

COLUMBIA UNIVERSITY

Pricing Emerging Market Corporate Bonds

An Approach Using the CDS-Bond Basis Spread

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I. Introduction and Motivation

Emerging Market (EM) bond markets expanded tremendously over the last ten years and, consequently, have become increasingly advantageous investments for investors seeking higher yields¹ than what more mature bond markets have been able to provide. Some degree of risk, however, remains as the reasons underlining these markets' traditionally heightened volatility² continue to affect these economies to varying degrees. Consequently, the high yields which make these investments so profitable reflect at the same time the added risk one takes on by investing in the sector.

But how risky is EM debt really? There is no real consensus on the matter. Because of the inherently more complex nuances of the fixed income sector, investors are even more befuddled about how to approach EM fixed income products than they are about handling traditional equity vanilla products (Marber 2010). Not only this, but investors are often unsure if they should even bother learning about the sector, as they view the recent surge in fixed income in the region as little more than a phase – a response to the current low-yielding environments in the Developed Markets (DM) at best and just another “bubble” at worse (Beeley 2005). Consensus, however, is

¹ Bond yields: are a measure of return for a bond or, in general, any fixed income instrument. The yield for a bond changes daily despite the pricing assumption that it will be held to maturity (yield to maturity). All else being equal, the higher the yield, the lower the price of the bond. Bond yields are also a reflection of the premium required by investors to compensate them for the risks associated with buying a bond; the riskier the bond issuer, the higher the cost (in yield) to tap into the bond markets.

² Volatility: is a financial measure of risk which captures the variation in price of a security over a certain period of time. Statistically, it measures the dispersion of observed values from estimated values. Historical volatility is often measured as standard deviation or variance, but since financial instruments are markovian in nature implied volatility – which is calculated as a function of current market prices and their underlying derivatives – is considered a more accurate measure in the financial community.

gradually emerging that this shift towards EM investing is structural (Chang et al 2010, Kopf 2006).

This means it is time the global investment community begin to expand their working knowledge of this area. This paper seeks to illuminate the debate surrounding the appropriate pricing and risk assessment of EM fixed income instruments. Although this paper will discuss the emergence of EM debt markets more generally, I focus my quantitative analysis specifically on the EM corporate bond sector as there is a substantial gap in this space (Levy 2009).

Further, I examine this sector through the lens of credit analysis.³ This is an area which despite garnering widespread investor attention and experiencing tremendous growth in the last decade still remains relatively unexplored by academia. The few seminal studies which have led the way, however, are widely respected and the methodological techniques therein reproduced have been shown to generate significant empirical results and concrete implications for the credit markets. Further, there has been very little research conducted in this area which focuses on the EMs, precisely because credit markets in the region are so nascent.

But now that these markets are growing at an even faster pace than they are in the DM it is time to fill this gap (Chang et al 2010). In fact, the main contribution of this study will be to extend the credit analysis which has already been done on the EM bond markets in general to the EM corporate bond market in particular; after all, to my knowledge, there has yet to be a study which focuses on the way the credit markets interact with and affect the development of the EM

³ Credit Analysis: is the study of financial instruments in general and fixed income securities in particular through a focus on risk measurement and the impact of credit metrics on the pricing of securities. More specifically, it focuses on analyzing the creditworthiness of a particular entity and seeks to explain how different levels of creditworthiness influence the underlying value of an entity as well as the financial securities it issues.

corporate bond market. The studies which did utilize credit analysis to study EM fixed income instruments instead limited their discussion exclusively to sovereign debt.⁴

For this very reason the growth of the credit markets in the region is so crucial. After all, there is ample evidence that the presence of a robust credit market is highly correlated with improved perceptions of risk and promotes price discovery⁵. As more investors develop their credit skills, the more they become comfortable with purchasing EM fixed income securities (de Wit 2006). Finally, as credit metrics improve in these countries the more they have a positive impact on drawing new investors to the space and on illustrating the potentially rich risk/reward ratios which are present there.

While there are many avenues from which to frame the above discussion, I believe a closer examination of the emerging area of Credit Default Swaps (CDS) warrants the most attention. CDSs are by far the largest product in the credit markets and play an ever increasing role in how investors view fixed income instruments. However, there is very little in the way of academic research which focuses on the CDS market in the EMs. There is especially not any study that I could find that analyzes how the growth of corporate bond market in the region is affected by the development of the CDS market.

⁴ Sovereign Debt: countries may issue debt in order to finance their day-to-day activities and/or long-term projects in the same way that a company may do so (corporate debt). This oftentimes occurs by issuing an announcement which includes details on the bond, such as its maturity, coupon payment and issue-date. Investors, generally large banks, then can buy this debt as soon as it is issued.

⁵ Price Discovery: is the process by which buyers and sellers freely trade assets and arrive at 'market efficient' prices for these assets. Contrary to valuation, which focuses on finding the fair price of the asset based on fundamentals, price discovery is the process by which investors use only the information available in the market to arrive at a market price that reflects the dynamics of supply and demand

2. Theoretical Background

A CDS is a credit derivative instrument which provides insurance against the potential default of a counterparty. More specifically, it is a bilateral financial agreement between the protection buyer and the protection seller whereby the protection buyer pays a periodic fee, typically expressed in basis points⁶ per annum, on the notional amount of the contract, i.e. how much is being insured, in return for a contingent payment in part of the protection seller in the case of a credit event involving a specific counterparty.

Not unlike that of other fixed income securities, the mark-to-market⁷ value of a CDS is then determined by equating the expected value of the payments by the buyer to the expected payout received from the seller in the case of default (Malone 2011, Hull and White 2000). To illustrate this idea, imagine a 5-year CDS contract with a coupon of 500bp. If one assumes a notional of \$1 million, the seller can expect to receive 500bps * \$1,000,000 or \$50,000 per year for the 5 years. The buyer will only enter into this agreement if he believes that the amount he stands to lose from investing in the bond in the case of a credit event is equal to or greater than the present value of those future payments. If the bond issuer were certain to pay him the agreed coupon and principal payments this cost would not exist, but since there is some probability that the issuer will default, the CDS spread is intended to compensate for this risk.⁸

⁶ Basis Points (Bps): is a measure which is typically used in measuring fixed income instruments, especially as it applies to yields and spreads. One basis point is defined as 1/100 of a percent.

⁷ Mark-to-Market (MTM): is a measure of fair value accounting which uses actual market prices to gauge the value of a security. Contrary to historical cost accounting, MTM accounting is intended to reflect the changing nature of market parameters and the effects of supply and demand. It considers the "fair value" of a security to be not the fundamental or historical value of its assets but rather the value assigned to it by the market.

⁸ The default probability is generally viewed as a function of the spread / (1 – recovery rate); the higher the default probability the higher the CDS spread. Consequently, in order to arrive at the MTM value of the CDS contract, one must discount the future cash flows not only by the risk-free rate but also by the survival rate, that is 1- the recovery rate. How to estimate this default probability is at the center of every CDS pricing model.

The value of a CDS contract is essentially then the value that the market assigns to the particular credit risk⁹ of any reference entity. Since by purchasing a bond and a CDS contract one theoretically eliminates the risk of the bond issuer defaulting, the return secured by entering into this joint position should theoretically represent the risk-free rate. That is, the difference between the bond yield and the risk-free rate – also called the bond spread – should be equivalent to the cost of a CDS contract (Figure 1). Another way to examine this relationship is to view the CDS as the cost of a put option¹⁰ written on that bond that compensates an investor from the losses incurred in a credit event (Whetten, Adelson and van Bemmelen 2004). Following Black and Scholes (1973), it is known that a portfolio composed of this put option (the CDS) and the risky bond has the same expected return as a portfolio of risk-free bonds.

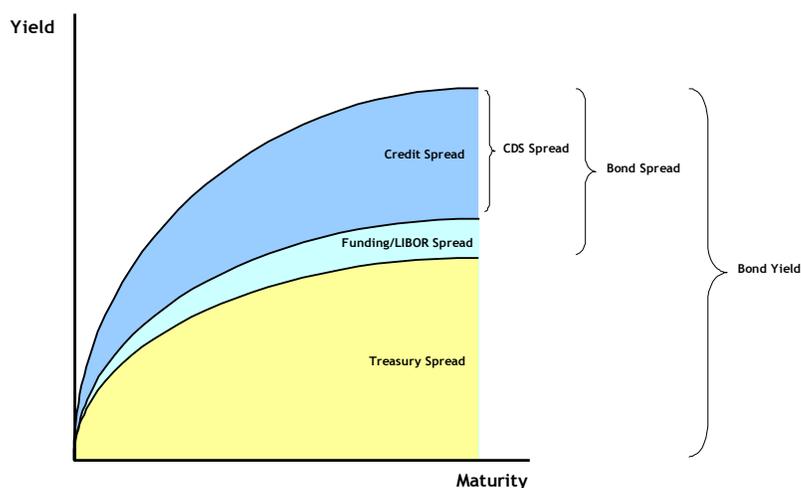


Figure 1

Source: Elder, JPMorgan, 01/2006

⁹ Credit Risk: whenever one purchases a fixed income security, it carries the risk that the issuer of the security will not make the promised coupon and/or principal payments as agreed. In addition, issuers can be downgraded or upgraded which also affects the price of their securities. Credit risk is greater for lower-quality issuers than for investment grade corporates or sovereigns. Rating agencies play a huge role in assessing credit risk.

¹⁰ Put Option: A put option protects you against the declining value of an underlying security. You pay a premium – the option price – for the option to sell the security at a predetermined value at a specified time. If the security falls below that predetermined value, then you can sell it and be protected from any further losses.

This theoretical equivalency between the CDS spread and the bond spread is one of the theoretical foundations of the credit markets and one of the assumptions examined closely in this paper. While this relationship has been tested and shown to hold true over time (Hull and White 2000, Duffie 1999), I show that this is not the case for the EM corporate bond market.

In order to understand why this theoretical equivalency fails in this environment, one must more closely analyze the way in which the two measures are compared. If one thinks of a CDS spread as the additional risk over LIBOR¹¹ (Zhou 2008, Malone 2011), then this should theoretically isolate the pure credit risk of the reference entity. However, bond yields are not solely composed of credit risk + the funding cost over the risk free rate. After all, it is well established in the fixed income community that bond yields are affected by eight different types of risk, from interest rate risk to inflation risk – credit risk being only one of these. The only way in which these two spreads to be analogous would therefore be in a *ceteris paribus* condition where these risks affected the CDS and the bond spread in precisely the same way. This would require that both instruments have the exact same maturities, financing costs, interest rates etc. – something which is rarely observable in the real world (de Witt 2006, Levy 2009).

In order to accurately compare bond yields to CDS spreads it is necessary, therefore, to interpolate the bond spreads that isolate the pure credit risk of a bond. The most established methodology for interpolating this bond spread is by looking at the bond's par equivalent CDS spread.¹² The difference between this and the CDS spread is called the CDS-Bond Basis

¹¹ LIBOR (London Interbank Offered Rate): is the average interest rate charged by banks in order to lend to other banks. While it originally pertained only to the largest banks based out of London, it is now a widespread proxy for the most basic funding cost. It is now viewed as more realistic than the previously held view that tied funding costs to Treasuries. Since Treasuries are viewed as risk-free assets and banks have risk, however low, the cost of inter-bank lending is considered to be a better measure for funding cost when risk is involved. It is an industry standard to tie one's actual funding cost (e.g. for a corporation) to a premium above LIBOR that reflects this added risk.

¹² Par-Equivalent CDS Bond Spread: is the bond spread that theoretically is required to be able to accurately compare bond and CDs spreads. The bond must be traded at par in order for the no-arbitrage argument first developed by Black and Scholes to hold; that is because one of the assumptions of the model is constant interest

(hereafter simply the basis). When this theoretical equivalency between them fails and bond spreads are priced lower (higher) than CDS spreads, the basis is said to be positive (negative) and there exists a potential arbitrage opportunity referred to in finance as a basis trade.

While the traditional literature concludes that in the long-run the basis is zero (Hull and White 2000, Duffie 1999), it neglects the inclusion of some real world factors which cause the basis to be positive/negative. I find these to be especially pronounced in the EM fixed income markets as they are not as mature as the DM markets where those studies were conducted. I especially find that the lack of adequate trading volumes and speeds mean that the kind of price discovery implied by the no-arbitrage argument described above is impossible to achieve. The fact that this market is still nascent in many countries means that there are still heightened levels of liquidity risk¹³ there, and my findings agree with Levy (2009), Akdogan and Chadwick (2011) and Jacobs and Karagozolu (2010) that the positive impact that this has on the CDS spread is one of the largest sources of this discrepancy. I also agree with de Witt (2006) and Zhou (2006) that the heightened volatility perceived at times to be present by investors in these markets spurs a demand for protection buying that overstates the CDS spread vs. the bond spread and causes a positive basis; this is especially evidential during the period of 2008 to 2010 when volatility was at its highest. Finally, I find a positive correlation between tightening CDS spreads in the EM and tightening bond yields paid by companies to investors in their bonds, signaling a looping effect between decreased perceived levels of risk and funding costs in the region.

rates. Since most bonds trade with fixed coupons, as interest rates change the bond deviates from par by trading either at a premium or at a discount. The moment this occurs the CDS spread and the bond spread cease to be equivalent and the no-arbitrage assumption fails.

¹³ Liquidity Risk: liquidity is the frequency with which a particular security trades. When a bond is very liquid, there are many buyers and sellers which promotes price discovery and tightens the bid-ask spread. If, however, a bond is not very liquid than it can be more difficult to accurately gauge the 'fair price' of the security. Further, if you wish to buy/sell the bond and you don't find any buyers/sellers, you'll probably have to change the price at which you buy/sell the security, possibly incurring a loss in your investment. This is especially a concern in the EM corporate debt space since liquidity is not always great for many of these securities.

Methodologically, I follow in the steps of Levy (2009) and update the traditional model for the basis first developed by Hull and White (2000) to account for differences in liquidity. I find that for more liquid corporates the basis is smaller than for their less liquid counterparts. I also follow in the steps of Jacobs and Karagozoglu (2010) and incorporate measures of market volatility and credit quality to show that as EM corporate bond markets develop the basis also decreases.

3. Background

3.1 The Origins of the Corporate Bond Market in the EMs

The recent development of the EM bond market owes much to the sub-optimal conditions which characterized these markets throughout the nineties (Kopf 2006, Luengnaruemitchai and Ong 2005). These economies traditionally relied on their large banking sectors to provide liquidity to their markets, but as macroeconomic conditions worsened and many countries began to experience economic distress, their banking systems could no longer keep either their countries – or themselves – afloat. It was noted, for example, that those countries which relied more heavily on their banking sectors for financing purposes were the ones hit hardest by the global volatility characteristic of the end of the millennium (Greenspan 1999). The Asian Crisis and the subsequent Argentine, Brazilian and Russian defaults and/or devaluations were especially large catalysts to these governments' realization that they needed to enlarge and deepen their bond markets in order to thrive as successful members of a new, more global investment community (Luengnaruemitchai and Ong 2005, Rozada 2005).

The fact that so many EM economies imposed limitations on the floating of their currencies up until then also meant that their bond markets could only remain nascent (Marber

2010). After all, as long as exchange rates were kept fixed by central banks, all interested parties – from governments to banks to domestic companies – had an interest in taking on hard-currency debt (Kopf 2006). With the gradual liberalization of the capital account¹⁴ and the growth of cross-border trading in general, these economies found themselves unable to maintain their fixed exchange-rate parity.¹⁵

Gradually, most of the EM ventured into the realm of floating exchange-rate regimes. This decision oftentimes accompanied economic distress, which meant governments were moving into this new system at a time when they were already in dire need of financing. This also meant that they would need to pay investors large premiums to convince them to undertake the risk of this financing (Marber 2010). Gradually, they found more and more investors willing to do so, especially in those countries which continuously re-emphasized their commitment to controlling inflation and adhering to a flexible exchange-rate policy (Kopf 2006, Schinasi and Smith 1998, Hund and Lesmond 2008). Latin America especially has had a particularly troublesome history with inflation and despite the various strides it has made in controlling this phenomenon the number one concern for EM fixed income investors even today is that rising inflation will eat at the higher yields provided by those markets (Beely 2005, Chang 2012). This concern as it applies to the fixed income space is referred to as inflation risk.¹⁶

¹⁴ Capital Account: in macroeconomics, the capital account is one of two primary components of the balance of payments with the other being the current account. While the current account refers to a country's net income, the capital account refers to the country's net change in ownership of assets.

¹⁵ Fixed Exchange Rate Parity: rather than float their currency based on supply and demand, many countries instead have historically chosen to fix the value of their currency to either another currency or a specific asset, e.g. gold in the case of the "Gold Standard."

¹⁶ Inflation Risk: particularly in EM economies which have a history of persistent inflation concerns, this is a very significant source of risk. After all, as inflation rises the real value of your coupon payment and, at maturity, your principal payment will go down. To combat this risk many governments issue inflation-adjusted bonds but this is not the case for corporate bonds.

Persistent fear of growing inflation has meant that the cost of financing in these countries is still relatively high compared to equivalent instruments in the DM (Chang et al 2010, Marber 2010). Many governments like that of Brazil and Turkey purposely keep their interest rates elevated in order to run tighter monetary regimes that make it harder for market participants to bid up the costs of goods and services. It has been an ongoing policy in many EM countries, and especially in Latin America, to keep these and other funding costs high in order to limit the access to credit and subsequently control inflation. However, as a result of these initiatives, the returns that can be secured by these fixed income instruments can often exceed even the traditionally higher returns achieved by equity investments (Chang et al 2010, Chang 2011, Roldos 2004). After all, since coupon payments are dependent on interest rates, high interest rates mean that the yields required to compensate investors have to be correspondingly high. The risk associated with changing interest rates is called interest rate risk.¹⁷

As EM's broke away from fixed exchange-rate regimes and decreased their reliance on the banking sector, they were also able to expand their fixed income offerings beyond the traditional Brady Bond¹⁸ instruments and issue domestic-currency denominated debt (Marber 2010, Chang et al 2010). Interestingly, they found growing investor demand not only abroad in the traditionally more mature investment communities but also increasingly more so among their

¹⁷ Interest Rate Risk: bond prices are significantly affected by changes in interest rates. If rates rise, the yields required to compensate investors for the added risk of investing in the security also go up. Newer securities will have to be issued with these higher yields to attract investors, causing the old securities to drop in price. If interest rates, on the other hand, fall then investors will pay a premium for those with a higher interest payment (also known as a coupon) and so these bonds will rise in price. In general, there is an inverse relationship between interest rates and bond prices.

¹⁸ Brady Bonds are dollar-denominated bonds originally issued in the late eighties as part of a general debt-restructuring provision for Mexico and other Latin American countries by U.S. Treasury Secretary Nicholas Brady in an effort to reduce their debt. They were innovative because they allowed American banks to package their claims on the assets of EM economies into tradeable assets which are collateralized by U.S. zero-coupon treasury bonds purchased by the EM country and held in escrow by the US Government. Prior to the nineties, most of the bond market in Latin America constituted of Brady bonds (Marber 2010, Yee 2000)

own populace (Kopf 2006). The geographic diversification of this investor base meant that these economies no longer only relied on foreign investment to develop their markets. The gradual expansion of the domestic investor base also created a loop-back effect, wherein more and more local investors and business leaders push their governments to continue to enact initiatives that further deepen these markets and expand the fixed income space (Luengnaruemitchai and Ong 2005).

The importance of the move away from the banking sector in favor of a broader investor base has been further supported by evidence coming out of Japan, where this country's own excessive reliance on the sector has been blamed for the economic stagnation of the last two decades (Reszat 2003). Thus, it is not only in the EM but also in the DM that reliance on bank funding alone is cause for serious concern. There are still some who maintain that there is no definitive evidence as to whether market or bank-based financial systems are better at providing liquidity to the economy (Luengnaruemitchai and Ong 2005) but it is, however, widely acknowledged that a diversified system is better at mitigating the various risks involved in making financial investments of any kind (Gorton and Pennacchi 1991). Further, evidence out of the credit markets seems to confirm this view, as one observes CDS spreads tightening significantly as fixed income bond markets expand – both on a corporate (Chang 2011, Malone 2011) and sovereign level (Levy 2009).

Governments in the EM have generally made the development of a strong and deep bond market one of their priorities following the macro volatility of the late nineties and early two-thousands (Kopf 2006, Chang et al 2010). By developing their bond markets, they hoped to create a financial landscape characterized by high levels of liquidity, fair pricing, low volatility

and increasingly lower yields. The question then remained as to how this development was best to be achieved.

While these economies have generally struggled with how to apply the models of their more developed counterparts to their present circumstances, it is actually a common misconception to associate the DM with having a long standing, developed bond market (Marber 2011, Kopf 2006). Canada, Australia, Japan and most European countries only saw their bond markets, especially their corporate ones, grow in recent decades when they already had more mature legal systems and stable currency regimes. The United States is the only country where the banking sector has never played a dominant financing role in the market; the existence there of a strong and competitive bond market has always kept the banking industry in check and provided widespread liquidity to all kinds of debt instruments (Schinasi and Smith 1998).

In the DM ex-USA, the corporate sector has played a huge role in helping the government to lead the effort to develop their bond markets. After all, they perceived how they could greatly benefit from increased financing levels and lower financing costs than those that the banking system alone could provide (Luengnaruemitchai and Ong 2005). It also allowed companies to issue debt which was much longer term than that which was previously available. They had long been used to raising funds in the American equity market, where investors looking to expand their foreign exposure while also limiting their cross-currency and cross-border risk could use their own more developed financial platforms to buy up ADR's¹⁹. Already familiar with ADR's, taking their corporate debt to a foreign level was naturally the next step.

¹⁹ ADR (American Depository Receipt) is a security that represents the underlying securities of a non-US company but that trades in the US financial markets. ADR's are denominated in US Dollars and are treated similarly to trading in shares of US-domiciled companies. They started trading in 1927 by J.P. Morgan in an attempt to raise funds for the British retailer Selfridges. They have since developed into a large and mature market and have played an important step in allowing domestic investors to buy foreign securities without many of the accompanying risks which are involved in cross-bordering trading.

These developments served to gradually decrease not only the cost of financing but also the risks associated with funding these investments (Dittmar and Yuan 2008) and by the mid-nineties many of these DM countries were able to reach debt funding levels that resemble those of the United States (Schinasi and Smith 1998).

3.2 Challenges and the Role of the Legal Framework: Differences in the EM Experience

While the DM ex-USA were able to benefit from an already established financial legal framework and sophisticated investor base used to investing in equity products, EM economies lacked the expertise with which to smoothly transition from a banking-based lending system to a financial one. The EM financial market was less mature and corporates only gradually learned to take advantage of government initiatives and to push for the right kind of reforms to spur this transition (Chang et al 2010, Marber 2010). Most of the effort came from the governments themselves. Further, even without a strong bond market, DMs already possessed an intricate market infrastructure and sophisticated risk measurement techniques which they could use to propel their bond markets more specifically (Luengnaruemitchai and Ong 2005). Finally, they also benefited from a sound legal framework from which to develop this market, with corporate governance and market transparency already at levels robust enough not to warrant significant reform (Schinasi and Smith 1998). These were all areas in which EM economies were, and in many cases still are, lacking and which inevitably has played a huge role in how investors price and perceive risk in these economies.

When it comes to EM's, then, the path followed by the more mature economies did not always seem directly applicable to their contemporary landscape. While some believe that targeted policy-making like that employed by the Europeans would be enough to develop deep

bond markets (Schinasi and Smith 1998), others saw the current deficiencies in the EM financial and legal framework as making it almost impossibly hard to issue more complex financial instruments (Roldos 2004, de Soto 1998). After all, underlining every financial contract is a legal system that enforces the rule of law and ensures that all matters are dealt with through fair and unbiased regulation (Hund and Lesmond 2008). This is especially important for corporate issuers who do not have the full faith of their governments to back them up; they have only their balance sheets and their audits to lure investors (Luengnaruemitchai and Ong 2005). A strong legal framework is thus a requirement for the establishment of a mature financial system.

This may explain why the CDS market has grown at such a fast-pace in the EMs since it was first introduced in the early two-thousands following the default of Argentina. Because the kind of legal enforcement mechanisms that theoretically already shield investors from counterparty risk can sometimes be precarious in the region, investors are hyper aware of the need to protect their loan exposure (Oxford Analytica 2005). A hypersensitivity to the need to buy protection against credit risk would be aligned with our hypothesis that CDS's may be overpriced vis a vis bonds (Zhou 2008). Another reason CDS's can be overpriced to bond's is the fact that despite experiencing rapid growth in both sector, the market between CDS's and bonds in the region can still be quite segmented (Chang 2011, J.P. Morgan Education: Credit Derivatives and Credit Exotics Training 2011). If investors are not allowed to move freely between the two markets then it can create a pricing mismatch between the two, something that occurs with greater force in less liquid, emerging markets (Akdogan and Chadwick 2011).

The CDS market in EM has, nevertheless, developed in a flexible way, with CDS's being issued for as little as three months of protection for up to eight years. This allows investors to gain exposure to different parts of the credit curve. Like in most other markets, however, the five

year contract is the most popular (Chang et al 2010, Oxford Analytica 2005) and therefore the most liquid. A focus on technological innovation and the ability of back-offices to keep up with trading levels in the local CDS markets has also greatly influenced the growth of this space in the region (Oxford Analytica 2005) and contributed to the flexible environment herein described.

One area that required particular reform before fixed income and credit markets could really develop is bankruptcy law. Since a CDS contract is by definition exercised when a particular type of credit event occurs, these need to be expressly delineated in order to accurately determine the price of any type of fixed income security and a CDS in particular. Market convention is to use the International Securities Dealers Association (ISDA) 2003 credit derivative definitions to formulate CDS contracts and EMs have generally followed this model. According to the ISDA there are three main types of credit events that would constitute a ‘default’ of the corporate/sovereign and would thus require the seller of the contract to pay the buyer the agreed bond price. These are 1) bankruptcy, 2) failure to pay (that is, the corporate/sovereign does not make a principal or coupon payment on any bond or loan issued or guaranteed by the company), and 3) restructuring.

The third of these constitutes the greatest ‘gray area’ requiring legal enforcement. Because most restructurings are voluntary, they do not constitute a credit event (Malone 2011). However, if the restructuring is not considered voluntary – that is, it has not been agreed on by all bondholders before the date of the event – than in most instances this does qualify. Steep price declines associated with restructurings are not in themselves credit events and thus not are protected against by a CDS.

Since recent evidence shows that the frequency of restructurings far outnumber that of actual defaults both in the DM and EM (Singh and Andritzky 2005), this particular part of the broader financial legal framework received the most attention from law-makers. Still, the area of restructuring continues to be a source of concern for investors. It is still a point of contention in many countries whether a voluntary restructuring constitutes a credit event if key terms in the bond are modified during the process (Singh and Andritzky 2005). Common terms are the interest rate, the principal amount or the position of seniority of a bond. In these more specific cases, CDS contracts can be more personalized to account for more specific terms than a standard contract would entail. This lack of standardization, however, precludes the growth of a larger and more liquid market as customizable contracts take up more time to be written out and can only be traded OTC.²⁰

There is, then, a continued need to keep improving the legal framework and especially the part which is more closely tied to the corporate bond and CDS markets (Oxford Analytica 2005, Singh and Andritzky 2005). Hernando de Soto (de Soto 1998) put forth a very compelling – and infamous – argument in the mid-nineties which traced the sources of many of the EM’s economic problems to the fact that it inherited the burdensome Napoleonic legal system rather than the Anglo-Saxon model present in most DMs today. Although his analysis does not address fixed income specifically, his conclusions indicate that the development of a strong debt market is pretty much impossible under the current legal framework.

²⁰ OTC (Over-the-Counter) markets are those in which bilateral contracts are traded directly between two counter-parties and without the intermediation of an exchange or regulator. Because of their specific nature, OTC instruments are allowed to be as personalizable as desired, but the downside to the lack of standardization is their limited-size and greater counter-party risks, as there is no intermediary which guarantees that the stipulations in the contract are maintained and enforced.

According to his seminal argument, the main problem is that the Napoleonic Model protects borrowers at the expense of lenders while the Anglo-Saxon Model does the exact opposite. That is, the Anglo-Saxon Model puts the burden on the lender to prove his worth, thereby naturally minimizing the risks associated with counterparty default (de Soto 1998). Under the less ‘business-friendly’ Napoleonic framework, investors are necessarily exposed to much larger risks because of how much more difficult it is to collect from a defaulting counterparty.

But rather than make fatalistic conclusions based on their legal heritage, many EM governments have instead focused on implementing various legal reforms aimed at assuaging some of these concerns – the maturing of their credit default markets being one of them (Marber 2010, Rozada and Yeyati 2005). Judicial reform has sought to make financial laws more straightforward, legally-binding and fair. Revision of bankruptcy procedures in order to make debt restructuring easier has been especially key (Singh and Andritzky 2005, de Soto 1998). Although certain countries have been more successful at this than others, South Africa, Chile and Malaysia have made particular strides in this direction (Luengnaruemitchai and Ong 2005, Rozada and Yeyati 2005, de Soto 1998). While there are no studies which compare the extent to which a country has engaged in legal reform and the depth of its bond markets, there are studies which point to a robust connection between legal reform and the development of a rich derivatives market (Chang et al 2010), especially that of credit derivatives (Oxford Analytica 2005).

Hand in hand with legal reform is policy targeted at improving the speed with which financial investments can be made in the EM (Kopf 2006, Rozada and Yeyati 2005). Clearing and settlement systems need to be improved in order to better the efficiency of timely transactions (Luengnaruemitchai and Ong 2005). After all, price discovery cannot function

properly unless it is conducted in real-time and anything traded OTC by definition cannot provide this kind of efficiency (Zurack 2010). In Germany, for example, regulatory delays – and the high costs associated with them – caused severe underdevelopment in the financial markets for decades until specific legislation targeting these concerns was pushed forth by the government (Luengnaruemitchai and Ong 2005).

Another development which complements the regulatory improvements described above is the introduction of standard contracts into these economies' bond markets. Reducing the high legal costs associated with non-standard contracts is a key constraint to growth in the fixed income markets in general and the CDS and corporate bond markets in particular (Oxford Analytica 2005). The consensus is, after all, that every financial contract should be fair and unbiased so as to incite investor confidence in the transaction (Luengnaruemitchai and Ong 2005) – both of which are achieved through standardization.

There are however those who believe that excessive standardization can limit the natural efficient progression of the markets (Greenspan 1999, Elton, Gruber, Agrawal, and Mann 2002, Kopf, 2006). Empirical evidence, however, generally seems to point to the need to establish a developed framework of standardized contracts, especially in places where the perception is that legal frameworks are not as sound as they could be (Hund and Lesmond 2008). There are obviously limitations in the way markets can develop if these contracts are not permitted to evolve at appropriate speeds (Marber 2010), but in general markets cannot mature until a full range of possible standardized contracts is fully in place.

Outside of the financial framework, another important kind of legal reform which has been the focus for many EM governments is the privatization of social security and pension

plans. Because this was in part a natural reaction to the expanding middle class in many EM's (Rozada and Yayati 2005), efforts in this realm were one of the first to make significant strides. This has been accomplished in large part through social security reform which aims to shift the burden of retirement funding to private pension funds. This has significantly impacted the bond market because pension funds not only have a natural positive bias towards investing in their home countries but they also oftentimes possess legal requirements to do so (Kopf 2006). Further, because the mandate of pension funds is to invest in long-term securities which abide by strict risk limitations, fixed income securities have traditionally formed a large percentage of their portfolios (Borenstein, Eichengreen and Panizza 2006, Chang 2011). These pension funds have also lobbied the government for better credit risk standards, more transparency, and more efficient corporate governance laws (Walker and Lefort 2000). The development of pension funds in the EM has therefore created a whole new class of institutional investors which were simply not present prior to the nineties.

3.3 Early Signs of Success and the Importance of the Sovereign Bond Market

As these governments sought to address many of the aforementioned obstacles through the use of targeted financial policies, the adoption of exchange-rate regimes, legal reform, financial contract standardization and social security reform, the first fixed income instruments to benefit from these changes and garner significant investor attention on a global scale were sovereign bonds. In fact, there is significant evidence that a mature sovereign debt market is necessary precursor to developing a robust corporate bond market (Dittmar and Yuan 2008, Marber 2010, Zurack 2010).

Dittmar and Yuan show that foreign investors tend to price corporate bonds at a premium to the sovereign, with the difference between the two accounting for the added payout needed to compensate investors for the added risk of investing in a corporate. In certain situations when the sovereign is experiencing significant macroeconomic distress, however, it can be that corporates start to trade at a discount to the sovereign (Singh and Andritzky 2005), but this is rare since usually the risk of sovereign default is significantly less than that of a corporate. This was, however, the case with Argentina in the early two-thousands.

Especially in countries like those in Latin America and South East Asia that have in the last twenty years experienced economic distress, sovereign debt plays an important role in introducing foreign investors to the country and generating comfort for them to trade a wider variety of assets. For this very reason, in response to the macroeconomic troubles they had in the late nineties and early two-thousands, governments in Latin America and Asia tried to build-up their bond markets by setting an example on the sovereign front (Dittmar and Yuan 2008). Exposure to the sovereign bond market allows investors to better formulate their expectations regarding those countries' corporate bonds, as the sovereign bond works to ballpark many of the same parameters that also apply to corporate bonds (Marber 2010, Chang et al 2010, Elton, Gruber, Agrawal and Mann 2002). These would be the aforementioned interest rate risk, inflation risk, yield curve risk²¹, liquidity risk and, yes, credit risk.

Sovereign credit risk is obviously one of the parameters that investors factor in when pricing sovereign bonds. For this reason, the sovereign CDS market plays a huge role in shaping

²¹ Yield Curve Risk: similar to interest rate risk is yield curve risks, which pertains to risks associated with shifts in the yield curve. When interest rates rise or fall, the yield curve does not shift equally for all maturities. After all, the monetary authority can only control the short-end of the curve through manipulations in the federal funds rate etc. Other factors such as investors economic expectations influence not only the level but also the slope and the curvature of the curve.

investor's views on the broader fixed income space of a particular country (Malone 2011). If one thinks of the CDS spread as the marginal cost of debt for an instrument, then the sovereign spread is very much an indication of the added premium needed to compensate investors for doing business in that country (Singh and Andritzky 2005).

The expansion of the sovereign bond markets also contributed to the growth of the broader financial derivatives market²² in these economies (Mihaljek, Scatigna and Villar 2002, Kopf 2006) – and to the credit derivatives market particularly. The growth of the derivatives space has been a key factor to further improving risk assessment and price discovery (Elton, Gruber, Agrawal, and Mann 2002). Ashcraft and Santos (2007) find that the emergence of a credit derivatives market in particular has a beneficial impact on the cost of debt for corporate borrowers that that CDS spreads decrease in tandem with financing costs. The effect is especially significant when firms are more transparent about their business. As expected, liquidity also plays an important role in determining the size of the effect of the CDS spreads on the cost of borrowing. Specifically, they find that less liquid corporates experience more pronounced effects than their more liquid counterparts (Ashcraft and Santos 2007). This means that as EM corporate CDS spreads go down, they can expect to see their cost of funding go down. This is even true on a sovereign level; as sovereign spreads go down the cheaper and easier it is for sovereigns to access funding on the international market (Hund and Lesmond 2008).

Most studies conclude that the reasons underlining the strong correlation between the sovereign, corporate and derivatives fixed income markets is: 1) sovereign instruments act as benchmarks and hedging instruments for their oftentimes riskier corporate counter-parts (Dittmar

²² Financial Derivatives Market: a derivative is an agreement between two parties concerning a belief about the future movement in the price of an underlining asset. These instruments can be traded over-the-counter (OTC) or electronically through an exchange which is overseen by the country's financial regulatory commission.

and Yuan 2008), 2) they promote price-discovery by contributing to price-information availability (Gorton and Pennachi 1991), and 3) they increase the liquidity available in the market (Dittmar and Yuan 2008, Gorton and Pennachi 1991).

3.4 Recent Developments and Key Considerations of the Present EM Corporate Bond Market

The significant strides achieved by the EM governments in effectively marketing and structuring their sovereign debt facilities only opened the way for more and more investors to move into this space. Its biggest stress test came in the wake of the financial crisis in 2008 when a worldwide flight to quality did not cause investors to flee but rather to move more aggressively into the space (Chang et al 2010). While many DM economies fell into dire recession, most EM countries were able to maintain positive levels of GDP growth. When worsening credit metrics became the defining characteristic of many corporates in the DM, credit metrics in the EM showed little to no evidence of being fundamentally affected by the global economic crisis (Chang et al 2010). In fact, local markets and corporate debt remain the fastest growing segments in the EM debt asset class and a total of 14 EM countries have already achieved net external creditor status (Chang et al 2010).

China obviously plays a large role in bringing the EM corporate debt market to the forefront of global investing trends (Chang 2010), but most of the other EM's have also seen significant changes in their participation in the global economy in general and an expansion in their corporate debt markets in particular (Chang et al 2010). EM economies' share of global trade is now at 39% compared to only 19% a decade ago and the JP Morgan GBI-EM Global Diversified Index of locally-issued sovereign bonds and the JP Morgan CEMBI of EM corporate bonds were two of the top performing asset classes throughout the crisis (Chang et al 2010).

An important determinant of their relative success in navigating the crisis was how much these EM economies were able to rely on their previous experiences in the nineties to implement the kind of counter-cyclical policies and fiscal stimulus measures capable of protecting them from the worse effects of the contagion from the DM (Chang 2011). In fact, the recent boom in the broader EM fixed income space is as much a symptom of the very real strides that these countries have taken to improve their market fundamentals as it is a reflection of increasing investor confidence in these markets (Kopf 2006, Dittmar and Yuan 2008). The boom is reflected not only in the ever increasing number of participants – both foreign and local (Kopf 2006) – but also in the ever extending tenor of the yield curve, which shows that investors are increasingly interested in purchasing more longer-term securities than ever before (Elton, Gruber, Agrawal and Mann 2002).

The flip-side of this development is that the easy high yields which used to characterize this asset class are also starting to fall (Chang 2011, Kopf 2006). This means cheaper access to financing for EM corporates, but also lower returns for investors. This is especially significant in the context of the increasing speeds with which investors enter in and out of trades; the more investors trade these securities, i.e. the greater the liquidity, the better price discovery becomes for these facilities, which inevitably means a decrease in the alpha²³ that can be secured by investing in the fixed income EM space (Jacobs and Karagozoglu 2010). Investors will now have to battle it out for even lower yields and tighter spreads than ever before.

²³ Alpha: is a risk-adjusted measure of the return on an investment. Given equal risk between two investment strategies, alpha is defined as the excess return that can be generated over the benchmark returns. Although more broadly used to assess an investor's risk adjusted returns, it originated as a result of the Capital Asset Pricing Model (CAPM) and is derived from the α in the following formula $R_i = \alpha + \beta R_m$

Securing liquidity levels which compare to those of mature bond markets is still perhaps the largest challenge to the development of a truly efficient bond market in the region, particularly in the corporate space (Chang 2011, Levy 2009). Although liquidity is well on the rise, there is still a significant time lag in the speeds with which one can enter in and exit out of a particular position. As previously mentioned, this keeps bid/ask spreads wide and limits price discovery (Kopf 2006, Marber 2010). Sadly, bid/ask levels are still no where as close as those observed in the DM (Akdogan and Chadwick 2011). This means that the risks associated with being unable to adequately gauge the fair price of the security are still very much a factor on investor's minds and even as trading levels increase there remain some portion of these securities' risk which cannot be fully computed and consequently hedged out (Dittmar and Yuan 2008, Hund and Lesmond 2008).

3.5 The Corporate Bond Market and the Importance of Credit Default Swaps

One of the most significant ways in which liquidity can be promoted – and thus price discovery maximized and risk minimized - is through the role of credit derivatives. Much like credit ratings, they can be broadly viewed as a barometer for a country's or corporate's general level of risk (Elton, Gruber, Agrawal and Mann 2002). From there one can make a better judgment about whether or not it is financially worthwhile to make a particular investment. While this has traditionally been a role played by credit ratings, the recent economic crisis has called the entire space into question (Chang et al 2010, Jacobs and Laragozogly 2010). Concerns over the accuracy of their methodology and the slow speed with which they are updated cause investors to increasingly believe that they do not accurately reflect the credit risk of an asset at a given time. Consequently, while credit ratings were previously the first stop for a global investor looking to become more familiar with a particular market (Marber 2010), CDS spreads are

becoming more and more popular tools for investors looking for an easy way to understand and measure credit risk.

Credit ratings did originally play a huge role in generating greater investor confidence in these markets. They were particularly important during the early two-thousands when they provided a way to demonstrate to foreign investors how much these countries had improved their economic fundamentals (Elton, Gruber, Agrawal and Mann 2002, Marber 2010). As credit agencies improved their ratings on EM debt instruments, they helped spark interest and provide visibility to these securities' oftentimes attractive risk/reward ratios (Koph 2006, Rozada and Yeyati 2005). There is also significant evidence which traces the development of corporate debt market in many EMs straight to improvements in the credit rating of the sovereign. After all, as previously discussed, domestic corporates are often perceived as possessing a risk premium on top of the sovereign (Koph 2006, Marber 2010). Thus, if the sovereign is viewed positively, this impacts investor's perceptions of that country's corporates positively as well – and vice-versa.

A fundamental flaw of credit ratings, however, is the fact that they are not real-time measures of risk. In fact, they are deliberately updated rarely and only after careful consideration (Jacobs and Karagozogly 2010). Precisely because of this characteristic, there is always a significant market reaction on bond prices following a re-evaluation of the credit rating. The fact that bond markets move so significantly following an update on their credit rating or even a positive or negative watch²⁴ indicates that bond prices do not accurately reflect the 'true' credit risk of the firm or sovereign at a particular time (Jacobs and Karagozogly 2010). After all, if there is not so much variability, it also means that rather than reflect the changes in a country's

²⁴ Positive/Negative Watch: a status given by rating agencies such as Standard & Poors or Moody's to companies or countries that they are currently reviewing in order to determine whether they deserve to have their credit rating upgraded or downgraded. Typically this process takes about three months.

or corporate's economic situation as they transpire, ratings only capture a broad picture of an otherwise complex and ever-changing framework (Rozada and Yeyati 2005). This is not the case with CDS markets.

As the CDS market expands in popularity in the EM, it is increasingly being viewed as the better tool to assess the credit risk of a particular entity. Further, the more popular these contracts become, and consequently the greater the liquidity with which they trade, the lower the CDS spreads for EM corporates fall (Chen, Cheng and Wu 2008). After all, the liquidity risk mismatch which occurs between more vs. less liquid contracts means that investors inevitably perceive less liquid firms as more risky than their more liquid counterparts. This creates a loop-back effect on the spreads; decreasing perceived credit risk attracts investors and a growing investor base pulls down corporate spreads (Levy 2009, Singh and Andritzky 2005). Evidence of the rise in popularity of this market in general and of rising liquidity in particular is a time series analysis conducted by Levy (2009) which shows a clear decreasing trend in sovereign CDS bid/ask spreads over the period between 2001 and 2008.

In general, CDS spreads have gone down in the EM following the boom in the fixed income space (Chang et al 2010, Chang 2011). This is well in line with what's been observed with regards to bond yield convergence with the DM; yields have been coming down as more investors realize that the risk-reward ratio of investing in the fixed income space, and particularly within corporates, is mismarked. The more investors trade these products and understand the actual risks associated with them, the more one expects to see this trend towards lower risks and lower yields prevailing.

4. Literature Review of Previous Work on the CDS Bond Basis

Since the meltdown of the financial markets in 2008 and the subsequent flight to quality that occurred following what was perceived by investors as deteriorating credit conditions worldwide, CDS spreads widened significantly across all fronts (Marber 2010, Malone 2011). Although spreads have since somewhat leveled, persistent levels of heightened volatility have created an economic environment where the mismatch between bond and CDS spreads is even more pronounced than what is typically observed in the credit markets (Chang 2011).

Under this scenario, basis trades have gained traction and become significant vehicles for investors seeking to exploit these market discrepancies. More sophisticated investors have even looked to these trades as a way to secure positive carry²⁵; by buying (selling) the bond and buying (selling) protection in the CDS market, an investor can presumably build a default-risk free position where these two off-setting positions lock in positive returns equal to the difference between the CDS and bond spread (Haworth, Schwarz and Porter 2009).

Due to the rising popularity of the CDS market in general and bond-basis trading in particular there have been a growing number of studies conducted in this area. They generally aim to better understand the reasons behind a non-zero basis and how it influences how investors perceive and price credit risk. In particular, these more recent studies conclude that the parity between the two measures previously found by Hull and White (2000) and Duffie (1999) does

²⁵ Carry: is defined as the loss/return secured by entering into two offsetting positions where, all other things being equal, the cash flows associated with one side throughout the life/holding period of the trade are greater than the cash flows related to the other. When inflows are greater than outflows, this strategy is called positive carry. Similar to an arbitrage opportunity, this strategy aims to secure risk-free guaranteed returns. But unlike an arbitrage opportunity where investors are guaranteed to make money no matter what, carry trades only make money if nothing changes in the carry's favor (Chang et al 2010)

not always hold up outside of their sample of U.S. investment grade²⁶ (IG) bonds (Haworth, Schwarz and Porter 2009).

In order to truly understand how the CDS markets impact corporate debt markets in the EM, one must begin by looking at the foundations of this research. The two most important studies which pioneered all others in this field were those by Duffie (1999) and Hull and White (2000). These papers came to the conclusion that, in the long-run, CDS spreads and bond spreads are highly co-integrated. That is, the basis is zero. They arrived at this conclusion by using two slightly different approaches. Duffie (1999) used a structural model²⁷ similar to that originally developed by Black and Scholes (1973) to price equity derivatives. Building on Black and Scholes, Duffie argues an investor can construct a risk-free portfolio by using a CDS and a corresponding bond with the same characteristics (maturity etc.) in order to replicate a risk-free bond also with the same characteristics. After all, theoretically, buying a risky bond and a CDS should eliminate the default risk associated with owning the risky bond. The value of this portfolio will consequently simply be the value of the corresponding risk-free bond.

The second approach by Hull and White (2000) builds on Duffie (1999) in that it uses a similar argument based on the same no-arbitrage proposition first developed by Scholes

²⁶ Investment Grade: is a rating that is given to corporates/sovereigns whose bonds are perceived to have the lowest risk of default. Although rating agencies slightly differ in the way they assign ratings, typically bonds which are rated as BBB and above (with AAA being the highest possible rating) are considered to be investment grade. Anything below BBB are called High-Yield (HY) bonds, in reference to the higher yields required by investors to compensate them for the added risks associated with investing in poorer credits.

²⁷ Structural Models: are those rooted in economic theory. The variables are all endogenous and information about them is typically viewed as being fully available and complete. In CDS models, this means default times for corporates and sovereigns are predictable. The benefits of this model are that they are more firmly rooted in economic theory and are more simple to model than their more complex reduced-form counterparts (Jarrow and Protter 2004)

portfolio. Hull and White (2000), however, employ a reduced-form model²⁸ which incorporates stochastic default rates to arrive at a similarly risk-neutral valuation of the par-equivalent CDs bond spread and CDS spread. They find that under a no-arbitrage environment, the premiums paid for by the buyer of a CDS contract equal that of the expected payment to be received under the case of a credit event (Hull and White 2000).

Rather than use CDS spreads to compute the par-equivalent CDS bond spread, Zhou (2008) does the opposite and uses the reduced-form model developed by Hull to calculate implied CDS spreads from observed bond spreads in the markets. He does not, however, go as far as to compare the difference between actual CDS spreads observed in the market and the ones implied by his formula over a significant period of time; his approach is much more reliant on the mathematical reasoning surrounding his conclusions. For the small sample of bonds and CDSs that he does analyze he does find the difference between the two to be minimal. Because his study lacks a reasonably large sample size for which to accurately assess the robustness of his conclusions, it is preferable to continue employing the more established methodology of using CDS spreads to imply par equivalent CDS bond spreads than to adopt his methodology. His solid mathematical reasoning, however, implies that there is much room for expansion in this area.

The same no-arbitrage assumptions that hold for Duffie (1999) and Hull and White (2000) form the basis of much of the subsequent research conducted in this field. Namely, these

²⁸ Reduced-Form Model: this approach assumes that some of the variables in the equation are exogenous, that is they cannot be fully determined by the system. The modeler assumes that they only have as much information as the market, which is incomplete. In the case of reduced-form CDS model, the sovereign or corporate' default time is considered to be exogenous and the equation is thereby solved by incorporating a default intensity that is stochastic. While it is less common in academic research to use reduced-form models, most industry standards are based on this model. Reduced form models are characterized by flexibility in their functional forms but suffer from a lack of clear economic rationale for defining exogenous variables the way that they do (Jarrow and Protter 2004).

are that there are no restrictions on short-selling²⁹ on both the corporate and risk-free level, no “cheapest to deliver” (CTD)³⁰ option in the CDS settlement, that interest rates are constant and there is no counterparty default risk in the CDS. These assumptions have become de facto over time and constitute common practice in the academic community.

Zhou’s mathematical model that sought to use observed bond market prices rather than implied par equivalent CDS bond spreads did promote the development of research that focused on ways to avoid the market data pitfalls involved in relying only on this implied par-equivalent spread rather than actual spread levels. While for Hull’s model to continue to generate statistically significant results it is necessary to model the default intensities of the two assets in a way that make them comparable, Adler and Song (2009) made an important break-through when they developed a model which shows that even non-par bonds can generate a zero basis when regressed against a CDS spread. This allowed for the use of a much larger sample of market data and brought increased generalizability to the theoretical findings previously presented by Hull.

Adler and Song’s (2009) interpolation of the non-par bond spreads still resembles the one used by Hull and White (2000) in that they employ a similar reduced-form model for default probabilities. But rather than apply those probabilities to the creation of a no-arbitrage, risk-free

²⁹ Short-Selling: also known as shorting, this is the practice of selling assets one does not actually own but instead has borrowed from another third-party with the intention of buying it back later on at a lower price. The purpose of this strategy is to profit from the difference between selling it at a higher price and then buying it back at a lower price. It is essentially a bet on the declining value of the asset. In practice, this can usher in a sell-off of various securities so some governments place restrictions on this. Proponents of these restrictions argue that they prevent excessive volatility from negatively eroding the tangible value of certain securities while critics of these regulations argue that they prevent accurate price discovery by limiting the kinds of trades one can enter into (Zurack 2010)

³⁰ Cheapest-to-Deliver (CTD): is a clause contained in CDS contracts that allows the buyer of the CDS to pick the cheapest bond out of a possible basket of pre-agreed upon bonds with which to calculate the CDS payoff he would receive as a result of a credit event. Since the payoff of a CDS in the case of default is defined as the Notional Principal * (1 – Recovery Rate) it is in the best interest of the buyer to select the bond with the lowest price, namely the lowest recovery rate, with which to calculate this pay-off (J.P. Morgan Education: Credit Derivatives and Credit Exotics 2011, Malone 2011)

portfolio which equates the present value of the future cash flows from the CDS and the bond, they imply bond yield spreads for the bonds present in their sample by applying to them the same default probabilities that are implied by the stochastic modeling of the default intensities implied by market CDS prices.

Only recently, however, has research like that of Adler and Song (2009) begun to emerge which questions the assumptions long held by Hull and White (2000). Singh and Andritzky (2005) find that the default probabilities implied only by using the CTD bonds are quite different from those implied by using a more complete dataset made up of a wider universe of bonds of varying prices and recovery rates.³¹ Consequently, they concludes that this is the main determinant of the large negative basis that he observes when he regresses the observed sovereign CDS spreads in his dataset to the Emerging Markets Bond Index Plus (EMBI+), an index which tracks total returns for domestic currency-denominated sovereign bonds. That is, he finds that CDSs trade tighter compared to bonds because the embedded clause which allows for the CTD option necessarily heightens the potential payout which can be received from a CDS in such a way that bond spreads cannot by definition correspond to.

While this certainly merits further investigation, there are potential drawbacks in using this approach which can result in a greater loss of data reliability. After all, the sample size employed by a study which only relies on CTD bonds is necessarily much smaller which calls into question the validity of his conclusions. Further, by not employing a reduced form model to calculate default probabilities like that developed by Hull and White (2000), one creates the need

³¹ Recovery Rate: is the percentage of a financial instrument that is recovered by the investor in the case of default. It is particularly important in pricing fixed income instruments, especially CDSs. It is most commonly given as a percentage of a bond's par value. In reduced form models, it is typically given as percentage of the bond's market value.

to rely on historical probabilities of default – a theoretical claim which has long been disproved as being theoretically sound by the academic community. After all, the performance of financial instruments has been shown to be time and time again the result of a stochastic distribution in its mean returns and not correlated at all to historical levels of performance (Black and Scholes 1973). Further, he does not employ the use of actual bond spreads in the study but rather regresses CDS spreads against a broader index of bonds which by definition do not correspond to the specifics of each sovereign CDS.

Other studies that are more firmly grounded in the original research but which have challenged the assumptions behind the Hull and White model are those of Levy (2009) and Akdogan and Chadwick (2011). Precisely because these are studies of the EM sovereign debt market, the authors already build on previous findings which show that the parity does not hold in less developed and less liquid markets (Chan-Lau and Kim 2004, de Wit 2006). Chan-Lau and Kim (2004) examine lead-lag relationships among certain EM sovereign bond indices, CDS spreads and stock market indices but do not find any significant patterns in the way these interact. Further, because they use indices for bonds rather than actual bond prices it is difficult to adequately compare the prices of the CDS to that of the underlying bonds, as was the case with Hull and White (2000) and Duffie (1999). De Wit (2006) finds the existence of a basis is positively correlated with spreads levels; that is, the higher the spread (and the perceived credit risk of a corporate or sovereign) the less it is co-integrated with corresponding bond spreads. He also finds that the basis is lowest in the most liquid part of the CDS curve, i.e. for bonds with maturities in the five-year range.

While de Wit's conclusions support the evidence that for less developed markets like that of the EM corporate sector there needs to be added variables included into the model that help

account for the larger discrepancy between the two measures, he does not propose a rigorous theoretical way to expand Hull and White's analysis in order to make the regression between CDS and bond spreads more significant. Levy (2009) and Akdogan and Chadwick (2011) on the other hand actually propose ways to improve the original Hull model to account for the reasons they believe that the basis exists. Both of them utilize a time-series of CDS and sovereign bonds spreads in the EM to arrive at their conclusions.

Levy's main contribution was the inclusion of a liquidity factor which at the same time challenges Hull's original assumption about there being no pricing discrepancy between the pricing of bonds and CDS contracts as it quantitatively extends his theoretical model to account for it. Building on previous research by de Wit (2006) and Adler and Song (2007), Levy (2009) started from the proposition that liquidity differences between different securities in the EM necessarily introduce difference liquidity premiums into the pricing of these assets, which in turn generates inequalities between bonds and CDS. By extending Hull's model to include a parameter which accounted for different liquidity premiums, that is, a variable which represented the difference in the bid ask spread, Levy found that he could much better approximate a zero basis. He consequently finds the co-integrating relationship between the par-equivalent CDS bond and CDS spreads to hold.

Akdogan and Chadwick's main contribution to the literature is their removal of the Hull model's assumption of linearity between the two variables. By building on previous research supported by Levy (2009) and de Wit (2006) that finds that liquidity plays an important role in determining the extent of the relationship between the two spreads, the authors introduce a new model that examines the speed with which the basis widens/ tightens over time based on different levels of market liquidity. Their study concludes that the speed with which the basis

reverts to zero over time is strongly correlated with the frequency with which the underlining bonds and CDS contracts trade. This is also shown by a time-series of data plotted by Levy (2009) in an appendix of his study.

By creating a model which maps out not only the correlation between the two measures but also the speed with which this correlation changes, Akdogan and Chadwick have opened up a new area of study which will certainly be the focus of future studies. Nevertheless, because they employ the use of a different model than the more established literature (a TAR Model with Garch Errors) it means that many more tests and studies have to be conducted with this model before it gains the recognition of the academic community.

5. Methodology

As previously mentioned, Hull and White (2000) and Duffie (1999) provide the most established pricing equation for modeling CDS contracts and the basis spread. These studies, however, like most others, only focus on corporates with IG ratings domiciled in the United States. These are markets characterized by tight bid-offer spreads, abundant liquidity and low levels of credit risk (Levy 2009). The so-called zero basis which emerges out of these studies is therefore limited in its application to EM corporates, where markets are not as developed.

The most applicable studies to our are the ones which study the basis from the point of view of the EM sovereign bond market. These studies in general confirm our hypothesis that there is generally a non-zero basis present in these economies (Adler and Song 2007, Singh and Andritzky 2005, Levy 2009, Akdogan and Chadwick 2011). Some of these studies, however, find that this discrepancy between the two spreads can actually be alleviated by the inclusion of certain external parameters into the general model. In particular Levy (2009) finds that the

inclusion of a liquidity parameter allows him to generate results which resemble those of Hull and White (2000). Because there is no such thing as a liquidity rating, Levy (2009) uses the bid ask spread of both the CDS and the bond as a proxy for liquidity. Since liquidity is demonstrated by tighter bid ask spreads which reflect active trading levels, this seems like a sound method. Jacobs and Karagozoglou (2010) find that there is a high correlation between CDS spreads and volatility in these markets and therefore choose to include a volatility parameter. Because a CDS is analogous to a put option on the bond, they find that the put option implied volatility on the company's stock is actually the best proxy for volatility when measuring the bond basis. These studies together appear to make the greatest contribution to the study of the CDS bond basis in the context of this paper.

The main problem with the methodology employed by both of these studies is the fact that even though they are written in the context of the EM bond market, sovereign credit spreads and bond spreads are not, as previously discussed, directly analogous to their corporate equivalents. The sovereign market is far more mature and liquid than its corporate counterpart and, by its very nature, less risky. In order to account for the added risk contained in investing in corporate rather than sovereign bonds I follow the methodology used by Jacobs and Karagozoglou (2010) and incorporate a measure which accounts for differences in the credit rating of the corporate. Since there is a large universe of different ratings available in our dataset it also seems like a good way to minimize the risk of heteroskedasticity³² in the regression.

³² Heteroskedasticity: occurs in statistical analysis when there are distinct sub-populations inside the broader sample which affect the dispersion of the regression. The presence of heteroskedasticity in the data means that the variables could be correlated with the error term to varying degrees and that the estimates generated by the regression could be biased.

Because an important element of the model developed by Hull and White (2000) and later employed by Levy (2009) is the reliance on par equivalent CDS bond spreads I test my data against two samples of bond spreads, one against the actual bonds spreads observed in the market over time and one against the bond spreads implied by the proposition of par equivalency as theoretically mandated by Hull and White (2000) and Duffie (1999).

Mathematically, my model builds on that originally employed by Black and Scholes (1973) and then expanded on by Levy (2009). Assuming a risk neutral world with three assets: 1) a CDS, 2) a corporate bond and 3) a risk-free bond, let $f(t)$ be the default probability for the bond at time t . Incorporating Hull and White's stochastic intensity of default, the survival probability for the corporate bond until time t becomes $F(t) = 1 - \int_0^t f(x)dx$. Let C be equal to the fixed coupon rate of the risky bond to be paid in each period $t = 1,2,3 \dots N$ and y to be the yield spread in each period. The recovery rate of the corporate bond out of its par value at the time of default t is denoted as R_t . Let r equal the risk-free rate during each period $t = 1,2,3 \dots N$ and S equal the fixed CDS spread paid for during each period $t = 1,2,3 \dots N$ or default, whichever arrives first. Then the value of the CDS spread S that satisfies the conditions of no arbitrage detailed previously is as found in Equation 1. Please note that the right side of the equation is how much the seller expects to pay the buyer in the event of a default, that is, the expected sum of the payments he receives from the buyer up until that point discounted at the risk-free rate. The left hand side represents the cost of the CDS premium to the buyer *without* the occurrence of a credit event. If there is no arbitrage, then they are equal.

$$\sum_{t=1}^N S e^{-rt} F(t) = \int_0^N e^{-rt} (100 - R_t) f(t) dt$$

Eq. 1

Equation 2 represents the value of the corporate bond in the portfolio. The right hand side is just the continuously discounted cash flow from the bond (coupon and then, at maturity, principal) weighed by a probability of receiving that payment during each period t followed by the stochastic expectation of the bond's value in the case of a default.

$$B = \sum_{t=1}^N C e^{-rt} F(t) + 100 e^{-rN} F(N) + \int_0^N R_t e^{-rt} f(t) dt$$

Eq. 2

Finally, equation 3 represents the value of the risk-free coupon-paying bond.

$$100 = \sum_{t=1}^N r e^{-rt} + 100 e^{-rt}$$

Eq. 3

If one applies the liquidity adjustment as employed by Levy (2009) and also inserts a credit quality metric similar to that employed by Jacobs and Karagozolu (2010), then the equation which one can use for our regression in order to satisfy the no-arbitrage condition for the risk-neutral portfolio first established by Hull and White (2000) is noted in Equation 4. Please note that due to the lack of an adequate liquidity premium, I follow in the steps of Levy (2009) and employ the difference between bid/ask spreads as a proxy for liquidity.

$$S_t = \alpha + \beta(y_t - r_t) + \gamma(\text{Bid. Ask. Spread}_{\text{Bond}} - \text{Bid. Ask. Spread}_{\text{CDS}}) + \rho \text{Volatility}_t + \delta \text{CreditRating}_t + \varepsilon_i$$

Eq. 4

Under the assumptions of equations 1, 2 and 3, in the following regression it is expected that $\alpha = 0$, $\beta = 1$, $\gamma > 0$ since it should be positive but not quite equal to the predicted value of 1, $\rho > 0$ (since the CDS is positively correlated with increases in volatility) and $\delta > 0$. After all, from the previous literature it is known that the CDS premium is equal to the spread on a par equivalent bond over the risk free rate minus transaction costs. If one views the bid ask spread like a market maker, that is, as a transaction cost (such that, $S = y - r - (\text{Spread}_{\text{Bond}} - \text{Spread}_{\text{CDS}})$) then the larger the difference between the bid ask spread of the CDS vs. that of the bond, the larger the impact on the basis. This implies that $\gamma > 0$ (Levy 2009).

Also, because CDS spreads are much more positively correlated with volatility than bond spreads (de Witt 2006), it should be that $\rho > 0$ but still comparatively high. Finally, δ should > 0 but not 1 since the literature finds that the effect of ratings on CDS spreads becomes less pronounced as one increases in rating category, but that bond spreads are less correlated to credit ratings since they are affected by so many more influences than pure credit risk (Jacobs and Karagozoglu 2010).

6. Data Description

In order to estimate equations 1-4, various time series were constructed. Daily quotes spanning the period between January 1, 2008 and January 1, 2012 were used unless duly noted as interpolated. This time frame was chosen in order to reasonably match the maturity of the five-year CDSs being used to calculate the spreads. One would have gone back to 2007 but the significant drop in sample-size ($\approx 50\%$) that occurred did not appear to compensate the increased

benefit of adding an extra year; the loss to generalizability would have been greater with the inclusion of 2007 data. The data was obtained from the follow sources: Bloomberg, Markit Partners and Moody's.

From Markit Partners, an independent data aggregation firm for fixed income instruments, I obtained a daily data set which contained all of the corporate bonds in their universe which had bid, mid and ask quotes going back to January 2008. This resulted in 2,314 bonds. Because Markit Partners does not include bonds in its universe for which it cannot procure more than three market quotes, all bonds in its universe are considered to have met a basic liquidity test. Furthermore, Markit Partners does not allow data to go stale for more than two days but for those days in which the previous bond's yield was missing (usually because of a holiday) it was manually replaced by me with the previous value. Markit Partners, like Bloomberg, also gives us "consensus" pricing which aggregates quotes from various Wall Street brokers to arrive at a fair MTM price. From there I filtered out those bonds which had a maturity greater than 7 years, using the same interpolation method as Levy (2009). This was done in order to reasonably match the maturity of the CDS 5 year contract used. This decreased my sample to 1,834 bonds.

From there I filtered for those bonds which belonged to corporates domiciled in those countries included in the EMBIG+, an index of EM corporate bonds published by J.P. Morgan. This decreased my sample to 207 bonds. I then used the resulting CUSIPs to lookup on Bloomberg the bid, mid and ask prices of the 5 year CDS contract associated with that corporate. In the case that the company had more than one CDS 5Y contract, I matched the seniority of the bond as given by Markit Partners (Senior, Subordinate or Other) to their respective contracts. In case that the bond was specified as "Other", I assigned it to the senior CDS contract, as that is

the more liquid and therefore empirically reliable contract of the two (Jacobs and Karagozoglou 2010). I found matching 5 year CDS spread for all but 4 bonds in my universe, which reduced my sample size to 203.

Following in the steps of Jacobs and Karagozoglou (2010), who find that out of various measures for volatility tested in their regression the put implied 30 day volatility to be the one which results in the highest correlation with CDS spreads, I downloaded also from Bloomberg these measures for each of the corporates represented in my sample set of bonds. Because put implied 30 day volatility is a calculation that can be implied by inputting equity and put option prices into Bloomberg's "CDSW" tool, it was possible for me to procure these measures for all of the bonds in my universe. Also from Bloomberg, I downloaded bond close quotes for the five year U.S. Treasury yields. These appear to be the consensus risk-free rate employed when making comparisons to the 5 year CDS (Levy 2009, de Witt 2006).

I consequently had 204 bonds for which to find respective credit ratings. Markit Partners had information for 153 of those bonds. Markit Partners has its own proprietary mechanism of averaging the credit ratings provided by the different agencies in order to arrive at a "fair" rating that is highly respected in the fixed income community (J.P. Morgan Education: Credit Derivatives and Credit Exotics 2011). There were a few missing data issues that occurred during this process, but since credit ratings do not change very often I simply replaced the missing data with the last available credit rating before the data issue occurred. Finally, for those bonds that did not have Markit Partners data, I downloaded Bloomberg rating's from both Standard and Poors and Moody's and established a lookup function whereby every bond in my sample would pull its rating data either from Markit Partners, then if unavailable Standard & Poors and then

Moody's. Seven bonds in my sample came up blank in all three sources leaving me with a final sample of 197 bonds.

Markit Partners also had par-equivalent CDS bond spreads for some of the bonds in our sample, namely 107 of those bonds. Because of the significant decrease in the sample size that would result from only running the regression with those spreads – albeit the gain it would entail to our theoretical model – I chose to run these only as a secondary regression. Further, following the findings of Levy (2009), I did not expect a significant improvement to be achieved in the robustness of my results by using this sample.

With the letter-based ratings assigned to each of the 197 bonds in our sample I employed the Moody's system of translation from letter based credit ratings to that of numeric credit ratings. Their system, called the MPR, assigns a value of 23 to a AAA rating and a value of 1 to a CCC rating. The dispersion between the different numbers is intended to reflect the observed relationships between historical credit ratings and observed levels of default (Metz and Cantor 2006).

Altogether, I had 1773 daily observations of data and a total of 448,469 observations.

7. Empirical Results

The main empirical results are located in Table 1. On the left hand side I present the main results of our regression and on the right-hand side I present the results of the regression where I used the more theoretically sound but overall less generalizable sample of par-equivalent CDS bond spreads. Table 2 shows the results of the more traditional Hull White model without the added effects of liquidity, volatility, and credit quality. Both models are cross-sectional time-series models using a generalized least squared regression method (GLS). I opted to use a GLS

Model rather than a Ordinary Least Squares (OLS) regression because of the limited size of our cross-sectional sample; since our variables were highly particular to the specific hypotheses herein predicted, it did not make sense to assume that many, if any, of the variables followed a normal distribution. This is especially important given the various studies which have at length demonstrated that financial instruments like bonds and CDS are Markovian in nature and hence follow a Gaussian rather than a normal distribution (Black and Scholes 1973).

In the main model I find that all coefficient estimators are significant even at the 5% level (denoted by an asterisk) and that the R-Squared is especially high - 93% - and hence follows in the same levels of robustness as other similar studies which have also examined the bond basis relationship. This is especially relevant given the fact that this study is perhaps one of the first, if not the first, to apply the same basic methodology as Hull and White (2000) as well as the extensions created by Levy (2009) and Jacobs and Karagozoglou (2010) but using corporate bond data as opposed to sovereign bond data.

Table 1							
R² = 0.93				R² = 0.92			
Observed Bond Yields			Par Equivalent CDS Bond Spreads				
Coefficient	Estimate	95% Confidence Interval		Coefficient	Estimate	95% Confidence Interval	
α	43.21*	39.31	44.03	α	25.31*	25.08	27.03
β	1.28*	1.23	1.32	β	1.17*	1.15	1.21
γ	1.23*	1.21	1.26	γ	1.45*	1.41	1.50
ρ	1.03*	1.02	1.04	ρ	1.13*	1.09	1.15
δ	1.80*	1.78	1.81	δ	1.69*	1.66	1.71

The intercept, the estimate for the basis and whose predicted value is obviously zero following the conclusions of Hull and White (2000), is a positive 43.21 bps, indicating the existence of a positive basis. This is in line with our hypothesis that predicted that due to various market deficiencies in the EM that the same theoretical conclusions arrived at by Hull and White would not directly apply here. That being said, the basis is not as pronounced as I would have

expected given how wide the differences were when I first analyzed the data on a corporate level. Although the basis experiences a somewhat significant decline if one includes only those bonds whose spread are interpolated (par equivalent CDS bond spreads), even then, the basis is still not close to the estimated value of zero that the established literature suggests. Further, the intercept is much further from zero when one includes only the basic variables present in the Hull White Model (89.01)

Table 2							
R² = 0.93				R² = 0.88			
Model Using All Variables			Hull White Model				
Coefficient	Estimate	95% Confidence Interval		Coefficient	Estimate	95% Confidence Interval	
α	43.21*	39.31	44.03	α	89.01*	85.46	92.31
β	1.28*	1.23	1.32	β	1.36*	1.35	1.38
γ	1.23*	1.21	1.26				
ρ	1.03*	1.02	1.04				
δ	1.80*	1.78	1.81				

The estimated slope between the bond's yield spread and the CDS spread for the main sample is 1.28, as opposed to the expected value of 1. This confirms our prediction that Hull's model alone cannot account for a parity between the bond and CDS spreads. Interestingly, even when one includes only par equivalent CDS bonds which are more in line with their theoretical model, the slope does not improve significantly (1.17). This shows that even under this more traditional approach the interpolation of bond spreads using analogous default rates and a par-equivalency measure is not enough to compensate for the neglected effects of the other variables that Hull and White neglect to include.

As predicted, our model supports the inclusion of liquidity, volatility and credit quality parameters in order to better account for the market frictions present in the EM corporate market. This is well in line with my hypotheses, previous empirical findings from other studies on the region and what has been observed concerning the broader EM experience as whole. Liquidity,

as expected, plays an important role in the development of the EM corporate debt market. Our estimator shows that relatively greater illiquidity in the CDS vs. bond markets has a significant increasing relationship with CDS spreads. Also, as expected, poorer credits have higher CDS spreads and a greater relative impact on the basis than credits of higher quality. This is illustrated by the relatively high estimator (1.8) which is present in the main regression as well as in the regression using only par-equivalent CDS spreads (1.13). Finally, as predicted, greater levels of volatility are positively correlated with the existence of a basis (1.03); given the fact that the basis is very much a pricing mismatch between two theoretically analogous measures of risk, this is quite an intuitive conclusion. Volatility, after all, is at the heart of every arbitrage opportunity – the CDS bond basis being an example.

8. Conclusion

In conclusion, the inclusion of these added parameters – liquidity, credit rating and volatility – helps solidify the basic theoretical foundations first initiated by Hull and White (2000) and then expanded on by Levy (2009) and Jacobs and Karagozoglu (2010) that CDS and bond spreads are intrinsically intertwined as measures relating to the pricing of risk in fixed income instruments. Because EM economies are still not as developed as their DM counterparts, they do not possess the same characteristics of the markets that underline the no-arbitrage assumptions first developed by Black and Sholes to price financial instruments. Namely, a liquidity premium exists whereby the price discovery which is inherent to the efficient markets hypothesis supported by Black and Scholes' no-arbitrage argument becomes incomplete. Bid and ask spreads are not tight enough to provide enough color to investors looking to price MTM securities. Further, the traditionally high levels of volatility which have always been associated with investing in the broader EM region are only maximized when dealing with such a nascent

sub-sector as is the corporate bond and CDS market. This means volatility comes even more into play than when investors look at other EM products.

Still my findings support the previous empirical evidence as well as the broader observed economic trends emerging from the region that this perceived risk is in fact not adequately reflective of the fundamental risk/reward ratios that this market provides. This is empirically demonstrated by how better credits have a smaller correlation with the existence of a basis than poorer credits do. This shows that as credits improve their ratings that markets move in such a way that promotes price discovery and the accurate pricing of risk. Decreasing volatility too is correlated with the existence of a more efficient market, where Hull and White's theoretical spread-equivalency is actually possible in the long term.

Hence, as governments work on both fronts – to decrease the risks associated with investing in the region and volatility in particular while at the same time enacting legal and fiscal reforms that promote the development of liquid financial markets and improve credit fundamentals – the effect can be both-sided and twofold.

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