assuming investors is risk neutral, the credit rating will be used as leading indicator. The Sovereign ratings indicate future debt-service capacity. The basic of the sovereign ratings is the each sovereign's overall creditworthiness that is evaluated by taking into account political and economic risks. The right-most column of the Table contains Transfer and Convertibility assessments (T&C). The history begins in November 2005, for studying the T&C risk. A country T&C assessment is the rating related with the probability of the sovereign restricts access to foreign exchange required for debt service. Sovereign local-currency ratings can be higher than sovereign foreign-currency ratings because of local-currency creditworthiness that can be maintained by the unique powers that sovereigns have domestically like local currency issuance etc.

3.5: The relationships between Credit ratings and the Sovereign bond spreads

Sovereign credit rating depends on a number of economic, political and social indicators like the stability of the current political system. This study will focus only on economic variables as political and social factors generally are difficult to compute. In addition of these variables sovereign bond spreads is determined by financial fragility and contagion to recognize financial vulnerabilities and external shocks to an individual country or group of countries. Figure 3.7 helps to identify the relationship between sovereign credit rating and sovereign bond spreads. It is not wrong to conclude that last decade was "BRICs Decade" as they make their mark on the global economic landscape by contributing over a third of world GDP growth and developed from one-sixth of the world economy to almost a quarter. In the past decade, the strong growth of BRIC economies astonished many and the BRICs themselves came into focus.

4: THEORETICAL FRAMEWORK

To analyze what are the factors, which are determinants of sovereign bond spreads in BRICs, theoretical framework is required.

4.1Theoretical Framework Analysis

A conventional approach is to assume that the spread over a risk-free interest rate is a function of a country's default probability and of the loss given the default. This probability of the default is exogenously determined with sustainability of a given level of external debt through liquidity or solvency indicators. (See, e.g., Hanson, 1974; Eaton, Gersovitz, and Stiglitz, 1986; Sachs, 1981, 1984). Assuming a risk-neutral lender, this paper uses the following model for the determinants of bond spreads:

$$S_i = \alpha_i + \sum_{j=1}^{k} \beta_{ij}\, x_{ij} + \varepsilon_i \qquad (1)$$

Where

S is the bond spreads,

α stands for the intercept,

k is the numbers of variables,

β_{ij} stands for the k × 1 vector of parameters to be calculated on the exogenous variables,

x_{ij} represents the 1 × k vector of included observations on the exogenous variables.

ε_i stands for the error term.

The theoretical foundation for the selection of the set of variables in equation (1) is provided by many previous studies. These include macroeconomic fundamentals & exogenous shocks that affect liquidity and solvency of developing countries (Edwards, 1986; Haque et al., 1996; Sachs, 1985).

Further financial fragility is included in the model in order to capture the debt dynamics and the probability of default. In this study the selection of variables is made by following the model of sovereign borrowing as provided by Bellas et al. (2010) that formalizes the consumption choice of small open economy. The economy usually tries to smooth its consumption path over time by borrowing from abroad when domestic resources are inadequate and paying back its debts when resources are ample.

In this situation foreign lenders concern about

- The ability of the economy to generate enough foreign exchange resources to service its external obligations.
- Government's ability of the economy to produce enough domestic resources to purchase the foreign exchange essential for servicing its external obligations.

The spread over U.S. Treasuries can be shown as

$$\mathbf{S_i = i - r_f}$$

Where
i stands for government bond yields of the estimated country and
r_f is U.S Treasuries rates.
The sovereign bond spreads are determined by a large number of factors. The choice of a set of explanatory variables is made by keeping in mind the limited degrees of freedom due to the low sample size and high number of estimation parameters. This explains why some variables are omitted as used in the literature like data on commodity and oil prices. However, more complex models comprise of external competitiveness indicators, such as the nominal or real exchange rate (Bordo et al. (2009); McGee 2005), which affect allocation of resources between the tradable[14] and the non-tradable sector.

4.2 Valuation of emerging sovereign bonds

The emerging sovereign bond market is distinctly different from that of private corporate market in many respects that go beyond differences in bond attributes such as size, maturity, currency of denomination and ratings. The risks of the sovereign bonds with some bonds such as United States treasury bonds being considered among the safest investments known and others, such as the bonds of many developing nations, are considered highly speculative. Emerging markets, being considerably highly speculative, tend to incorporate the higher spread, which itself leads towards the feeble economic variables.
For valuation and analysis of emerging market bonds, it is very important to know how it is priced by investors. Corporate debt can be priced by option theory. According to the Modigliani-Miller theorem

A= D + S

Where
A is the current market value of firm's assets
D is the market value of the corporation's debt
S is the market value of the firm's common stock
In case of firm's default it becomes insolvent and by bankruptcy procedures creditors get the control of its asset. The valuation of sovereign debt is not an easy task. The option-pricing models are not very helpful in valuing sovereign debt because sovereigns not having a well-defined asset base and limited possibilities for creditors to take control of sovereign assets. In case of sovereign defaults, lengthy negotiations are usually required for restructuring debt as no obvious structure for sovereign default procedures.
Sovereign risk is a subtype of credit risk and an essential element of emerging economies' yield curves. It is linked to the probability of a government failing to honor its payment obligations. Figure 4.1 shows that sovereign risk depends on the following factors.

- Willingness to pay
- Issuer's ability to pay

The value of sovereign debt is largely reliant on the perceived willingness of a sovereign government to pay as sovereign default is mainly a political decision. Deutche Bank notes down for Russian default (1998) as "We continue to maintain that a default depends far more on Russia's willingness to pay versus its ability to pay its debt". However, it is very important to value sovereign debt but it is very difficult to estimate. In case of defaults, sovereign usually traded off the cost of servicing the current debt against the costs of repudiation which are generally estimated in political terms. Mostly sovereigns are inclined towards restructuring or renegotiation of its debt rather than outright default. While on the other side, sovereign's ability to pay can be predicted. As given by figure 4.1, the foreign debt is serviced by the foreign exchange reserves. Foreign exchange reserves can be taken in the form of foreign investment and exports. If the major source of foreign exchange reserves is the foreign investment, it shows that country is greatly reliant on capital inflows and results into high volatility. Foreign investment further categorized in the form of direct investment or portfolio investment while portfolio investment can be short term or longer term. If portfolio investment is mainly composed of the short term then it usually tends to increase the volatility in the country. Contrary the short term part of portfolio investment, direct foreign investment seems to be long term and improves the private sector output. On the other hand, if foreign exchange reserves are received through exports then it describes the long term stance of the country exports serves as the foundation for foreign exchange reserves. Exports are further divides into composition and sustainability. The composition part can be value-added goods or commodities while the sustainability deal with productivity or an undervalued currency or cheap labor. If the larger part of the composition is commodities then it means that exports are price sensitive while value added goods are less prone to price fluctuations. Sustainability analysis shows that high productivity produce better results for the country in comparison with cheap labor or an undervalued currency. Despite of above mentioned factors; there are many other variables that impact on sovereign risk like imports, fiscal balance, public debt, GDP etc. This paper will cover economic and financial aspects of sovereign bonds.

5: VARIABLE AND DATA SOURCES

This section defines and discusses the choice of a set of explanatory variables of the sovereign bond spreads. Table
To explain the spread level following variables are used

- External debt/GDP
- Interest payments on external debt/reserves
- Short-term debt/reserves
- External debt amortization/reserves
- Fiscal balance/GDP

- Public debt/GDP:
- Current account balance/GDP
- Trade openness
- Financial fragility (financial stress index)
- Risk-free rate and external liquidity conditions (U.S. 3-month Treasury bill rate and 10-year government bond yield and volatility index VIX).

5.1Explanatory Variables

A number of variables can be envisaged to influence the sovereign spread. In terms of explanatory variables, they can be further divided into two important classifications. Those are

- Fundamental Factors
- Financial fragility

Fundamental Factors include Public debt as a percentage of GDP, Fiscal balance as a percentage of GDP, Liquidity Variables, Interest payments on external debt/reserves, Short-term debt/reserves, External debt amortization/reserves, Solvency variables like Trade Openness, Current account balance/GDP and External debt/GDP, while Financial Fragility incorporates Volatility index of S&P 500 (VIX) and US interest rate.

Table 2: Description of the variables and data sources

Variable	Description	Unit	Extrapolation	Source
Spreads	Secondary market spreads, calculated as premium paid over U.S. government bond with comparable features	Basis Points	Yes	Bloomberg (JPMorgan EMBIG Index)
GDP	Nominal GDP, in current prices	Dollars	Yes	International Financial Statistics(IMF 2010)
External debt	Stock of external debt	Dollars	No	Global Development Finance (World Bank 2010)
Public debt	General government gross debt	Percent	No	World Economic Outlook (IMF 2010)
Short-term debt	Short-term external debt	Dollars	No	Global Development Finance (World Bank 2010)
Interest	Interest payments on external debt	Dollars	No	Global Development Finance (World Bank 2010)
Reserves	Stock of International reserves, excluding gold	Dollars	No	International Financial Statistics (IMF 2010)
Amortization	Principal repayments on external debt	Dollars	No	Global Development Finance (World Bank 2010)
Fiscal balance	Fiscal balance to GDP	Percent	No	World Bank national account data and OECD national accounts data
Current account	Current account balance	Dollars	No	International Financial Statistics (IMF 2010)
Openness	Exports + imports/GDP	Percent	No	International Financial Statristics (IMF 2010)
Financial stress index	Standard components: exchange market pressure index (which depends on exchange rate and change in reserves); sovereign spreads (excluded); banking sector beta stock returns; stock return volatility	None	Yes	Balakrishnan and others (2009)

VIX	Chicago Board Options Exchange (CBOE) Volatility Index (VIX)	Index	No	CBOE
U.S. 3-month Treasury bill	U.S. 3-month Treasury bill rate	Percent	No	Federal Reserve
U.S. 10-year government bond	U.S. 10-year government bond rate	Percent	No	Federal Reserve

Source: Author's compilation.

5.2 Econometric Procedures – Theoretical Issues

For the empirical results this study used pooled data to estimate the exogenous variables.

5.2.1 Pooled data

Campbell (1996) put emphasis on the need to combine time series and cross sectional techniques to reduce the possibility of spurious results. Pooling and panel models are estimated by combining time series and cross sectional data. Pooled data refer information on a relatively small number of cross-sectional units observed over time or pooled time-series, cross-section data correspond to data with relatively few cross-sections, where variables are held in cross-section specific individual series. On the other hand panel data refer to data with large numbers of cross-sections, with variables held in single series in stacked form.

Difference

How these two models differ can be explained as

- The data are arrayed prior to estimation.
- Corrections are proposed for a non-constant variance that occurs due to heteroscedasticity, cross equation and/or serial correlation.

5.2.2 The fixed effects method

The fixed effects method is the use of dummies to capture systematic differences among observations. It is an efficient method in case of annual series with few observations. By pooling of the data, the aim is to generate differences among the different cross sectional units that can be captured with the inclusion of dummy variables. In the fixed effects method the constant is used as section-specific in order to allow for different constants for each group. Its estimator is known as the least squares dummy variables (LSDV) estimator.

Functional form

The functional form of fixed effects method is given below

$$\mathbf{Embi}_{i,t} = f(\mathbf{EXT}_{i,t} + \mathbf{INTEREST}_{i,t} + \mathbf{SHORT}_{i,t} + \mathbf{AMORT}_{i,t} + \mathbf{VIX}_{i,t} + \mathbf{PUB}_{i,t} + \mathbf{FSI}_{i,t} + \mathbf{TO}_{i,t} + \mathbf{CA}_{i,t} + \mathbf{FB}_{i,t} + \mathbf{BOND}_{i,t} + \mathbf{BILL}_{i,t}) + \varepsilon_{i,t} \quad \text{..... (3)}$$

F-test:

The F-test is used to check the validity of fixed effects method. The null hypothesis is that all the constants are the same.

$$H_o: a_1 = a_2 = \cdots = a_N$$

If F-statistical is greater than the F-critical then the null hypothesis is rejected. The fixed effects method can be described by the following table.

Table 3: Summary of fixed effect model

Fixed Effect Model	
Intercept	Varying across groups and/or times
Error variance	Constant
Slope	Constant
Hypothesis test	Incremental F test
Estimation	Least squares dummy variable(LSDV), within effect method

6: ESTIMATION RESULTS

This study presents the determinants of sovereign bond spreads with the help of dynamic fixed effect model. In the process of measuring fixed effect model on pool data two methods can be used.

- The fixed effect model in country specific
- The fixed effect model in period specific

In this study, the fixed effect model in country specific is used for finding the determinants of sovereign bond spreads. The advantage to adopting this technique is to measure the individual country effect. In order to show the importance of financial fragility a comparison is made among six models. Table 4 presents the six models (a to f) by employing only macroeconomic fundamentals to explain sovereign bond spreads without incorporating FSI while Table 6 presents the six models (1 to 6) with FSI which provides a high-frequency measure of stress in emerging economies.

6.1 Models without FSI

In this method, six equations have been performed for six models of Table 6.1 by using fixed effects.

Model a:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 EXT_{i,t} + \beta_2 INTEREST_{i,t} + \beta_3 SHORT_{i,t} + \beta_4 AMORT_{i,t} + \beta_5 VIX_{i,t} + \beta_6 PUB_{i,t} + \beta_7 TO_{i,t} + \beta_8 CA_{i,t} + \beta_9 FB_{i,t} + \beta_{10} BOND_{i,t} + \beta_{11} BILL_{i,t} + \varepsilon_{i,t}}$$

This model incorporates all the explanatory variables except FSI, used as benchmark specification for Table 6.1.

Where
i indexes stands for the countries.
t indexes stands for time.
α_i stands for country specific.

Model b, c & d are made by excluding liquidity variables in different patterns.

Model b:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 EXT_{i,t} + \beta_2 SHORT_{i,t} + \beta_3 VIX_{i,t} + \beta_4 PUB_{i,t} + \beta_5 TO_{i,t} + \beta_6 CA_{i,t} + \beta_7 FB_{i,t} + \beta_8 BOND_{i,t} + \beta_9 BILL_{i,t} + \varepsilon_{i,t}}$$

Model b excludes certain variables like interest payments/reserves and amortization/reserves.

Model c:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 EXT_{i,t} + \beta_2 INTEREST_{i,t} + \beta_3 VIX_{i,t} + \beta_4 PUB_{i,t} + \beta_5 TO_{i,t} + \beta_6 CA_{i,t} + \beta_7 FB_{i,t} + \beta_8 BOND_{i,t} + \beta_9 BILL_{i,t} + \varepsilon_{i,t}}$$

Model c excludes short-term debt/reserves and amortization/reserves.

Model d:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 EXT_{i,t} + \beta_2 AMORT_{i,t} + \beta_3 VIX_{i,t} + \beta_4 PUB_{i,t} + \beta_5 TO_{i,t} + \beta_6 CA_{i,t} + \beta_7 FB_{i,t} + \beta_8 BOND_{i,t} + \beta_9 BILL_{i,t} + \varepsilon_{i,t}}$$

Model d is made by excluding interest payments/reserves and short-term debt/reserves.

Model e:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 EXT_{i,t} + \beta_2 INTEREST_{i,t} + \beta_3 SHORT_{i,t} + \beta_4 AMORT_{i,t} + \beta_5 VIX_{i,t} + \beta_6 PUB_{i,t} + \beta_7 TO_{i,t} + \beta_8 CA_{i,t} + \beta_9 FB_{i,t} + \varepsilon_{i,t}}$$

Model e excludes global liquidity variables like U.S 10 year government bond yield and U.S 3-month Treasury bill rate.

Model f:

$$\mathbf{EMBIG_{i,t} = \alpha_i + \beta_1 INTEREST_{i,t} + \beta_2 AMORT_{i,t} + \beta_3 VIX_{i,t} + \beta_4 TO_{i,t} + \beta_5 CA_{i,t} + \beta_6 FB_{i,t} + \beta_7 BOND_{i,t} + \beta_8 BILL_{i,t} + \varepsilon_{i,t}}$$

Model f is made by excluding external debt/GDP, short-term debt/reserves and public debt.

Table 4: Models without FSI

Variables	Model a	Model b	Model c	Model d	Model e	Model f
Intercept	-3.718930	-1.096540	-1.203819	-2.135521	-1.627526	-3.701339
	(-0.972785)	(-0.543247)	(-0.612632)	(-0.985513)	(-1.358383)	(-1.184913)
External debt/GDP	7.786253*	5.671280*	5.768193	6.212102*	7.025572*	
	(1.821466)	(1.716909)	(1.670758)	(2.026052)	(1.997529)	
Interest payments/reserves	-4.633417		1.456222		-2.951788	-0.996879
	(-0.745121)		(0.692983)		(-0.735208)	(-0.227348)
Short-term debt/reserves	1.306780	1.375847			1.209883	
	(0.829604)	(1.149871)			(0.801135)	
Amortization/reserves	1.673591			0.693058	1.058211	2.443295
	(0.831187)			(1.007529)	(0.896510)	(1.616972)
VIX	0.051391**	0.037540**	0.035927**	0.041563**	0.047669***	0.063079***
	(2.308706)	(2.570988)	(2.363787)	(2.700745)	(3.564001)	(2.807405)
Public debt	-3.731847** (-2.435276)	-4.493615*** (-4.356160)	-4.017392*** (-3.732587)	-3.601072*** (-3.009646)	-3.814892*** (-2.870112)	
Financial stress index						

Trade openness	0.643196	-0.133800	0.656489	0.904231	-0.326664	2.996694
	(0.267868)	(-0.071364)	(0.368209)	(0.486725)	(-0.166598)	(1.318605)
Current account /GDP	9.403127	10.81071**	8.596941*	7.911943	10.31426*	1.213837
	(1.594237)	(2.216638)	(1.766150)	(1.577584)	(1.868018)	(0.234127)
Fiscal Balance /GDP	4.565310	1.166187	-0.046069	1.445743	1.372161	-0.447120
	(0.619880)	(0.198576)	(-0.007757)	(0.229067)	(0.253500)	(-0.088800)
U.S. 10-year government Bond yield	0.405456	0.075179	0.027662	0.134933		0.112393
	(0.678823)	(0.175796)	(0.064635)	(0.305031)		(0.181579)
U.S. 3-month Treasury bill rate	-0.121113	-0.073369	-0.044628	-0.061837		-0.030464
	(-0.746698)	(-0.508329)	(-0.308703)	(-0.414074)		(-0.162038)
R-squared	0.7558	0.7373	0.7528	0.7672	0.7668	0.6401
F-statistic	4.643640	5.379034	5.836999	6.316537	6.301187	3.880174
D-W Stat	2.146509	2.176022	2.016364	2.045194	2.316172	1.906606

Source: Author Compilation
*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.
T-statistics are in parentheses

Explanation

Regression results presented in Table 4 perform with the specification of country in fixed effect model. By running the data for fixed effect model, the coefficients of the variables indicate different results like some are significant at 1%, some at 5% and 10% level of significance and many of them proved to be insignificant. The benchmark specification of the estimation of equation 4 is (model a) that includes all the variables except FSI. This model indicates that in all the variables, external debt to GDP, VIX and public debt are significant. The external debt is significant at 10% while VIX and public debt are significant at 5%. The results of model b is to some extent different to model a. It confirms the significance of external debt to GDP, VIX and public debt but at different level of significance like public debt is significant at 1%. In addition to this, current account/GDP is also significant at 5%. According to model c VIX, public debt and current account/GDP are significant at 5%, 1% and 10% respectively. Model d confirms that VIX and public debt are significant at same level as model c but its results are different with regard of current account as it shows that current account is not significant while external debt/GDP is significant at 10%. The Model e results are in accordance with model c and model d as it shows that VIX and public debt are significant at 1% while external debt/GDP and current account/GDP are significant at 10%. However the results of model f are different from all the previous models as it only indicates the significance of VIX at 1%. Overall, among the fundamental variables, the coefficient of external debt, public debt and current account are statistically significant. This set of estimations indicates that liquidity variables do not appear to be significant determinants of sovereign bond spreads.

All the specifications show that the fiscal balance is not statistically significant; confirming the findings of Bellas et al. (2010) as only limited studies find the significance of fiscal stability in determining sovereign bond spreads. The coefficient of VIX is positive and significant in all the models, verifying that global liquidity conditions play an important role in determining sovereign bond spreads. Other global liquidity variables like U.S 10 year government bond yield and U.S 3-month Treasury bill rate are not consistently statistically significant in all the specifications. These results are in accordance to the empirical literature as mixed literature regarding U.S policy conditions. As well as R square value is concerned, which is the most common goodness of fit statistic. It is actually a measure of goodness of fit of regression line. A value of R square close to 1 shows that the model clarifies almost all of the variation of the dependent variable from its mean value. On the other side a value close to zero shows that the model fits the data poorly. Here R square is acceptable as greater than .5 and near to 1. Nevertheless, with the intent of detecting the autocorrelation problem, the Durbin-Watson test statistic is used. The problem of auto-collinearity is not found in all the models as Durbin Watson results are satisfactory. To be precise, Durbin Watson test (see Durbin and Watson, 1950) is the most frequently used statistical test for the existence of serial correlation as it presents the likelihood that the deviation values for the regression consists of a first-order autoregressive component. As the results show that DW statistics are very close to 2 which means that models do not have serial correlation.

6.1.1: Test for the significance of the fixed effects

Further, the test for the joint significance of the fixed effects is performed. This test suggests that fixed effects in the estimation of the equation should be allowed.

Table 5: Significance test for models without FSI

Redundant Fixed Effects Tests **Test cross-section fixed effects**			
Effects Test	**Statistic**	**d.f.**	**Prob.**
Cross-section F			
Model a	4.828880	(3,21)	0.0104
Model b	6.955781	(3,23)	0.0017
Model c	6.639268	(3,23)	0.0022
Model d	6.382169	(3,23)	0.0026
Model e	5.525838	(3,23)	0.0052
Model f	2.887755	(3,24)	0.0564

Source: Author Calculations

The p-values associated to the F-statistic are less than 0.10 in all the models which provides strong evidence against the null hypothesis that the fixed effects are all equal to each other. This suggests that there is unobserved heterogeneity in the data and models with fixed effects should be used. Hence, the validity of fixed effects is proved for all the models from a to f.

6.2: Models with FSI

Now in this selection, the same variables are used in all the models with the only difference that FSI is included now in model specification.

Model 1:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{EXT_{i,t}} + \boldsymbol{\beta_2}\mathbf{INTEREST_{i,t}} + \boldsymbol{\beta_3}\mathbf{SHORT_{i,t}} + \boldsymbol{\beta_4}\mathbf{AMORT_{i,t}} + \boldsymbol{\beta_5}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_6}\mathbf{PUB_{i,t}} + \boldsymbol{\beta_7}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_8}\mathbf{TO_{i,t}} + \boldsymbol{\beta_9}\mathbf{CA_{i,t}} + \boldsymbol{\beta_{10}}\mathbf{FB_{i,t}} + \boldsymbol{\beta_{11}}\mathbf{BOND_{i,t}} + \boldsymbol{\beta_{12}}\mathbf{BILL_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

Model 1 is benchmark specification for table 6.3 as it includes all the variables.

Model 2:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{EXT_{i,t}} + \boldsymbol{\beta_2}\mathbf{SHORT_{i,t}} + \boldsymbol{\beta_3}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_4}\mathbf{PUB_{i,t}} + \boldsymbol{\beta_5}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_6}\mathbf{TO_{i,t}} + \boldsymbol{\beta_7}\mathbf{CA_{i,t}} + \boldsymbol{\beta_8}\mathbf{FB_{i,t}} + \boldsymbol{\beta_9}\mathbf{BOND_{i,t}} + \boldsymbol{\beta_{10}}\mathbf{BILL_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

Like model b, it excludes certain variables like interest payments/reserves and amortization/reserves.

Model 3:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{EXT_{i,t}} + \boldsymbol{\beta_2}\mathbf{INTEREST_{i,t}} + \boldsymbol{\beta_3}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_4}\mathbf{PUB_{i,t}} + \boldsymbol{\beta_5}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_6}\mathbf{TO_{i,t}} + \boldsymbol{\beta_7}\mathbf{CA_{i,t}} + \boldsymbol{\beta_8}\mathbf{FB_{i,t}} + \boldsymbol{\beta_9}\mathbf{BOND_{i,t}} + \boldsymbol{\beta_{10}}\mathbf{BILL_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

The composition of model 3 is same as model c as it excludes short-term debt/reserves and amortization/reserves.

Model 4:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{EXT_{i,t}} + \boldsymbol{\beta_2}\mathbf{AMORT_{i,t}} + \boldsymbol{\beta_3}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_4}\mathbf{PUB_{i,t}} + \boldsymbol{\beta_5}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_6}\mathbf{TO_{i,t}} + \boldsymbol{\beta_7}\mathbf{CA_{i,t}} + \boldsymbol{\beta_8}\mathbf{FB_{i,t}} + \boldsymbol{\beta_9}\mathbf{BOND_{i,t}} + \boldsymbol{\beta_{10}}\mathbf{BILL_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

Like model d, it excludes interest payments/reserves and short-term debt/reserves.

Model 5:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{EXT_{i,t}} + \boldsymbol{\beta_2}\mathbf{INTEREST_{i,t}} + \boldsymbol{\beta_3}\mathbf{SHORT_{i,t}} + \boldsymbol{\beta_4}\mathbf{AMORT_{i,t}} + \boldsymbol{\beta_5}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_6}\mathbf{PUB_{i,t}} + \boldsymbol{\beta_7}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_8}\mathbf{TO_{i,t}} + \boldsymbol{\beta_9}\mathbf{CA_{i,t}} + \boldsymbol{\beta_{10}}\mathbf{FB_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

The composition of model 5 is same as model e as it excludes global liquidity variables like U.S 10 year government bond yield and U.S 3-month Treasury bill rate.

Model 6:

$$\mathbf{EMBIG_{i,t}} = \boldsymbol{\alpha_i} + \boldsymbol{\beta_1}\mathbf{INTEREST_{i,t}} + \boldsymbol{\beta_2}\mathbf{AMORT_{i,t}} + \boldsymbol{\beta_3}\mathbf{VIX_{i,t}} + \boldsymbol{\beta_4}\mathbf{FSI_{i,t}} + \boldsymbol{\beta_5}\mathbf{TO_{i,t}} + \boldsymbol{\beta_6}\mathbf{CA_{i,t}} + \boldsymbol{\beta_7}\mathbf{FB_{i,t}} + \boldsymbol{\beta_8}\mathbf{BOND_{i,t}} + \boldsymbol{\beta_9}\mathbf{BILL_{i,t}} + \boldsymbol{\varepsilon_{i,t}}$$

Model 6 is made by excluding external debt/GDP, short-term debt/reserves and public debt like model f.

Table 6: Models with FSI

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	1.1679	1.4055	1.3633	0.7977	0.2232	2.0703
	(.8539)	(1.4578)	(1.2376)	(0.6758)	(0.4264)	(1.6212)
External debt/GDP	4.1717*	3.2855*	4.5122*	4.9499**	4.4078*	
	(1.7399)	(1.8942)	(1.9568)	(2.7009)	(1.9874)	
Interest payments/reserves	-1.2206		1.2749		-1.8373	3.9159*
	(-.4447)		(0.8563)		(-0.8027)	(2.0210)
Short-term debt/reserves	2.1431**	1.8931**			2.2998***	
	(2.2677)	(2.4917)			(3.0023)	
Amortization/reserves	.1017			0.4988	0.2692	-0.1901
	(.1116)			(1.0456)	(0.3897)	(-0.2465)
VIX	-.0057	-0.0066	-0.0071	-0.0032	-0.0046	-0.0054
	(-.5604)	(-0.8379)	(-0.7891)	(-0.3245)	(-0.5719)	(-0.5041)
Public debt	-1.2327	-1.0593	-0.2463	-0.0379	-1.3450*	
	(-1.2019)	(-1.3299)	(-0.2897)	(-0.0421)	(-1.7559)	
Financial stress index	.3363***	0.3379***	0.3532***	0.3511***	0.3351***	0.3473***
	(12.7282)	(13.2200)	(11.7212)	(11.7372)	(12.8060)	(11.8384)
Trade openness	-4.1946***	-4.0666***	-3.5636***	-3.3495***	-3.8045***	-3.0272***
	(-4.7223)	(-5.9266)	(-4.2528)	(-3.7369)	(-5.0854)	(-3.3443)
Current account /GDP	12.1205***	11.3847***	7.0147***	6.5157**	11.9630***	7.1418***
	(3.8368)	(4.7646)	(3.1511)	(2.7849)	(5.0038)	(3.5415)
Fiscal Balance /GDP	2.3879	1.8241	0.8262	1.4497	3.9123*	-2.2357
	(.9364)	(0.8239)	(0.3271)	(0.5773)	(2.0537)	(-1.0468)
U.S. 10-year government Bond yield	-.2109	-0.2514	-0.3577	-0.3040		-0.4127*
	(-.9683)	(-1.2861)	(-1.6292)	(-1.3636)		(-1.7300)
U.S. 3-month Treasury bill rate	.0628	0.0723	0.1362*	0.1334*		0.1325*
	(.8879)	(1.0846)	(1.9186)	(1.8861)		(1.8841)
R-squared	.9673	0.9665	0.9533	0.9542	0.9615	0.9492
F-statistic	39.4077	48.8958	34.5460	35.2589	42.2399	35.8062
D-W Stat	2.2756	2.2211	1.6703	1.6289	2.2845	1.7222

Source: Author Compilation
*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.
T-statistics are in parentheses.

Explanation

In Table 6 all the specifications are presented in comparison with the specifications of Table 4, particularly to demonstrate the impact of adding the financial stress index to the estimations. The results indicate that specifications of Table 6 are satisfactory in terms of explanatory power, sign, and significance level. The set of estimations indicate that financial stress index is highly significant and positively correlated with the sovereign bond spreads in all the models. The significance of FSI demonstrates the importance of idiosyncratic financial environment in financing conditions of BRICs. A considerable increase in the coefficient of determination (R square) is examined as a result of inclusion of FSI, indicating the importance of FSI in explaining the spread. This is an innovative result that extends the findings of Bellas et al. (2010). There is no problem of autocorrelation so the null hypothesis would not be rejected as Durbon Watson statistics are near to 2 in all the models from 1 to 6. The results of Table 6 are somewhat different from Table 4 showing the impact of financial fragility in the models. The benchmark specification of the estimation of equation 10 (Model 1) includes all the variables. According to this model external debt/GDP and short term debt/reserves are significant at 10% and 5% respectively while trade openness and current account are highly statistically significant at 1%. Model 2 confirms the results of model 1 in terms of significant variables and their significance levels. In addition to previous findings, when short term debt/reserves and amortization /reserves are excluded from Model 3, suggesting the significance of U.S 3-month treasury rate in explaining spread. Model 4 indicating the significance of same variables as shown by model 3 but at different significance level like external debt/GDP and current account/GDP are significant at 5%. Model 5 and model 6 results are different from other models as in addition to other variables, model 5 shows the significance of fiscal balance/GDP and public debt while model 6 indicates the significance of interest payments/reserves and U.S 10 year bond in determining sovereign bond spreads. Among the fundamental variables, the coefficients of the external debt/GDP, trade openness, current account/GDP and short term debt/reserves are statistically significant in all the models. The specifications from (2) to (4) confirm the significance of short term debt/reserves among all the liquidity variables. In these specifications the three liquidity indicators are used one at a time, and two of them (interest payments/reserves and amortization/reserves) are not consistently statistically significant. All the estimations prove the importance of solvency variables in explaining the spread level which means that sustainability of external indebtedness is key indicator. Fiscal balance and public debt do not appear to be significant determinants of sovereign bond spreads as only limited papers found it to be significant. Specification in which global variables (e.g., the 3-month U.S. Treasury bill rate and the 10-year U.S. government bond) are not included in the regression show significant coefficients for the fiscal balance and public debt. Models with FSI indicate that the coefficient of the volatility index is negative and not statistically significant, suggesting a colinearity impact as all the models without FSI showing the significance of global financial variables as determinants of EMBI spreads. However, it also shows that during the period of financial stress, market sentiments cannot play significant role in explaining the spread level. The 3-month U.S. Treasury bill rate and the 10-year U.S. government bond are not consistently statistically significant in all the estimations. Furthermore, they appear to be significant in those specifications in which some of the liquidity variables and public debt are excluded.

Hence these findings show the importance of FSI in clarifying the movements of BRICs sovereign bond spreads relating to financial vulnerabilities. It indicates that transmission of financial stress through financial and economic linkages is the major determinant of sovereign bond spreads of BRICs. The results also conform to those past studies which find that fundamental factors play significant part with external factors in determining the spread level.

6.2.1: Test for the significance of the fixed effects

Again, next step is to perform F-Test for the joint significance of variables that are included in the estimation.

Table 7: Significance test for models with FSI

Redundant Fixed Effects Tests **Test cross-section fixed effects**			
Effects Test	**Statistic**	**d.f.**	**Prob.**
Cross-section F			
Model 1	19.149500	(3,20)	0.0000
Model 2	20.562716	(3,22)	0.0000
Model 3	16.505018	(3,22)	0.0000
Model 4	17.319974	(3,22)	0.0000
Model 5	19.479039	(3,22)	0.0000
Model 6	15.287831	(3,23)	0.0000

Source: Author calculations

The p-values associated to the F-statistics are 0 in all the models which strongly rejected the null hypothesis that the effects are redundant. These results suggest that models with fixed effects are the right choice. Hence, validity of fixed effects is proved for all the models from 1 to 6.

6.3: Comparison of Models without FSI and with FSI

Table 8: The comparison of testing results

Testing	**Models without FSI**	**Models with FSI**
A Test of autocorrelation - The Durbin-Watson test statistic	No autocorrelation problem	No autocorrelation problem
The coefficient of determination (R^2)	Models without FSI indicate significant value of coefficient of determination (R^2) as value above 50% is acceptable and consider good. Models from (a to e) demonstrate its value above 70% while model f shows 64% only.	A substantial rise in the value of coefficient of determination (R^2) is observed when all the estimations include the FSI. After incorporating the FSI, all the models indicate that R^2 value reached 95% and above.
Validity Test -F Statistics	The joint significance of all the variables is proved by F-Statistics	The joint significance of all the variables is proved by F-Statistics

Table 9: The result of determinants of sovereign bond spreads in BRICs over the years 2001 to 2009 by using fixed effect model

	Results	
Variables	**Models without FSI**	**Models with FSI**
External debt/GDP	The coefficient sign is positive and it is statistically significant at 10% critical values in all the models except model c. The results suggest that higher debt burden corresponds to wider spread.	The coefficient sign is positive and it is statistically significant at 10% critical values in all the models except model 4 where it is significant at 5%. The results suggest that after incorporating FSI, significance of external debt is further increased.
Interest payments/reserves	The results indicate that the interest payments/reserves are not consistently statistically significant across all specifications.	Only model 6 confirms its significance at 10% with positive coefficient sign which leads to wider spread. But its significance and sign is not confirmed as mixed results by other models.
Short-term debt/reserves	Although the coefficient of short-term debt/reserves is positive but it is not significant in all the models.	The coefficient of short-term debt/reserves is positive and statistically significant at 5% critical values in models 1 & 2 while at 1% in model 5.This suggesting that greater financing needs implying greater compensation for risk and corresponds to wider sovereign bond spreads.
Amortization/reserves	The coefficient of amortization/reserves has positive signs as expected, but it is not significant in all the models.	The coefficient of amortization/reserves has positive signs but it is not significant in all the models.

VIX	The coefficient of the VIX is positive and highly significant in all the models; verifying that global liquidity conditions are important in determining sovereign bond spreads.	The coefficient of the VIX is negative and do not appear to be significant determinant of sovereign bond spreads in all the models. It indicates that during the time of financial stress, VIX become insignificant.
Public debt	The coefficient of the public debt is negative as expected and highly significant in all the models; suggesting that improved composition of public debt tends to lower sovereign bond spreads.	The coefficient of the public debt is negative as expected but do not appear to be significant determinant of sovereign bond spreads except model 5 which confirms it to be significant at 10%.
Financial stress index	--	The coefficient of the FSI is highly significant and positively correlated with the sovereign bond spreads in all the models signifying that idiosyncratic financial environment of a country can affect sovereign's financing conditions.
Trade openness	The coefficient of the trade openness has negative signs in two models (b and e) and it is not significant in all the models.	The coefficient of the trade openness is negative as expected and highly significant in all the models; suggesting that a low degree of openness require projected trade surpluses for future foreign debt repayments and lead to wider spread. Contrary to this, large exports decrease sovereign bond spreads.
Current account /GDP	The significance of the current account/GDP is confirmed by models (b, c and e) in determining sovereign bond spreads.	The coefficient of the Current account /GDP is highly significant and positively correlated with the sovereign bond spreads in all the models. It indicates that the economies depend heavily on funds from abroad.
Fiscal Balance /GDP	The coefficient of the fiscal balance/GDP is not consistently statistically significant across all specifications.	Only model 5 indicates its significance at 10% as only limited paper find its role in determining sovereign bond spreads.
U.S. 10-year government Bond yield	All the models indicate that the 10-year U.S. government bond is not playing important role in determining spreads on international sovereign bonds.	The results indicate that the 10-year U.S. government bond has negative impact on sovereign bond spreads while it is statistically significant in only one model while all the other models indicate it as insignificant.
U.S. 3-month Treasury bill rate	The coefficient of 3-month U.S. treasury bill does not appear to be consistently statistically significant across all specifications.	The coefficient of 3-month U.S. treasury bill is significant at 10% and positively related to sovereign bond spreads in some models when domestic liquidity variables are excluded.

7. Conclusion

The investigation conducted in this study focuses on the impact of financial fragility on the sovereign bond spreads of the four rapidly rising emerging economies Brazil, Russia, India and China (BRICs). This is achieved by adding the financial stress index as a determinant of sovereign bond spreads. The study is accomplished using fixed effects model and reliable data for the BRICs which has traditionally been very difficult to get and has limited the extent and scope of study in the emerging economies to date. A primary reason for choosing BRIC countries is its fastest growing markets and emergence as the larger force in the world economy with the strong economic growth potential. The BRICs, representing a quartet of countries leading the emerging market economies of today and have been on the rise in the global economy. Despite the growing importance of the BRICs in both demographic and economic terms, the increased external investment inflow, and the significance of the BRICs in worldwide investment portfolios, the existing emerging markets literature is limited with respect to the essential market characteristics of BRICs that lead to eventual mispricing of investment tools in these countries. The contribution of this research is to fill the existing information gap by capturing the financial health of BRICs with the help of Financial Stress Index (FSI) that provide practical and theoretical empirical evidence of the determinants of sovereign bond yield spreads in the BRICs. Since the 1980s, emerging market economies have gradually more turned to private investment and to the issuance of sovereign bonds in order to secure investment. As a result of this process, the role of credit rating agencies has increased to evaluate the ability and probability of sovereigns to pay its sovereign bond issues. The

information provided by credit rating agencies impact on global capital flows as it is proved to be signal for investors about problems and opportunities. For example, if credit rating of a country is downgraded, the risk premium increases resulting in a higher bond spread and larger cost to bond issuers. With the intention of finding impact of financial fragility on sovereign bond spreads, a comparison is made among different models by using fixed effect technique. In this study, six models used without incorporating FSI and then results of these regressions compare with the results of those models that are made with using FSI. In particular, the comparison suggests that financial fragility is a major determinant of sovereign bond spreads than other variables as it appears to be highly significant in all estimations. By adding FSI, the coefficient of determination (R square) significantly increases, indicating the importance of financial volatility in explaining spread level. This is a novel finding that extends the results of Bellas et al. (2010) and other researchers like Mody (2009) who use dummy variables for crisis periods to explain the correlation between financial fragility and sovereign bond spreads. The significance of FSI depicts the importance of idiosyncratic financial environment in financing conditions of BRICs by showing the transmission of financial stress through financial and economic linkages. The results also indicate the importance of local factors in explaining the sovereign bond spreads of BRICs economies that is in conforming to those past studies which find that those fundamental factors play significant role with external factors in determining spread level.

8. Policy Recommendations

The findings of this study have implications for investors and policymakers. Different factors are identified that explain variation in spreads across countries and over time. The empirical results of this study illustrates the significance of financial fragility, levels of debt, Trade openness, current account balance in determining the sovereign bond spread in the BRICs. In view of these identified factors some suggestions are given below.

Level of debt

Short term debt and external debt both are playing crucial role in determining sovereign bond spreads in BRICs. The external debt of BRICs suggests the sensitivity to economic crisis as higher debt burden reveals the larger transfer effort of the countries in order to service its obligations over time while short term debt implies higher financing needs for higher compensation for risk. So BRIC countries should be careful in identifying levels of debt as higher debt burden may result in higher risk of default.

Financial fragility

Financial fragility has a larger impact on the BRICs sovereign bond spreads by transmission of financial stress through financial and economic linkages. Based on these findings, it is suggested that international investors must price the risk of investing in sovereign bonds on individual basis not as a group (BRICs) because of idiosyncratic financial environment and financing conditions of these countries.

Trade openness

The significance of trade openness suggests that a low degree of openness require projected trade surpluses for future foreign debt repayments. So policy makers of BRICs must be vigilant towards trade policy and investors should take investment decision in sovereign bonds after observing export growth of the country.

Current account

The importance of current account in explaining sovereign debt illustrates that the BRIC economies depend heavily on funds from abroad and country's sustainability can be affected by consistent current account deficit. These findings reveal the dependence of BRIC economies on foreign creditors.

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