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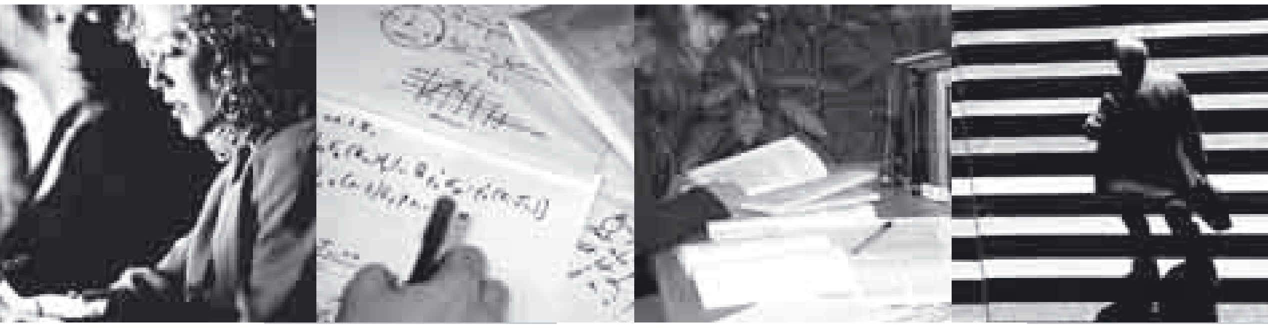
Exploring the CDS-Bond Basis

Jan De Wit



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EXPLORING THE CDS-BOND BASIS

Jan De Wit (*)

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Abstract

Markets for credit default swaps (CDS) and bonds of the same reference entity and maturity are bound by no-arbitrage conditions. Indeed, using a large data set we show that CDS premia and par asset swap spreads are mostly cointegrated. Nonetheless, the average CDS-bond basis (i.e. the difference between both measures) is positive in the period 2004-2005. We detect fourteen different economic basis drivers, which make the basis firm-specific and time-dependent. Furthermore, we describe the basis smile, and illustrate that the average basis is the lowest for five year maturities of corporate credits denominated in euro.

JEL codes: C12, C19, C23, G15, G19.

Key words: Bond, Co integration, Credit, Risk Neutrality.

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1. Introduction

No-arbitrage assumptions have a key role in the pricing of financial instruments, and in finance theory more generally. As derivative markets for credit risk transfer have experienced tremendous growth over the past decade on the back of contract standardization efforts, increasing market transparency and the introduction of tradable indices, it is worthwhile examining to what extent theoretical no-arbitrage relationships have held in this recently established segment of the global finance industry.

According to ISDA (2006), the worldwide market for credit derivatives expanded more than fivefold in the space of two years, and amounted to 17.3 trillion USD by the end of 2005. It is thus the fastest growing part of the 285 trillion USD global financial derivatives market, according to figures from BIS (2006). Both BIS (2006) and Batterman et al. (2006) argue that single-name credit default swaps (CDS) are the most important product, as they account for more than two thirds of all outstanding credit derivatives. CDS are also the main building blocks for many structured credit products.

The number of reference entities, mostly corporations but also sovereign issuers, has been steadily increasing. Also the investor base has been broadening over time, and consists of a diversity of players such as banks, brokerage firms, insurance companies, pension funds, financial guarantors, hedge funds and asset managers. As more dealer/brokers have developed their credit skills, market liquidity has improved and CDS bid-ask spreads have consequently narrowed. In some cases, both outstanding volumes of credit derivatives and daily trading activity have even outgrown the comparable cash bond market, imposing new challenges for the credit community.

Flow of funds statistics from Federal Reserve (2006) show that, at the end of 2005, outstanding amounts of aggregate US non-financial corporations' balance sheets exceeded 10 trillion USD and that corporate bonds accounted for 30% of the liability side. Comparable European data (ECB (2006)) show that corporate bonds only represent 7% of euro area non-financial corporations' aggregate balance sheets, confirming the widespread thesis that public markets for corporate debt are more developed in the US, while European corporate financing remains more focused on bank loans. Nevertheless, markets for credit derivatives have known comparable growth on both sides of the Atlantic.

A credit default swap is an agreement between two parties to exchange the credit risk of a reference entity. The buyer of the CDS is said to buy protection, has a similar credit risk position to selling a bond short and investing the proceeds in a risk-free asset, usually pays a periodic fee, and profits if the reference entity has a credit event, or if the credit worsens while the swap is outstanding. A credit event triggers a contingent payment on the CDS and includes bankruptcy, failure to pay outstanding debt obligations, and — in some CDS contracts — a restructuring of a bond or loan (ISDA (2003)).[1] Conversely, the seller of the CDS is said to sell protection, collects the periodic fee, and profits if the credit of the reference entity remains stable or improves while the swap is outstanding. Selling

[1] However, several versions of the restructuring credit event are used in different market segments. So-called "Modified Restructuring", which considers only certain types of restructuring as a default event, and under which the maturity of the debt instruments eligible for delivery is restricted, is common in US investment-grade markets (rated Baa3/BBB- and better); European CDS contracts are usually drafted with "Modified Modified Restructuring", which imposes different limits on the bonds that can be delivered upon restructuring; US high-yield markets (rated Ba1/BB+ and worse) do not include restructuring at all under standard documentation.

protection has a similar credit risk profile to maintaining a long position in a bond or a loan. If a credit event occurs, the compensation is to be paid by the protection seller to the buyer via either physical settlement (i.e. receiving the defaulted bond against payment of par) or cash settlement (i.e. paying the difference between par and the bond's recovery value), as specified in the contract. Physical settlement is the most common form of settlement in the CDS market, and normally takes place within 30 days after the credit event. Under physical settlement the protection buyer holds a delivery option, as in the event of default he is free to choose from a basket of deliverable bonds.

The premium paid by the protection buyer to the seller, often called "spread", is quoted in basis points per annum of the contract's notional value, is usually paid quarterly, and is not based on any specific risk-free bond or benchmark interest rate. Therefore, a CDS is like a put option written on a bond, as the protection buyer is protected from losses incurred by a decline in the value of the bond as a result of a credit event.[2]

Like CDS premia, bond spreads over a risk-free benchmark mainly compensate investors for default risk embedded in credit-risky assets. Both corporate bond and CDS spread levels and changes are influenced by a mixture of micro- and macroeconomic determinants such as default rates, corporate soundness (leverage, profitability, and liquidity), ratings, equity volatility, the economic cycle, risk-free interest rates or the slope of the yield curve.[3] Besides fundamental factors, technical drivers are also important, as prices for a specific bond and CDS are determined by supply and demand and may include a varying liquidity premium. Credit spread modelling for both cash and derivative instruments has focused on two types of frameworks. Structural models of credit risk build on Merton's original idea that both debt and equity can be modelled as options on the firm's assets. Reduced-form models of credit risk, also called intensity-based models, look upon defaults as exogenous rare events that can be modelled by a jump process.[4]

It can be shown that, under certain assumptions, investing in a floating rate note or investing in a credit-risky bond together with a buying a fixed-to-floating interest rate swap (combined position known as an asset swap), has the same economic risk profile as selling protection in a CDS. As a result, no-arbitrage arguments imply that the CDS premium should reflect the LIBOR spread on an equivalent asset swap. Previous studies (Blanco et al. (2005), Chan-Lau and Kim (2004), Norden and Weber (2004) and Zhu (2004)) have indeed found that this long-term theoretical equilibrium relationship broadly holds, though they have also shown that short-term deviations can be considerable. While evidence has remained thinly-based, analysis of lead-lag relationships has shown that CDS tend to lead cash bond markets, hence indicating that some price discovery exists.

We will extend this field of research, both by describing in great detail the economic determinants of the CDS-bond basis (hereinafter also denoted simply as the "basis"), and by applying cointegration analysis on a new and significantly richer dataset. The interest of this paper is threefold. Firstly, it enables to get an in-depth understanding of the differences between two important, related segments of today's financial markets (credit-risky bonds and credit default swaps). Secondly, it arms the reader/investor to assess

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[2] See Skinner and Townend (2002) or Whetten et al. (2004) for a description of the option-like characteristics of a CDS.

[3] See e.g. Aunon-Nerin et al. (2002), Collin-Dufresne et al. (2001), Van Landschoot (2004) and many others.

[4] Examples of structural and reduced-form models of credit risk are Longstaff and Schwartz (1995) and Jarrow and Turnbull (1995), respectively. More exhaustive overviews of credit risk models are presented in a large number of papers, such as Meng and Gwilym (2004).

apparent arbitrage opportunities that may arise between those two market segments. Thirdly, it bridges between rigorousness of previous academic studies and invaluable hands-on experience of market participants.

Our conclusions are (i) we show that credit default swap premia and par asset swap spreads are mostly cointegrated, suggesting the existence of a long-run equilibrium relationship; (ii) for the period 2004-2005 the average and median CDS-bond basis is positive; (iii) the basis tends to be positively correlated with the level of spreads; (iv) the CDS-bond basis is both firm-specific and time dependent, and is determined by a smorgasbord of 14 hard-to-proxy fundamental and technical factors; (v) we find evidence of the basis smile across rating buckets; (vi) the basis for emerging market sovereign entities is significantly higher than for corporate issuers; (vii) the basis is the lowest in the most liquid part of the CDS curve, i.e. the 5-year segment; (viii) the basis of credits denominated in EUR is significantly lower than for contracts in USD.

The remainder of this paper is organized as follows: In the first, theoretical part we define and discuss measures of bond spreads, we formally define the CDS-bond basis and we then outline in detail the various fundamental and technical basis drivers. The second, empirical part first outlines the characteristics of the dataset and methodology, then presents our results and discusses them in the light of the outcome of prior studies. We end with some concluding remarks.

2. Theoretical considerations

2.1. Bond spread measures and the CDS-bond basis definition

2.1.1. Spread measures for fixed-rate bonds

Our quest for the "holy scale", finding an appropriate definition of the CDS-bond basis, starts with the observation that the trading and valuation of credit-risky bonds in the cash market is based on a spread quotation. Ignoring the risk premium, tax and liquidity aspects, credit spreads are designed to compensate investors for expected loss from default. Explaining the basis requires an understanding of inherent characteristics of key spread measures used to compare cash and CDS markets (Batterman and Nordqvist (2005)). A CDS premium is a relatively straightforward measure, which tends to reflect the perceived credit risk of the reference entity in a pure way. However, different bond spread concepts exist, depending on the choice of the risk-free benchmark and the computational complexity. This complexity is a function of the accuracy by which maturity matching is accomplished, and depends on whether timing of cash-flows is considered, by explicitly taking into account the shape of the benchmark term structure. While later in this paper it will be argued that asset swap spreads are the appropriate spread measure to compare CDS premia with, it is useful to first review concepts of other, often more intuitive, widely used spread measures.

Originally, bond spreads were mostly calculated as the simple yield-to-maturity differential between a credit-risky bond and a credit risk-free benchmark bond. The closest on-the-run Treasury bond, in terms of maturity, was commonly chosen as the risk-free benchmark. This concept of a *"spread to a benchmark Treasury bond"* can be refined by interpolating the Treasury curve in order to exactly match the risky bond's maturity. Interpolation to obtain a *"spread to the interpolated Treasury curve"* may be carried out roughly by drawing a straight line between the yields of the closest longer and shorter

Treasury issues, or, alternatively, may result from yield curve estimation procedures, like the one proposed by Nelson and Siegel (1987), providing a smooth curve shape.

Traditionally, Treasury bonds were used mostly as a risk-free benchmark by bond traders, but nowadays interest rate swap rates are the most common reference, certainly for derivative traders, since (i) the swap curve is actually a more liquid curve in many developed markets, (ii) the swap curve does not suffer from temporary humps due to repo specialness, as on-the-run Treasuries do, (iii) the swap curve is less influenced by regulatory and taxation issues, (iv) LIBOR / swap rates correspond closely to the funding cost of many market participants. Also, academics seem to have adopted swap instead of Treasury benchmark curves. Previous studies on the pricing of CDS, such as Houweling and Vorst (2003), and on the analysis of the CDS-bond basis, such as Blanco et al. (2005), have built their analysis using swap benchmark curves.

The yield-to-maturity differential between a credit-risky fixed-rate bond and the interpolated swap rate is denoted as the *"I-spread"* (I from Interpolated). It may be noted that the difference between the spread to the interpolated Treasury curve and the I-spread is equal to the swap spread. A more refined measure that takes into account the full term structure of the benchmark swap curve for discounting each of the cash-flows at its own rate, is denoted as *"Z-spread"* (zero volatility spread), sometimes also called *"stripped spread"*. Z-spread is defined as the spread that must be added to a given benchmark zero swap curve so that the sum of the bond's discounted cash flows equals its price, with each cash flow discounted at its own rate.[5]

2.1.2. Asset swap spreads

While the above spread concepts were developed for calculating spreads on fixed-rate securities, Francis et al. (2003) found that, in terms of cash flow profile, a CDS is most readily comparable with a par floating rate note funded at LIBOR or with an asset swapped fixed-rate bond financed in the repo market. Duffie (1999) has formalized this argument for floaters, under the assumptions that there are no transaction costs or tax effects. However, floating rate notes are much less commonly traded securities than fixed-rate bonds, so we will focus on the asset swap structure. Through an asset swap an investor can separate interest rate risk from credit risk, transforming fixed payments into a floater. Such a fixed-to-floating asset swap is an over-the-counter package product consisting of two simultaneous trades: buying a fixed-rate bond and entering into a fixed-to-floating interest rate swap (IRS) of the same maturity. The fixed leg of the IRS is the bond's coupon, while the floating leg is LIBOR augmented by an agreed amount (in bp.), denoted the *"asset swap spread"* (ASW-spread).

Francis et al. (2003) further distinguish between par asset swaps and market asset swaps.[6] In a par asset swap, the asset swap buyer effectively buys the package from the asset swap seller at par, regardless of the cash price of the bond, and the notional amount of the swap is equal to the face value of the underlying bond. A par asset swap is the most

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[5] It should be noted that neither of the above spread measures is able to account for options which might be embedded in a bond (e.g. callable or putable securities). In a so-called *"option-adjusted spread"* (OAS), appropriate adjustments have been made. According to Galdi et al. (2000), OAS is the parallel basis point shift applied to the par coupon government curve in an option pricing model that produces a theoretical price equal to the corporate bond's actual market price. As bonds with embedded options will be excluded from the empirical exercise, we will not consider OAS.

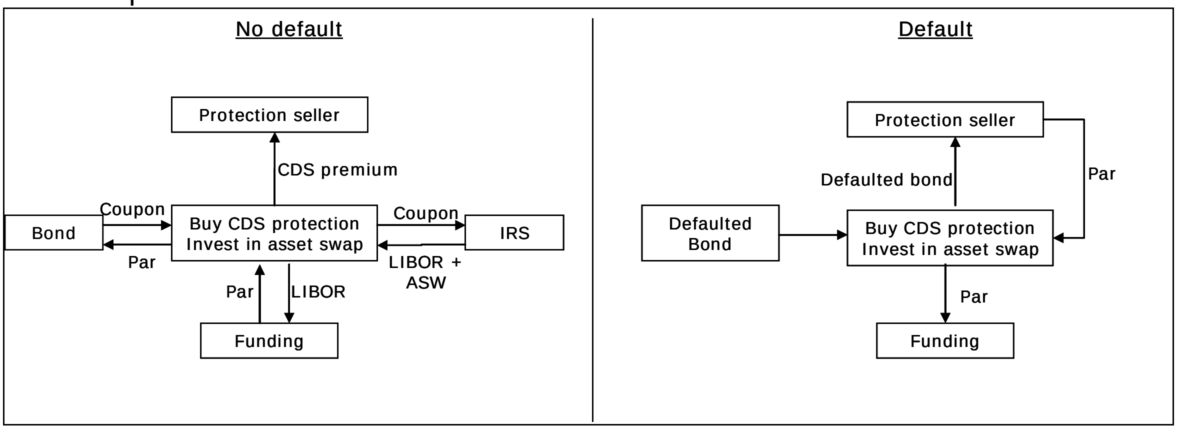
[6] Francis et al. (2003) also denote both structures as par in - par out asset swaps versus market in - market out asset swaps. Calamaro and Thakkar (2004) use the terminology par asset swaps versus proceeds asset swaps.

commonly traded asset swap package. When the deal is initiated, the present value of all cash flows must be zero, so that any upfront difference due to the bond trading away from par will be accounted for in the asset swap spread. Consequently, the *"market asset swap spread"* equals the *"par asset swap spread"* divided by the dirty price of the bond on a percentage basis.

2.1.3. The CDS-bond basis

Exhibit 1 is an adapted version of a scheme presented by Hjort et al. (2002). It illustrates how, for an investor who funds himself at LIBOR, a combined position of buying protection in a CDS and entering into an asset swap in which the fixed coupon payments of a bond that trades at par are swapped against a stream of floating rates is fully hedged in any state of the world. Before maturity, there are two possibilities: no default (left-hand side) and default (right-hand side, assuming physical delivery and unwinding of the IRS). In both cases, the combined position is credit risk-free. Therefore, the CDS premium should match the asset swap spread. If the difference between the CDS premium and the asset swap spread were to diverge from zero, that would constitute a theoretical arbitrage opportunity.

Exhibit 1 – The theoretical no-arbitrage relationship between credit default swaps and asset swaps



Comparison of asset swap spreads with CDS premia requires fulfilment of one important condition: the two credit risk sensitive instruments need to have the same remaining maturity. As the bond and the CDS will rarely trade at exactly the same remaining maturity, some calculation will be needed to match maturities. Both interpolation and yield curve estimation techniques may be considered to avoid maturity mismatches.[7]

Even if the par asset swap spread is an appropriate bond spread measure to compare CDS premiums with, there may be room for further refinement. Calamaro and Thakkar (2004) argue that in quantifying the CDS-bond basis to express an outright rich / cheap judgment, both probability of default — which may vary through a bond's lifecycle — and recovery on default must be considered in addition. Also, when a credit event occurs, the interest rate swap of an asset swap package persists, unless the investor has opted to enter into an extinguishable IRS. However, that is an illiquid instrument, so allowance should also be made for the potential cost of unwinding the IRS in an asset swap.

[7] Under 3.1. it will be discussed in detail how maturity matching has been accomplished for our dataset.

Many financial institutions have built their own proprietary models to reflect these issues in their in-house assessment of the CDS-bond basis.[8] Nevertheless, according to Memani et al. (2005a) the biases of using asset swap spreads instead of those more refined spread concepts are small and negligible, certainly for low-spread securities. The *true* credit risk is reported to be very close to the asset swap spread, the interest rate risk is almost perfectly hedged, and an asset swap is said to be a very convenient structure to trade as a package. Also, Calamaro and Thakkar (2004) acknowledge that, for relative value considerations in the high grade market, assessing asset swaps versus CDS may be sufficient to extract value from the basis between the two, and Beinstein et al. (2005) point out that, for most investment grade bonds, the difference in relation to par equivalent CDS spreads will be "within a few basis points". Felsenheimer (2004) goes even further by stating that in *any* case the appropriate spread measure for comparing cash bonds with CDS is the asset swap spread. Also, Francis et al. (2003) define the CDS-bond basis as the CDS premium minus the asset swap spread.

For the purpose of this paper, we also define the CDS-bond basis (the basis) as the difference between the CDS premium and the maturity matched par asset swap spread. If this difference is higher (lower) than zero, we say that the basis is positive (negative). The CDS premium for a given CDS ticker n at time t is denoted as $CDS_{n,t}$, and the corresponding maturity matched par asset swap spread as $ASW_{n,t}$. Then the basis $B_{n,t}$ can be written as the simple difference:

$$B_{n,t} = CDS_{n,t} - ASW_{n,t} \qquad (1)$$

A basis which diverges from zero might present an arbitrage opportunity. In the case of a positive (negative) basis, a positive (negative) basis trade can be set up, in which the cash bond is sold (bought) in an asset swap and CDS protection is sold (bought) at the same time. However, an investor should be aware that not every apparently attractive basis trade will necessarily be a free lunch, as transaction costs (bid-ask spreads) are significant in credit markets and the basis is determined by a complex set of factors, some of which cannot be controlled in a quantitative manner. In the following section we will look into these various economic basis drivers.

[8] Credit Suisse defines the *"par equivalent spread"* as the modeled spread of a par bond that has the same implied probability of default as the traded bond (Memani et al. (2005b)). Citigroup and Bank of America introduced *"probability-adjusted spread"* and *"par CDS equivalent spread"* along the same lines (Rajan et al. (2004b) and Taksler et al. (2006)). JPMorgan introduced both probability of default and recovery rates into the measure, and define a five-step process to derive *"bond equivalent par CDS spreads"* which permit direct comparison between bonds and CDS while at the same time adjusting for coupon features and for the cost of unwinding the IRS in case of default (Stephenson and Paras (2003)). Lehman Brothers derives a *"bond implied CDS spread"* from a bond-implied CDS spread term structure (Mashal et al. (2005) and Pedersen (2006)). Finally, Deutsche Bank considers the concept of *"funding spread"* as the appropriate bond spread measure (Calamaro and Thakkar (2004)). In most of these examples, adjustment for time varying probability of default, and hence consideration of the credit term structure, has been accomplished by deriving implied probabilities of default from *CDS* curves which have, contrary to most cash bonds, a clearly defined and traded curve, at least for important market participants.

2.2. Basis drivers

Although the no-arbitrage condition between CDS premia and asset swap spreads predicts the basis to be equal to zero, this relation does not always hold in practice. Indeed, market data shows that the basis can be either positive or negative, and that its value is both firm-specific and time-dependent. A smorgasbord of factors determines both the direction and the amplitude of the basis. This section will outline the various basis determinants that have been described by both academic and market sources.

Table 1 - Basis drivers

		Basis		
		Positive	*Negative*	*Undecided*
Factors	*Fundamental*	**CDS cheapest to deliver option** CDS premia are floored at zero CDS restructuring clause - technical default Bond trading below par Profit realization	Funding issues Counterparty default risk Accrued interest differences on default Bond trading above par	Coupon specificities
	Technical	**Demand for protection - difficulties in shorting cash** Issuance patterns	**Synthetic CDO issuance**	**Relative liquidity in segmented markets**

Table 1 shows that basis drivers can be ordered across two different axes. First, factors can be grouped according to their expected impact, as they can either cause the basis to become positive or negative, or even have a mixed effect depending on the precise situation. Second, factors can be grouped according to whether they are more fundamental or technical in nature. Adopting conventions as laid out in the pivotal article by McAdie and O'Kane (2001), we define fundamental factors as reasons that relate to the precise specification of a CDS contract that can make it behave differently from a cash bond, while technical factors refer to the nature of the markets in which both contracts are traded.

In general terms, factors that add risk to the CDS relative to the asset swap tend to increase the basis, while factors that add risk to the asset swap relative to the CDS tend to decrease the basis. Also, factors that tend to increase the return of an asset swap relative to a CDS drive the basis upwards, while factors that tend to increase the return of a CDS relative to an asset swap have the effect of depressing the basis.

It is clear that not all features are equally powerful and that, depending on the specific reference entity and moment in time, some factors can outweigh others in importance, while some determinants might even be totally irrelevant under certain conditions. While we define 14 different economic basis drivers, it is our understanding that four of them (i.e. the CDS cheapest to deliver option, difficulties in shorting cash bonds in a context of structural demand for protection, relative liquidity in segmented markets, and synthetic CDO issuance) are the main determinants of the CDS-bond basis.

Knowing that it is already difficult to quantify, or even find a proxy, for the assumed impact of some individual factors, it need hardly be said that assessing the combined effect of all determinants together on the basis of a specific CDS-asset swap combination is a very challenging task for a credit trader. When faced with an apparently attractive arbitrage opportunity, one should always question to what extent all relevant basis drivers are reflected in the observed basis measure. If this measure is judged to be appropriate, then the issue is whether sufficient liquidity is available in both market segments (CDS and bonds) to permit the profitable execution of arbitrage trades, after having accounted for the existence of transaction costs.

2.2.1. Factors that make the basis positive

A. Fundamental determinants

(i) CDS cheapest to deliver option[9]

In the case of physical delivery after a credit event, a protection buyer holds a delivery option, as he is free to choose the cheapest from a basket of deliverable bonds. Since it is likely that protection sellers will end up owning the least favourable alternative if different deliverable bonds are trading at different spreads, they should receive a higher premium to compensate for this risk. As a result, the cheapest to deliver option tends to increase the basis.

Depending on the type of credit event and the composition of the basket of deliverables, this ability to switch out of one asset into a cheaper one to deliver into the contract can be of significant value. The higher the likelihood of occurrence of a credit event and the wider the spectrum of deliverable bonds and loans in terms of covenants, maturities and coupons, the more valuable this delivery option may be, though it is difficult to quantify its exact value.

Given the exponential growth of outstanding derivative contracts, following a default there can be heavy demand from protection buyers for the cheaper cash bonds, which can lead to a market squeeze on the deliverable obligations, with the paradoxical effect of their price rising. This phenomenon has recently been observed at several occasions, e.g. in case of the Delphi and Calpine defaults, that occurred in October 2005 and December 2005, respectively. It tends to reduce the value of the cheapest to deliver option, and has revived market participants' interest in developing standardized cash settlement procedures.

(ii) CDS premia are floored at zero[10]

Asset swap spreads for high quality issuers (e.g. AAA / Aaa names) may well trade at levels below LIBOR, given that markets for interbank lending and interest rate swaps are generally populated by institutions that carry an AA- / Aa3 rating. Conversely, default swap premiums cannot be negative since these are insurance-like contracts, in which no protection seller would be accepting a negative premium. Consequently, the basis for reference entities that are perceived to be very creditworthy tends to be positive.

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[9] See Beinstein et al. (2005), Blanco et al. (2005), Calamaro and Thakkar (2004), Chan-Lau and Kim (2004), Cossin and Lu (2005), Crouch and Marsh (2005), Felsenheimer (2004), Francis et al. (2003), Hjort et al. (2002), Hull et al. (2004), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Taksler et al. (2006), Zhu (2004).

[10] See Hjort et al. (2002), McAdie and O'Kane (2001).

(iii) CDS restructuring clause - technical default[11]

The risk of technical default is the risk that the definitions or the legal structure used in the default protection documentation of the CDS differ from those which would constitute default on the cash bond. If, under specific circumstances, protection sellers in a CDS are forced to pay out on an event that is not a full default, a higher CDS premium will be required, thereby increasing the basis. More specifically, CDS contracts that include the restructuring credit event are vulnerable to divergence from bond documentation, despite improvements by ISDA in standardizing and harmonizing CDS legal documentation.

(iv) Bond trading below par[12]

A seller of protection in a CDS is exposed to the par amount following a credit event, while fixed rate bonds can trade significantly below par as a result of an increase in risk-free rates or credit spreads after the security has been issued to the market. In such a case, the seller of a CDS contract — who guarantees the par amount — will require a higher spread than the comparable bond investor who is exposed to lower risk, increasing the basis. Contrary to many other basis determinants, in the case of a bond price that diverges from 100, the impact on the basis can be mathematically estimated, even if an assumption about the expected recovery rate will be required.

(v) Profit realization[13]

Locking in a profit on a CDS position requires entering into an offsetting transaction, in which a lower premium is paid. Hence the full mark-to-market can only be monetized by waiting until both trades mature. However, if default occurs during the remaining lifetime, both contracts will trigger a credit event, remaining spread payments will terminate, and any further anticipated gain is lost. As a compensation for this risk, an investor would require a higher premium when selling a CDS contract, which should widen the basis.

However, two caveats apply. Firstly, while selling a bond enables gains to be locked in immediately, it can be argued that terminating an asset swap also requires entering into an offsetting interest rate swap. However, the credit risk involved in an outstanding IRS is perceived to be lower than for an outstanding CDS, at least for lower rated reference entities. Secondly, while profit locking on a CDS for an end-investor does indeed require entering into another CDS contract, early termination services exist, which organize novation of outstanding default swaps between dealer/brokers participating in the system.

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[11] See Calamaro and Thakkar (2004), Felsenheimer (2004), Francis et al. (2003), Hull et al. (2004), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Zhu (2004).

[12] See Beinstein et al. (2005), Blanco et al. (2005), Cossin and Lu (2005), Crouch and Marsh (2005), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Rajan et al. (2004a), Mc Pherson et al. (2002), Zhu (2004).

[13] See Beinstein et al. (2005), Felsenheimer (2004), McAdie and O'Kane (2001).

B. Technical determinants

(vi) Demand for protection - difficulties in shorting cash bonds[14]

Banks constantly shed credit risk, as they often hedge exposure of the loan book in order to be able to maintain a client relationship in full respect of all applicable risk limits, including concentration constraints. For these hedging purposes, banks tend to buy protection in CDS markets, as shorting in the cash bond markets is less convenient. Indeed, shorting the cash market tends to be difficult, as the bond needs to be sourced in a fairly illiquid and short-dated repo market in which bonds additionally might trade on special, making it expensive to borrow the bond. This drives out the CDS premium relative to cash bond spreads, hence widening the basis. This is all the more the case for reference entities which experience a negative market sentiment due to deteriorating credit quality.

Furthermore, a long bond investor can fund his position in the repo market at a rate that is close to LIBOR, as it constitutes a collateralized loan. However, if the asset becomes special and its repo yield decreases, the investor would be able to roll over the funding at a cheaper level. Since such repo optionality is not present in a CDS, it tends to further increase the basis.

(vii) Issuance patterns[15]

CDS spreads are often driven wider by market flows during and following the issuance of a convertible bond. Hedge funds specialized in convertible arbitrage strategies are frequently reported to provide a strong bid to the new issue as a means of acquiring a cheap source of equity volatility. At the same time, they hedge out the credit risk by buying protection in the CDS market, hence driving default swap spreads up and the basis wider.

Also, bond syndication desks which hedge forthcoming straight issuance, and banks participating in syndicated loans, will usually buy protection in the CDS markets, causing the basis to widen. Conversely, new bond issues are often launched in the primary market at a somewhat higher spread in order to provide attractive levels for investors to step in, driving the CDS-bond basis back down.

[14] See Blanco et al. (2005), Calamaro and Thakkar (2004), Cossin and Lu (2005), Crouch and Marsh (2005), Felsenheimer (2004), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Rajan et al. (2004a), Taksler et al. (2006), Zhu (2004).

[15] See Calamaro and Thakkar (2004), Felsenheimer (2004), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Taksler et al. (2006).

2.2.2. Factors that make the basis negative

A. Fundamental determinants

(viii) Funding issues[16]

The supposed equality between CDS premia and asset swap spreads is derived under the assumption that cash investors can fund themselves at LIBOR. However, many market participants only obtain funding above LIBOR levels, prompting them to obtain credit exposure by selling CDS rather than by acquiring asset swaps, driving the CDS-bond basis down. On balance, the greater the ratio of lower-rated versus higher-rated market participants, the more negative the basis should be. In addition, investors are exposed to future changes in the cost of funding (relative versus LIBOR), while a default swap locks in an effective funding rate of LIBOR flat, reinforcing the effect. The fact that different investors may fund themselves at different rates implies that the actual no-arbitrage level of a CDS versus asset swap trade varies for different market participants.

(ix) Counterparty default risk[17]

The two contractors in a CDS bear exposure to each other's ability to fulfil their respective obligations throughout the life of the trade. While the protection seller's counterparty risk is fairly contained, the buyer of protection faces greater uncertainty since, following a credit event, the difference between par and the recovery value of the defaulted asset is at stake, should the protection seller default on the back of the reference entity's credit event. Protection buyers will, as a form of compensation, tend to be only willing to pay a lower premium, reducing the basis.

Buying a cash bond is a fairly straightforward transaction that involves no additional layer of counterparty risk. However, entering into an asset swap also involves an interest rate swap that overlays the reference bond, and funding of the purchase of the bond often takes place through repo. These additional transactions create additional counterparty risks. However, both of these risks are considered as being minimal.

(x) Accrued interest differentials on default[18]

In the event of default, in most cases a bond does not pay accrued interest as issuers rarely compensate investors for any coupons owed. In contrast, under standard CDS documentation, protection buyers must pay the accrued premium up to the credit event. While the expected present value of this contractual difference, which is a function of the coupon size and the probability of default, is typically small, it tends to drive the CDS-bond basis more negative.

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[16] See Calamaro and Thakkar (2004), Crouch and Marsh (2005), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Taksler et al. (2006).

[17] See Felsenheimer (2004), Francis et al. (2003), Hjort et al. (2002), Hull et al. (2004), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Zhu (2004).

[18] See Beinstein et al. (2005), Calamaro and Thakkar (2004), McAdie and O'Kane (2001), Zhu (2004).

(xi) Bond trading above par[19]

As argued above, a bond trading below par makes the basis positive. As a corollary, and following the same logic, a bond trading above par causes the basis to be negative. Indeed, if a bond trades at a price above 100, the seller of a CDS contract who guarantees the par amount will settle for a correspondingly lower spread.

B. Technical determinant

(xii) Synthetic CDO issuance[20]

Issuance in structured credit markets, and in markets for synthetic collateralized debt obligations in particular, has been rising exponentially over the past few years and is expected to continue to grow. At the same time, this is a key factor that has been driving CDS spreads tighter and, as a result, depressing the CDS-bond basis. Indeed, in order to be able to sell synthetic credit risk to investors via these structures, the originators will typically have to take an offsetting long credit risk position by selling protection to hedge the transaction. The impact may vary significantly among individual credits, as it is a function of the relative liquidity of a reference name in the CDS and cash bond markets.

2.2.3. Factors that make the basis either positive or negative

A. Fundamental determinant

(xiii) Coupon specificities[21]

Some bonds carry clauses triggering a coupon step-up in the event of a ratings downgrade, which adds another layer of protection for bondholders that is not reflected in a similar default swap position. As a result, the CDS should trade wider than this bond, i.e. the basis should be positive and widening in case of a negative rating trend or weakening market sentiment for the issuer. Alternatively, coupon step-down clauses in the wake of a rating upgrade are also sometimes included in a bond structure, and these should imply a negative basis.

Coupon payment conventions also play a role; e.g., in case of US corporate bonds, coupon payments are made semi-annually on a 30/360 day-count convention, while CDS premia are due quarterly and accrue using an actual/360 convention. It is of course possible to control for this factor, but the investor who is considering a basis trade should be aware.

[19] See Beinstein et al. (2005), Blanco et al. (2005), Cossin and Lu (2005), Crouch and Marsh (2005), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Rajan et al. (2004a), Zhu (2004).

[20] See Beinstein et al. (2005), Calamaro and Thakkar (2004), Felsenheimer (2004), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Rajan et al. (2004a), Taksler et al. (2006).

[21] See Beinstein et al. (2005), Francis et al. (2003), Hjort et al. (2002), McAdie and O'Kane (2001), Taksler et al. (2006).

B. Technical determinant

(xiv) Relative liquidity in segmented markets[22]

Prices in both cash bond and CDS markets are a function of their specific supply and demand dynamics, which tend to exhibit diverging characteristics in these two, segmented markets. Despite ongoing integration of global financial markets, blurring of frontiers, and the existence of arbitrageurs, who are technically able to exploit price discrepancies between the two markets, this is still one of the main reasons for the existence of the CDS-bond basis. The basis will depend on the relative liquidity in both markets, and will compensate an investor who invests in the less liquid segment.

On the demand side, the investor base of the two markets is intrinsically different. A wide range of investors populates cash bond markets, though to a large extent bonds end up in buy-and-hold portfolios of funded investors, such as insurance companies and pension funds. Conversely, protection sellers in CDS markets are often more dynamic investors, such as hedge funds and proprietary trading desks, which can easily leverage their exposure due to the unfunded nature of derivatives. Different investor types are also governed by different regulatory frameworks and restrictions, while tax treatment may vary across products that are equivalent in economic terms. Finally, the off-balance-sheet nature of CDS is an incentive for some types of investors to sell protection in derivatives markets rather than to buy cash bonds outright.

Also, on the supply side, the two markets are organized in a different fashion. Protection buyers in CDS markets are often institutions such as banks that want to shed risks in a structural way. On the other hand, bond issuers such as corporations and sovereign states drive bond market supply according to their financing needs. Hence, on a maturity scale, the cash market for a particular credit name only trades large, liquid, bonds where issuers have decided to sell benchmark bonds into the market. Furthermore, these issues roll down the curve as time elapses, and only a few creditors have regular issuance programs spread out across the curve. On the other hand, CDS markets ensure liquidity around fixed maturities: the five-year segment attracts by far the most liquidity, while three-, seven- and ten-year CDS are also frequently traded maturities.

3. Empirical observations

3.1. Composition of the dataset

Conducting empirical work on opaque or developing segments of financial markets is challenging, as data sources are often proprietary and / or lack accuracy and completeness. In general terms, one could describe corporate bond markets as "not very transparent" or "opaque", and CDS markets as "recent", "emerging", or "developing". It was therefore surprising to find that it was feasible to construct a fairly large and — in our view — reliable dataset based on data publicly available on Bloomberg. The final dataset consists of daily observations for the period January 2004 to December 2005 for 144 combinations of CDS premia and corresponding maturity matched par asset swap spreads, representing a total of 70,847 observations of the CDS-bond basis.

[22] See Beinstein et al. (2005), Blanco et al. (2005), Chan-Lau and Kim (2004), Cossin and Lu (2005), Crouch and Marsh (2005), Francis et al. (2003), Hjort et al. (2002), Hull et al. (2004), McAdie and O'Kane (2001), Mc Pherson et al. (2002), Rajan et al. (2004a), Taksler et al. (2006), Zhu (2004).

To collect the bond (and thus asset swap spread) data, we reduced, in several steps, the set of bonds of the combined investment-grade and high-yield Merrill Lynch universes as available at the end of 2005. First, only bonds denominated in EUR and USD were retained. Second, all non-senior debt (such as subordinated or securitized issues) was removed from the sample. Third, all US Treasury notes and bonds were left out. Fourth, securities with embedded options were removed, and only bullet bonds were retained. Fifth, only securities with maturity not diverging more than five years from the term of the corresponding CDS tickers were retained. Sixth, in order to restrict the sample to liquid and frequently traded bonds, bonds with less than 500 million USD outstanding were removed. After application of all these filters, the reduced sample consisted of 714 bonds.

In order to collect the CDS data, all CDS tickers that had observations over the period 2004-2005 were initially gathered. Only senior CDS were retained with a 3-, 5- or 10-year tenor, for which at least one corresponding bond was available (i.e. with both a matching reference entity and denominated in the same currency), so the number of CDS tickers decreased 176. Consequently, daily par asset swap spreads and CDS premia for the period 2004-2005 were downloaded. A first look at the data showed that, in some instances, there were large gaps in the time series, so the dataset was then further restricted to 607 bonds and 165 CDS tickers. These represented 270,273 asset swap spread observations and 84,213 observations of CDS premia.

Maturity matching of the asset swap spreads towards the CDS term was carried out by applying the following set of rules. At each daily point in time, the remaining maturity of all available bonds (with the same reference entity and denominated in the same currency) was evaluated for each individual CDS ticker. Two methods were considered: "direct matching" and "linear interpolation". Direct matching was applied for days when only one bond was available with the remaining term to maturity of that bond diverging less than one year from the CDS term.[23] Linear interpolation of asset swap spreads towards the corresponding CDS term was applied when at least two bonds were available, one with a lower and one with a longer term to maturity than the CDS term. Where multiple maturity matched asset swap spreads were available (through either direct matching or linear interpolation), the arithmetic mean of these calculated spreads was taken as the final bond market reading for that observation.

It is important to recognize that the assessment of bond availability for each CDS ticker was carried out for each individual daily observation. As a result, the time series of maturity matched asset swap spreads corresponding to one specific CDS ticker may be composed of price data taken from different bonds for different periods in time. Furthermore, as bond availability has been evaluated at each point in time, this leads to a further reduction in the size of the dataset. Indeed, after application of the above procedures, a final dataset was left, consisting of two years of daily observations for 144 CDS premia, their corresponding maturity matched par asset swap spreads, and the difference between the two measures, i.e. the CDS-bond basis. The total number of basis observations amounts to 70,847, i.e. an average number of 492 observations per CDS ticker.

[23] Quarterly rolls of CDS contracts were left out of the analysis, so at each point in time the remaining maturity of the CDS was assumed to be equal to its term. Correcting for the exact CDS maturity would produce only a very marginal improvement in the results, but would drastically complicate the data handling process.

Table 2 - Number of reference entities by rating and by sector

		Rating					
		Aaa	Aa	A	Baa	Ba	*Total*
Sector	Basic Materials			2	3		5
	Communications			5	5	1	11
	Consumer, Cyclical		1	3	4	1	9
	Consumer, Non-cyclical		1	4	5	1	11
	Diversified				1		1
	Energy		1		1		2
	Financial	3	12	14	3	1	33
	Government			4	2	5	11
	Industrial	1	2	4	3		10
	Utilities		2	6	2		10
	Total	4	19	42	29	9	**103**

One reference entity may have multiple CDS tickers, denominated in different currencies and/or with different maturities, so the number of reference entities is lower than the number of CDS tickers. Table 2 shows that the dataset covers 103 different reference entities. 94 of them are considered as investment-grade (Baa or better, following Moody's rating scale) and 9 of them as high-yield.[24] The majority of reference entities carry a rating A (42 out of 103). From the 103 reference entities, 11 are emerging market sovereigns (the government sector) and 92 are corporations. The financial sector is well represented with 33 entities, but it must be recognized that in this sector a variety of institutions such as banks, brokers, insurers and finance companies are grouped together. Six sectors are all represented by 9 to 11 companies, while the three remaining sectors (basic materials, energy and diversified) only consist of a small number of corporations.

Table 3 - Number of CDS tickers by currency and by term to maturity

		Currency		
		EUR	USD	*Total*
Term	3	26	15	41
	5	56	38	94
	10	4	5	9
	Total	86	58	**144**

In table 3 the CDS tickers of the final dataset are broken down according to their currency and term. It is no surprise to observe that the biggest part of the dataset consists of 5-year contracts, as that is generally perceived to be the most liquid part of the CDS curve. For that reason, most other empirical studies, including Blanco et al. (2005), Chan-Lau and Kim (2004), Norden and Weber (2004) and Zhu (2004), actually *only* considered the five-year tenor. However, we are able to extend the analysis, mainly to the front end of the credit curve (41 contracts with a 3-year term), but also to the long end (9 contracts with a 10-year term). Also, previous studies have focused very much on the credit markets denominated in USD, while in our dataset a majority of 86 contracts were denominated in EUR against 58 in USD.

[24] A potential flaw is that ratings were only considered at the end of the sample period, so rating migration was not taken into account. However, as only a 2-year period is considered, as ratings are believed to provide a through-the-cycle assessment of credit risk and as ratings are regrouped in larger buckets (e.g. Baa1, Baa2 and Baa3 are all considered as Baa), it is a likely assumption this should not bias our results.

3.2. Descriptive statistics

3.2.1. Full dataset

As shown above, the sector and rating of each of the 103 reference entities are known, as are the currency and term of each of the 144 CDS tickers. For each CDS ticker, a time series of daily CDS premia and maturity matched par asset swap spreads for the period January 2004 to December 2005 is available. The difference between the CDS premium and the maturity matched par asset swap spread is denoted as the basis.

The main characteristics for each separate element of the cross section are given in appendix 1. This appendix reveals that, for some series, the average basis is very close to zero (e.g. Usinor: +0.1 bp.), while for others the average basis differs significantly from zero. The extrema for the averages per series are British American Tobacco (-6.2 bp.) and the 10-year tenor for the Philippine government (+ 136.7 bp.). As illustrated by the example of TDC, which was involved in a Leveraged Buy-Out during the period, a close to zero *average* basis (in this case only -0.1 bp.) may hide much of the time series dispersion. The basis for TDC varied from -32.2 bp. to as much as 45.8 bp. during the period, with a standard deviation of 11.4 bp. The series with the lowest and highest standard deviation were the 5-year RWE contract and 3-year GMAC contract, with 2.2 bp. and 66.6 bp., respectively. The 3-year GMAC series also had the highest individual basis observation within the sample (274 bp. on 11 May 2005), while the lowest basis reading in our sample (-76 bp. on 9 January 2004) came from Alcatel.

Table 4 - Basis: main characteristics

		2004	2005	2004-2005
Mean	All Sectors	16,0	16,8	16,3
	Corporates only	8,1	11,6	9,9
Median	All Sectors	6,5	8,1	7,5
	Corporates only	5,6	7,2	6,5

(in basis points)

Table 4 gives key aggregate statistics for the basis. This shows that, for the full period 2004-2005, the arithmetic mean basis of the full dataset was a positive 16.3 bp., hence reflecting a higher average CDS premium than asset swap spread. However, if we ignore the 11 emerging market sovereign reference entities in the sample, thus focusing only on corporate issuers, the mean drops to 9.9 bp. The distribution is characterized by its skewness, since focusing on the median basis instead of the mean significantly alters the outcome. The full sample median is 7.5 bp., dropping to 6.5 bp. when only corporations are considered as reference entities. These results are in line with other studies such as Blanco et al. (2005), Levin et al. (2005), Norden and Weber (2004) and Zhu (2004), which reported average bases of 6 bp., -2 bp., 14 bp. and 13 bp., respectively. While Norden and Weber (2004) report significant divergence in the average basis for the different years in their sample (2000 to 2002), our dataset seems to be more homogeneous through time, as averages for 2004 and 2005 are fairly close to each other.

Chart 1 - The CDS premium, asset swap spread and basis through time

AVERAGES MEDIANS

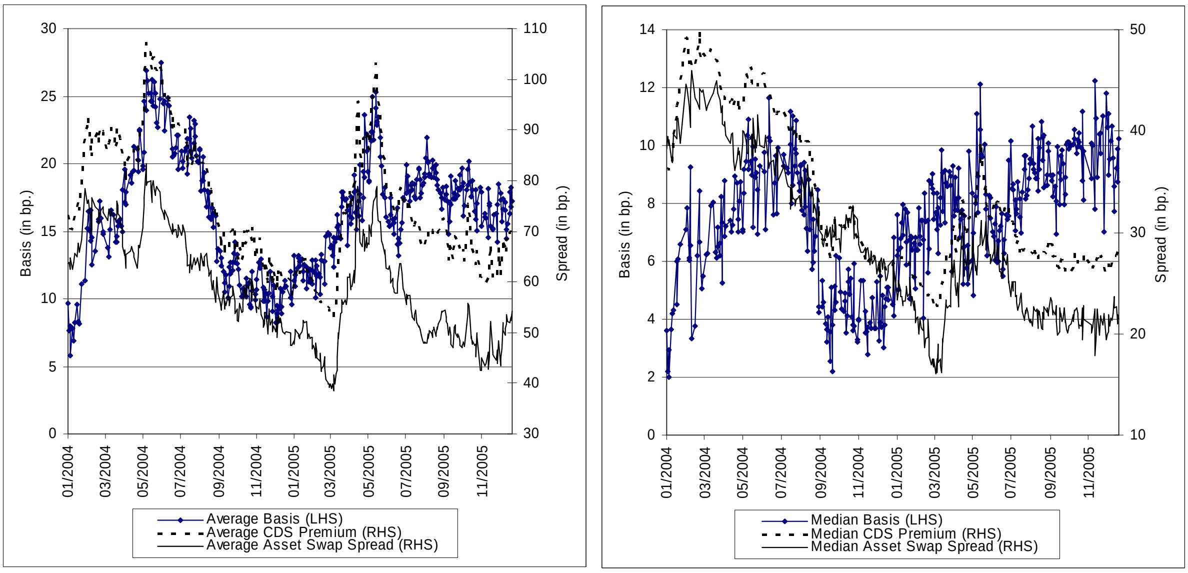


Chart 1 illustrates the dynamics of the basis through time. For each daily observation both averages and medians of all CDS premia, asset swap spreads and bases of the cross-section were plotted. Average CDS premia moved in a range from 55 bp. to 105 bp., and average asset swap spreads in a range from 40 bp. to 80 bp. Medians for CDS premia and asset swap spreads moved in ranges from 20 bp. to 50 bp., and 15 bp. to 50 bp., respectively. The average basis increased from 5 bp. in the beginning of the time series to a top of 27 bp. at the end May 2004, and than reverted back to 8 bp. at the end of 2004. A second cycle was observed in 2005, in which again a peak of 25 bp. was reached in May, ending the time series back at some 17 bp., a level which is also close to the average for the full sample. The median basis followed similar patterns, but moved in a narrower range, from 2 bp. to 12 bp. Chart 1 shows that average and median bases are positive throughout the period, but that they are also time-varying and exhibit large swings. Nevertheless, CDS premia and asset swap spreads tend to move broadly in parallel.

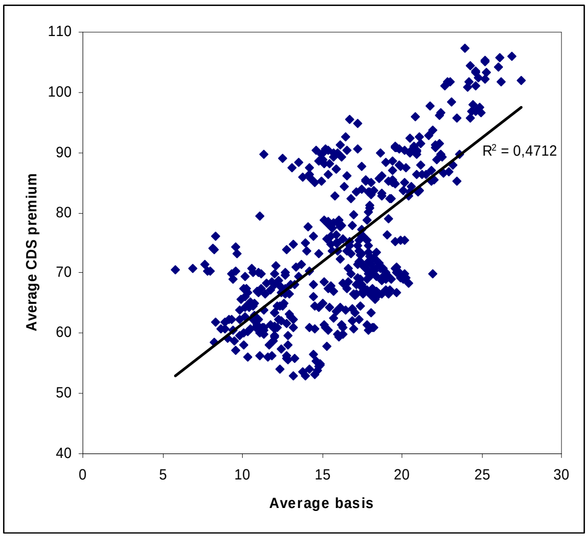
Chart 1 implies one other notable conclusion: the average basis tends to be market directional, so there is a positive correlation between the basis and the level of spreads.[25] This means that in periods when credit markets sell off, hence when spreads widen, the basis tends to increase accordingly. For the sample period as a whole, this is best illustrated in the months March to June 2005.[26] Chart 1 showed how CDS premia, asset

[25] See also Fage (2003), who presents anecdotal evidence for emerging market sovereign issuers, and Taksler et al. (2006) for a more general discussion.

[26] At the beginning of March 2005, spreads were reaching record lows as corporate fundamentals were very solid (low default rates, low balance sheet leverage, strong and increasing profitability, solid liquidity positions) and technical conditions were supportive (muted supply, strong demand due to the global search for yield and strong CDO issuance). In mid March 2005 the main US auto manufacturer, General Motors (GM), then issued a significant profit warning. This sparked speculation among market participants about the possibility of GM becoming a fallen angel, should the rating agencies downgrade GM's ratings from investment-grade to junk in the wake of the deteriorating fundamentals. This fear became reality at the beginning of May 2005 when Standard and Poor's did indeed lower GM's rating to below investment grade. In the wake of that decision, many hedge funds were then rumoured to have suffered big losses on so-called correlation trades involving auto sector debt, causing further and more widespread losses in credit markets. In late May and early June 2005, it became clear that these fears were broadly unfounded and spreads tightened back in as a result.

swap spreads, and the difference between the two did indeed all increase significantly from mid-March 2005 to mid-May 2005, to revert back in the subsequent month.

Chart 2 - Scatter plot of the average CDS premium and basis

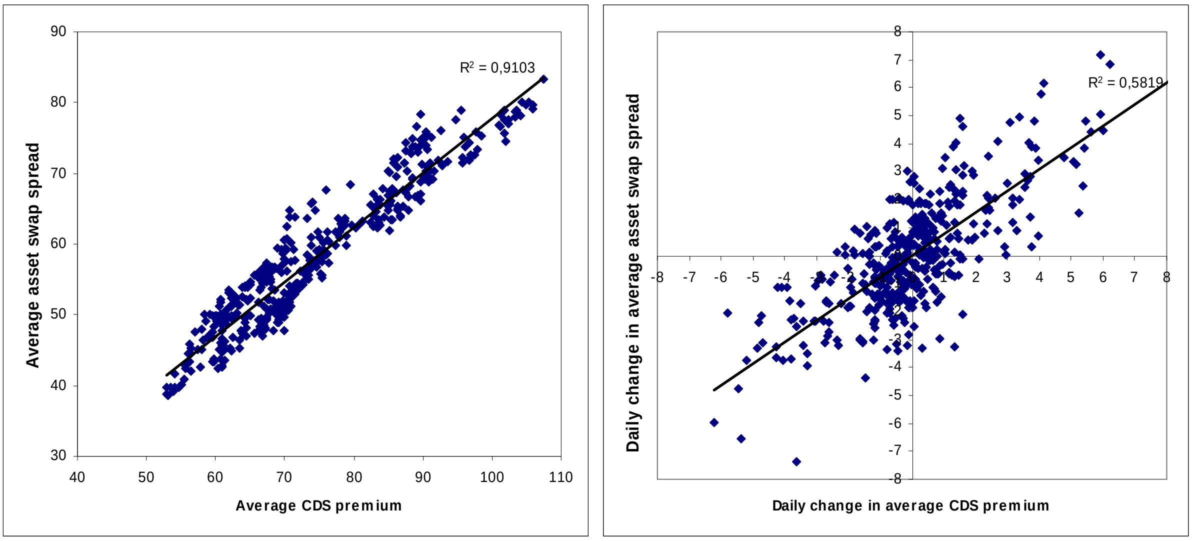


(in basis points)

Chart 2 further illustrates this market directional behaviour of the basis for the entire sample period by scatter plotting the average basis together with average CDS spread levels, indicating a strong positive relationship.

Chart 3 - Scatter plot of the average CDS premium and asset swap spread

LEVELS DAILY CHANGES



(in basis points)

Chart 3 elaborates further on the observation made earlier that average CDS and asset swaps tend to move broadly in parallel. The left-hand panel of this chart indicates a strong positive relationship between the levels of average CDS premia and asset swap spreads. Linear approximation through regression shows a very high R^2 of 91%. However, both series are suspected not to be stationary, making the regression potentially spurious. Further on in this paper, formal testing for unit roots will be carried out, followed by appropriate cointegration analysis. That said, the right-hand panel of chart 2 shows that there is also a strong positive relationship in first differences: between *daily changes* in average CDS premia and *daily changes* in asset swap spreads, R^2 equals 58%, further supporting the case for strongly related credit market segments, as expected.

3.2.2. Basis by subset of the dataset

While the above description was based on the full dataset, some distinguishing features may also be highlighted for different subsets of the sample. Appendix 2 presents tables with descriptive statistics by rating, sector, currency and term.

Calculation of the average basis by rating bucket shows a fairly high average basis of 21.6 bp. for Aaa credits, a very high average basis of 74.5 bp. for high-yield entities (rated Ba), and a much lower average basis for intermediary ratings, with a minimum of 6.6 bp. for entities rated A. Market participants refer to this phenomenon as the so-called basis smile. Hjort et al. (2002) argue that the zero-floor for a CDS premium mainly drives the basis upwards for very high grade credits, while other factors, such as the cheapest-to-deliver option, mainly affect credits with a low rating. These drivers are reported to have less impact on the intermediary rated entities, hence keeping their basis lower. In 2004 the average basis was lower for all rating classes than in 2005, except for Ba-rated entities which had a lower average basis in 2005.

The government sector, representing emerging market sovereign issuers — which are frequently rated below investment-grade — has a much higher average basis than all corporate sectors, at 54.2 bp., and its dispersion is also the highest with a standard deviation of 51.1 bp. The average government basis was higher in 2004 than in 2005, which is another illustration of the market directional behaviour of the basis, as emerging market spreads have indeed become tighter in the last year. Some corporate sectors such as basic materials have a very close-to-zero average basis, while others have seen a significantly positive basis. One sector to highlight is the financial sector. Given their great relative importance in terms of number of reference entities and its high average basis of 15.4 bp., financials are the largest single sector making the average basis for the full corporate dataset as high as it is. Digging into the details shows a much wider average basis for the financial sector in 2005 than in 2004. This again mainly reflects the market directional feature of the basis, as auto sector finance companies such as General Motors Acceptance Company (GMAC) and Ford Motor Credit Company (FMCC) experienced gyrations in 2005.

In terms of currencies, highly significant differences have been observed. The average basis for credits denominated in EUR has only amounted to 7.5 bp., while USD contracts are reported to have an average basis of 29.3 bp. However, this divergence largely reflects the fact that all emerging market sovereign debt and the vast majority of auto sector related financial credits have been denominated in USD. A similar explanation can be given for the much higher than average basis for the 10-year segment of the credit curve (35.8 bp.), as most of these contracts once again concern emerging market sovereign debt. While the difference between the average basis for 3-year (16.9 bp.) and 5-year (14.1 bp.) contracts is less striking, it is nonetheless remarkable that the lowest average basis is observed in the most liquid part of the CDS curve, i.e. the 5-year segment. This may illustrate the fact that arbitrage opportunities tend to disappear faster as markets become more liquid.

3.3. Methodology

As has been illustrated, aggregate CDS premia and par asset swap spreads tend to move together in time. However, should these series be non-stationary, this may lead to spurious regressions in which results from traditional regression analysis might look good, while the series may be totally unrelated (Brooks (2002)). For interpreting long-term relationships among non-stationary series, cointegration analysis, as proposed by Engle and Granger (1987), is the appropriate framework.[27]

As a first step, the supposed non-stationarity of the CDS and asset swap series is verified. As argued by Brooks (2002), if a series must be differenced once before it becomes stationary, it is said to be integrated of order one or to contain one unit root. A stationary series follows a process which has a constant mean, variance and autocovariance structure through time. In order to test for a unit root we use the augmented Dickey-Fuller test.[28] The test regressions are

$$\Delta CDS_{n,t} = \alpha CDS_{n,t-1} + \sum_{i=1}^{p} \beta_i \Delta CDS_{n,t-i} + u_{n,t} \qquad (2a)$$

and

$$\Delta ASW_{n,t} = \alpha ASW_{n,t-1} + \sum_{i=1}^{p} \beta_i \Delta ASW_{n,t-i} + u_{n,t} \qquad (2b)$$

p is the appropriate number of lags to be included, which is determined by the Schwartz information criterion. The null hypothesis is that the series contains a unit root (α = 0), versus the alternative hypothesis of a stationary series. The test statistic equals $\frac{\hat{\alpha}}{S\hat{D}N(\hat{\alpha})}$, and critical values, as derived from simulation experiments, are tabulated as they follow a non-standard distribution (Brooks (2002)). If the test statistic exceeds the critical value for a given confidence level (10%: -2.57; 5%:-2.87; 1%: -3.44), the null hypothesis of a unit root cannot be rejected.

In a second step, it is verified whether (non-stationary) CDS and asset swap series are bound by a cointegration relationship. Formally, Engle and Granger (1987) define a set of variables as cointegrated if any linear combination of them is stationary. However, in this specific case, following Zhu (2004), we look for a more restricted form of cointegration as we "know" by theory exactly which linear combination we expect to be stationary, i.e. the difference between the two series, the CDS-bond basis. Therefore, one only has to test for a unit root in the basis series, using a similar augmented Dickey-Fuller test regression.

$$\Delta B_{n,t} = \alpha B_{n,t-1} + \sum_{i=1}^{p} \beta_i \Delta B_{n,t-i} + u_{n,t} \qquad (3)$$

When the test statistic is lower than the critical value at a certain confidence level, the null hypothesis of a unit root is rejected. In that case, the basis series is stationary, so the CDS and asset swap series are said to be cointegrated.

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[27] Blanco et al. (2005) argue that the time of reversion to equilibrium provides grounds for the use of "long run" cointegration analysis on data sets that cover only a relatively small time period. We simply subscribe to their conclusion that it is indeed methodologically appropriate to make use of cointegration techniques.

[28] Alternatively, one could run Phillips-Perron tests. However, as argued by Brooks (2002), the two tests tend to give similar results, which is why we only consider the Dickey-Fuller framework.

3.4. Results

Appendix 3 includes detailed results of all unit root tests for individual series. Both test statistics and probabilities (MacKinnon one-sided p-values) are tabulated, and a concluding assessment is added. In all 144 CDS series and in a very large majority of asset swap spread series (137 out of 144) we find evidence of a unit root, which confirms the view that the regular framework of regression analysis is inappropriate and that cointegration analysis needs to be applied instead.

Table 5 - Number of cointegrated CDS-bond combinations

		Cointegrated	Not cointegrated
	overall	87	57
Currency	USD	40	18
	EUR	47	39
Term	3	27	14
	5	54	40
	10	6	3
Rating	Aaa	3	1
	Aa	13	11
	A	36	21
	Baa	29	12
	Ba	6	12
Sector	Basic Materials	6	1
	Communications	11	9
	Consumer, Cyclical	10	5
	Consumer, Non-cyclical	8	5
	Diversified	1	0
	Energy	1	2
	Financial	25	16
	Government	10	11
	Industrial	7	3
	Utilities	8	5

Testing for cointegration in the individual basis series gives somewhat mixed results, which are however in line with other studies. As shown in table 5, we find evidence of cointegration in 87 cases out of 144. Test statistics diverge as far as from + 0.18 for the 3-year series of FMCC, indicating 97% certainty of a unit root, to -7.23 for John Deere Capital Corporation, indicating near 100% certainty of cointegration. It is not surprising to note that the worst outcome again is auto sector debt related. In the case of the 3-year FMCC contract, the May 2005 gyrations made both spreads and the basis behave in a very volatile fashion. On some days, the basis reached levels of almost 200 bp. This presumably reflects the fact that, in an attempt to hedge exposure or to monetize views on the credit, many investors primarily chose the CDS market to execute trades.

Furthermore, table 5 shows that we find more evidence of a long-term equilibrium relationship for credits denominated in USD than those in EUR, which may reflect better liquidity conditions in USD corporate bond markets. A less intuitive conclusion is that cointegration seems to occur less in the most liquid part of the CDS curve, being the 5-year maturity. In terms of ratings and sectors, our results imply that cointegration occurs less in high-yield than in investment-grade credit markets, and occurs more for corporate credit than in emerging market sovereign credit markets. An alternative interpretation of the overall results could be that arbitrage opportunities between CDS and bond markets tend to last longer in emerging market sovereign markets, in high-yield markets, in markets denominated in euro and in the 5-year segment of the credit curve.

3.5. Comparison with other studies

Although credit derivative markets have only emerged over the past decade, a vast number of authors have shown interest in this increasingly important segment of the global finance industry. Also, the "niche" of arbitrage opportunities between CDS and bond markets has already been explored by several academics. In comparing the outcome of different studies we will only focus on the most pertinent and relevant papers. Other related, often interesting, papers that have a somewhat different or broader focus, will therefore not be included from here on.[29]

In table 7 our paper is compared with five other articles, namely Blanco et al. (2005), Chan-Lau and Kim (2004), Levin et al. (2005), Norden and Weber (2004) and Zhu (2004). All the papers but one use cointegration techniques for analyzing long-run relationships, in some cases complemented by lead-lag analysis of short-term deviations. The exception that has been included in the table is Levin et al. (2005), whose approach differs significantly from that of the other papers, but which we consider to be a very relevant contribution in this domain. Levin et al. (2005) perceive the basis as a reflection of the existence of market frictions between the two credit market segments, and focus their analysis on defining proxies for the different basis drivers. Finally, they show that firm-specific causes of these market frictions are significantly more important than systematic factors.

Table 6 - Comparison of main papers

	Blanco, Brennan and Marsh (2005)	**Chan-Lau and Kim (2004)**	**Levin, Perli and Zakrajsek (2005)**	**Norden and Weber (2004)**	**Zhu (2004)**	**De Wit (2006)**
DATASET						
CDS Term	5	5	1/2/3/5/7/10	5	5	3/5/10
Period	02/01/2001 to 20/06/2002	19/03/2001 to 29/05/2003	02/01/2001 to 01/09/2005	2000-2002	01/01/1999 to 31/12/2002	01/01/2004 to 30/12/2005
# reference entities	33	8	306	58	24	103
# contracts	33	8	1290	58	24	144
*Type reference entities**	IG Corporates	EM Sovereigns (USD only)	IG/HY Corporates (US-USD only)	IG (+HY) Corporates	IG Corporates	IG/HY Corporates + EM Sovereigns
METHODOLOGY						
Spread estimation	Interpolation bond spreads to CDS term	No duration mapping (EMBI+ vs. 5-y CDS)	Spline estimate CDS curve, match to bond term	Interpolation bond spread to CDS term	Interpolation/Matching bond spread to CDS term	Interpolation/Matching bond spread to CDS term
Long-term relationship	Cointegration	Cointegration	/	Cointegration	Cointegration	Cointegration
Lead-lag relationship	VECM Hasbrouck and Gonzalo-Granger	Granger causality, VECM Hasbrouck and Gonzalo-Granger	/	Granger causality, VECM Gonzalo-Granger	Granger causality, VECM Gonzalo-Granger	/
RESULTS						
Basis	+6 bp. (mean)	"CDS and bonds tend to converge"	0 bp. (median), -2 bp. (mean)	+14 bp. (mean)	+13 bp. (mean)	+7 bp. (median), +16 bp.(mean)
Long-term relationship	26 out of 33 cointegrated (unrestricted)	5 out of 8 cointegrated (unrestricted)	/	36 out of 58 cointegrated (unrestricted)	15 out of 24 cointegrated (restricted)	88 out of 144 cointegrated (restricted)
Price discovery	CDS tends to lead bonds	Undecided	/	CDS tends to lead bonds	CDS tends to lead bonds in US, not elsewhere	/
Other		No equilibrium price relationship between equity and bond markets	- Mainly idiosyncratic factors cause market frictions - Employs proxies for systematic and idiosyncratic basis determinants	Stock returns lead CDS and bond spread changes		- Basis smile - Basis lowest for 5-year corporate credits denominated in euro

*: IG, HY and EM stands for investment-grade, high-yield and emerging markets, respectively.

29 Examples include Crouch and March (2005), Houweling and Vorst (2003), Hull et al. (2004), Longstaff et al. (2003), and Trück et al. (2004).

In comparison with other papers, it appears that our dataset is fairly rich in terms of both the number of reference entities and the diversity of the credits included. We consider a two-year timeframe of daily observations, which is in line with most other articles. Besides the most common 5-year maturity, we also include the 3-year and 10-year segment of the credit curve. Our dataset also includes a large amount of credits denominated in euro, while many authors only consider USD. Finally, both corporate and emerging market sovereign credits are included in the sample, while most other papers only consider one market segment.

Our methodology for maturity matching is a combination of direct matching and linear interpolation, which is also common practice in other articles. Two notable exceptions are Chan-Lau and Kim (2004), who do not consider maturity matching at all, and Levin et al. (2005) who make use of the superior richness of their CDS dataset to estimate a full CDS curve and match the CDS spread to the exact remaining maturity of the bond. We found a median positive basis of 7.5 bp., which is in line with results from other studies.

Besides Levin et al. (2005), all other papers made use of a cointegration approach to consider long-run relationships. It should be noted that some authors have worked with an "unrestricted" definition of cointegration, allowing for any linear combination of CDS and asset swaps to be stationary. Conversely, Zhu (2004) and ourselves have "restricted" the examination of the long-run relationship to testing for a unit root in the CDS-bond basis, as predicted by theory. We focused the analysis on the presence of a long-run equilibrium relationship between both market segments, while other authors also made an assessment of short-term lead-lags between CDS and asset swaps. Both Blanco et al. (2005) and Norden and Weber (2004) have found some mixed evidence of price discovery in CDS markets, as they tend to lead their cash bond counterparts, while in Chan-Lau and Kim (2004) and Zhu (2004) this tentative conclusion could not be confirmed.

4. Concluding remarks

We have shown that CDS and bond markets are closely related and bound by a long-run equilibrium relationship, as CDS premia and par asset swap spreads are mostly cointegrated. Nevertheless, we found that for the period 2004-2005 the median CDS-bond basis was positive (7.5 bp). The CDS-bond basis is both firm-specific and time dependent, and is determined by at least 14 different factors which have been discussed in great detail. Furthermore, we found that the basis tends to be market directional. Evidence of the basis smile was found across rating buckets. We showed that the basis for emerging market sovereign entities is significantly higher than for corporate issuers, and that the basis is lowest in the 5-year segment of the CDS curve. Finally, we found that the basis for credits denominated in EUR is significantly lower than for contracts denominated in USD.

Using publicly available information, we have been able to construct a large and reliable dataset, which has been analyzed for long-run equilibrium relationships. Future research could logically focus on more detailed analysis of short-term deviations from this equilibrium, using lead-lag analysis techniques such as Granger causality and vector error correction models. More detailed analysis of the effective practical exploitability of apparent arbitrage possibilities, including an assessment of transaction costs, would also be an interesting path for future research. Finally, constructing a model for the basis level by using proxies for the different economic basis drivers may yield better insights into the relative importance of the various factors.

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Appendix 1 – Dataset characteristics

					Basis (in bp.)				CDS premium (in bp.)				Asset swap spread (in bp.)				pm: Number of
Entity	Currency	Term	Rating	Sector	Average	Min.	Max.	SDN	Average	Min.	Max.	SDN	Average	Min.	Max.	SDN	observations
ABN Amro Bank NV	EUR	5	Aa	Financial	6,8	-4,4	14,5	2,9	11,9	7,8	18,0	2,9	5,1	-5,1	20,5	4,5	*500*
Akzo Nobel NV	EUR	5	A	Basic Materials	-4,4	-16,7	3,4	3,2	30,6	20,0	54,9	7,2	35,1	18,8	68,8	8,9	*500*
Alcatel SA	EUR	3	Ba	Communications	9,9	-76,0	79,2	27,0	93,2	32,0	186,4	42,4	83,3	30,7	239,6	48,1	*449*
Allianz AG	EUR	3	Aa	Financial	9,5	0,8	15,2	3,0	15,8	10,0	24,5	3,9	6,3	-3,1	22,3	6,2	*499*
Allianz AG	EUR	5	Aa	Financial	11,8	0,4	20,0	3,7	23,0	16,4	31,7	3,8	11,2	2,8	30,1	6,4	*502*
Altria Group Inc	USD	3	Baa	Consumer, Non-cyclical	32,9	-26,6	73,1	14,1	110,1	39,1	224,3	48,4	77,2	8,9	181,1	46,9	*484*
American Express Co	USD	5	A	Financial	16,4	3,3	27,6	5,1	25,3	17,3	32,9	4,1	8,8	-2,7	19,2	4,9	*487*
Arcelor	EUR	3	Baa	Basic Materials	0,3	-24,4	17,4	6,7	37,7	17,2	79,5	15,6	37,5	16,1	96,4	19,2	*477*
Arcelor	EUR	5	Baa	Basic Materials	0,3	-23,9	18,2	6,4	53,0	31,3	89,2	14,5	52,7	27,0	101,3	16,0	*495*
Assicurazioni Generali SpA	EUR	5	Aa	Financial	3,5	-7,1	18,1	6,3	19,6	13,9	27,3	3,5	16,1	1,7	30,6	6,9	*499*
Banca Intesa SpA	EUR	5	A	Financial	1,0	-7,7	9,9	4,4	17,5	12,0	31,0	4,2	16,5	5,1	33,9	6,4	*501*
Bank of America Corp	USD	5	Aa	Financial	13,3	5,4	22,1	2,9	20,1	12,4	28,0	3,8	6,8	-4,9	16,3	3,6	*498*
Bayer AG	EUR	3	A	Basic Materials	0,3	-12,4	7,5	3,8	22,3	12,0	42,5	8,6	22,0	9,2	52,8	10,4	*499*
Bayer AG	EUR	5	A	Basic Materials	-0,4	-12,1	7,1	3,4	31,9	20,5	55,4	8,6	32,3	19,2	61,1	8,4	*500*
Bayerische Hypo-und Vereinsb	EUR	5	A	Financial	8,1	-6,9	21,6	4,2	24,5	15,3	38,8	5,3	16,4	0,5	38,8	7,2	*501*
Bayerische Motoren Werke AG	EUR	5	A	Consumer, Cyclical	7,4	-2,7	17,8	3,4	25,8	16,8	39,4	6,0	18,4	8,2	32,8	4,9	*498*
Bear Stearns Cos Inc/The	USD	5	A	Financial	7,6	-5,2	22,5	4,7	32,6	21,2	45,2	5,9	25,0	12,0	35,1	4,3	*501*
Bouygues	EUR	5	A	Industrial	-2,0	-13,7	6,9	3,4	29,8	19,7	45,0	5,8	31,9	17,8	52,8	6,7	*499*
Brazilian Government Interna	USD	3	BB	Government	60,5	-5,5	159,2	28,7	325,0	131,8	792,2	152,6	264,5	101,3	734,2	132,7	*496*
Brazilian Government Interna	USD	5	BB	Government	60,9	-29,5	153,2	34,8	434,6	221,0	902,7	155,6	373,8	151,1	782,7	150,3	*495*
British American Tobacco PLC	EUR	5	Baa	Consumer, Non-cyclical	-6,2	-20,6	1,2	3,7	57,8	35,0	101,4	13,8	64,1	37,6	103,5	15,2	*496*
Capital One Bank	USD	5	Baa	Financial	5,9	-9,9	30,2	8,6	49,1	24,2	76,3	13,7	43,2	23,3	71,5	11,6	*496*
Carrefour SA	EUR	5	A	Consumer, Non-cyclical	5,4	-2,3	20,2	3,4	23,6	17,4	36,4	4,2	18,2	8,9	26,9	4,1	*500*
Casino Guichard Perrachon SA	EUR	3	Baa	Consumer, Non-cyclical	-0,1	-19,9	18,8	6,3	54,9	33,3	96,6	10,1	55,0	30,2	90,9	12,7	*501*
Casino Guichard Perrachon SA	EUR	5	Baa	Consumer, Non-cyclical	1,6	-18,6	19,9	7,1	79,3	51,6	141,0	17,8	77,7	47,9	133,6	21,6	*502*
Cie de Saint-Gobain	EUR	5	A	Industrial	-0,3	-8,8	11,8	3,6	32,4	23,0	52,4	5,6	32,7	19,0	51,4	5,8	*497*
CIT Group Inc	USD	5	A	Financial	11,5	-5,1	30,2	5,5	40,7	25,5	58,3	8,3	29,2	14,3	42,4	5,7	*488*
Citigroup Inc	USD	3	Aa	Financial	10,3	-2,0	20,1	3,4	12,5	7,5	20,3	3,4	2,2	-7,4	13,0	3,5	*500*
Citigroup Inc	USD	5	Aa	Financial	8,0	-8,8	17,8	3,8	19,5	12,0	26,4	3,7	11,5	-1,5	25,2	5,7	*502*
Colombia Government Internat	USD	3	BB	Government	99,8	24,1	209,0	44,8	250,2	90,4	524,5	94,0	150,5	38,8	383,3	58,3	*490*
Colombia Government Internat	USD	5	BB	Government	116,8	50,4	216,5	39,1	357,7	166,4	642,5	100,4	240,9	102,5	453,0	68,9	*490*
Comcast Cable Communications	USD	5	Baa	Communications	15,8	-2,8	35,3	6,7	55,3	25,8	85,8	16,0	39,5	9,8	69,8	12,9	*491*
Commerzbank AG	EUR	5	A	Financial	9,9	-0,8	19,7	3,1	21,9	15,1	34,7	5,1	12,0	2,4	28,9	4,6	*501*
Compagnie Generale des Etabl	EUR	5	Baa	Consumer, Cyclical	-1,8	-20,3	19,6	5,7	41,3	28,9	69,2	8,0	43,1	24,6	71,8	10,0	*501*
Countrywide Home Loans Inc	USD	5	A	Financial	15,9	-1,5	30,6	6,8	49,7	34,9	66,4	6,9	33,8	20,1	45,0	4,2	*490*
DaimlerChrysler AG	EUR	3	Baa	Consumer, Cyclical	9,8	-2,0	26,7	5,3	54,5	30,7	127,6	16,2	44,7	22,7	116,4	14,2	*498*
DaimlerChrysler AG	EUR	5	Baa	Consumer, Cyclical	20,5	8,4	39,5	7,1	79,8	52,0	170,9	17,8	59,3	37,6	142,0	14,3	*499*
DaimlerChrysler AG	USD	5	Baa	Consumer, Cyclical	-1,4	-48,2	20,5	7,6	80,2	52,0	197,8	19,2	81,6	43,2	195,5	22,5	*458*
Deere & Co	USD	5	A	Industrial	12,0	-7,3	23,0	4,6	25,2	19,7	34,6	4,4	13,2	-0,4	28,1	6,1	*498*
Deutsche Bank AG	EUR	5	Aa	Financial	9,8	1,1	19,4	3,1	16,7	13,1	21,5	2,1	7,0	-3,3	20,1	4,4	*503*
Deutsche Telekom AG	EUR	3	A	Communications	0,9	-12,6	19,8	7,7	29,4	12,8	57,3	9,9	28,5	7,3	64,7	13,3	*494*
Deutsche Telekom AG	EUR	5	A	Communications	4,9	-3,5	16,9	4,3	44,0	23,8	74,5	10,2	39,1	23,3	70,6	9,8	*499*
Deutsche Telekom AG	EUR	10	A	Communications	7,0	-3,2	18,0	3,9	68,0	43,0	95,9	9,6	61,0	36,0	97,2	10,5	*481*
Electricite de France	EUR	5	Aa	Utilities	11,6	-5,3	23,3	6,3	21,9	14,8	32,3	5,0	10,3	-6,8	27,6	8,4	*496*
Enel SpA	EUR	5	Aa	Utilities	18,5	7,9	28,2	5,2	22,9	16,1	32,8	5,1	4,4	-5,0	14,6	4,0	*497*
Energias de Portugal SA	EUR	5	Aa	Utilities	0,4	-20,4	11,3	4,9	27,3	19,5	42,3	6,1	26,9	12,8	51,8	9,8	*497*
Fannie Mae	USD	5	Aaa	Financial	26,2	16,9	34,4	3,3	19,8	9,0	30,1	4,6	-6,4	-15,1	3,0	4,5	*480*
Fiat SpA	EUR	3	Ba	Consumer, Cyclical	88,3	-59,2	221,4	63,7	353,7	198,7	629,0	93,9	265,4	165,2	569,2	74,3	*493*
Fiat SpA	EUR	5	Ba	Consumer, Cyclical	77,6	-13,5	196,2	47,2	419,3	303,5	711,8	76,9	341,7	238,5	599,7	68,7	*499*
Ford Motor Credit Co	EUR	5	Baa	Financial	37,8	-3,0	145,3	26,8	286,2	140,2	673,3	139,8	248,4	106,5	560,6	121,2	*495*
Ford Motor Credit Co	USD	3	Baa	Financial	26,0	-49,1	188,6	39,2	216,4	88,3	628,2	130,7	190,4	88,6	539,9	101,7	*466*
Ford Motor Credit Co	USD	5	Baa	Financial	45,3	-11,4	172,9	34,5	283,4	138,5	651,0	137,9	238,1	130,4	505,6	109,0	*499*
Fortis Bank SA/NV	EUR	5	A	Financial	11,6	3,4	28,5	3,8	20,8	13,3	34,7	2,6	9,2	-0,8	16,2	3,3	*495*
Fortum Power & Heat AB	EUR	5	A	Utilities	-0,4	-27,7	14,6	7,3	30,5	19,0	44,3	6,3	30,9	9,7	56,7	10,7	*494*
France Telecom SA	EUR	3	A	Communications	9,6	-1,2	23,6	3,9	32,1	13,7	59,7	10,3	22,5	11,5	47,6	7,8	*495*
France Telecom SA	EUR	5	A	Communications	8,8	-9,2	23,1	5,4	47,8	26,0	75,6	10,2	39,0	20,8	84,9	12,7	*496*
France Telecom SA	EUR	10	A	Communications	-4,0	-26,7	19,9	6,7	74,9	46,9	100,3	8,7	78,9	45,2	111,3	11,4	*467*
Freddie Mac	USD	5	Aaa	Financial	28,7	19,5	44,0	4,3	17,5	7,2	30,0	5,9	-11,2	-27,5	2,8	6,8	*482*
General Electric Co	USD	5	Aaa	Industrial	18,2	2,7	31,2	4,6	26,7	18,0	42,1	4,6	8,5	-0,3	19,2	4,2	*498*
General Motors Acceptance Co	EUR	5	Ba	Financial	34,3	-8,5	115,9	20,7	303,2	110,5	764,8	162,5	268,8	102,9	649,0	152,6	*494*
General Motors Acceptance Co	USD	3	Ba	Financial	65,2	-21,5	274,2	66,6	247,4	78,8	681,6	160,2	182,2	79,0	496,2	104,2	*470*
General Motors Acceptance Co	USD	5	Ba	Financial	62,2	-10,3	254,0	56,5	302,9	110,8	754,6	162,4	240,7	115,1	501,2	111,4	*500*
GlaxoSmithKline PLC	EUR	5	Aa	Consumer, Non-cyclical	14,0	0,6	23,4	4,1	13,1	8,5	28,9	3,2	-1,0	-12,2	18,1	6,0	*496*
Goldman Sachs Group Inc	USD	3	Aa	Financial	11,6	-0,9	27,1	5,6	20,0	12,3	29,5	5,2	8,3	-4,5	20,0	4,6	*496*
Goldman Sachs Group Inc	USD	5	Aa	Financial	3,2	-6,0	16,5	3,7	30,9	20,5	42,3	5,1	27,7	13,1	41,1	6,4	*502*
Groupe Danone	EUR	3	A	Consumer, Non-cyclical	3,8	-9,6	15,2	3,9	14,0	7,1	24,3	5,7	10,2	2,0	21,1	3,8	*497*
HBOS PLC	EUR	5	Aa	Financial	7,5	-3,7	17,1	4,0	12,7	9,8	17,6	2,1	5,2	-5,5	16,9	5,4	*486*
Honeywell International Inc	USD	5	A	Industrial	6,6	-22,1	22,3	6,7	23,7	15,4	44,3	7,3	17,1	0,0	47,5	10,9	*499*
Iberdrola SA	EUR	5	A	Utilities	4,1	-8,7	10,6	2,5	24,2	18,2	33,2	3,7	20,1	11,7	33,4	4,2	*498*
ING Bank NV	EUR	5	Aa	Financial	5,9	-1,8	14,0	2,9	11,9	7,8	20,3	3,3	6,0	-4,5	19,2	4,7	*500*
International Lease Finance	USD	5	A	Financial	-0,1	-14,7	18,4	6,5	39,0	25,1	57,4	6,9	39,2	23,6	58,3	7,3	*487*
John Deere Capital Corp	USD	5	A	Financial	15,1	-0,6	33,7	4,3	28,2	21,5	46,3	4,6	13,2	-0,4	26,8	6,1	*466*
JPMorgan Chase & Co	USD	5	A	Financial	21,4	-2,6	31,8	5,4	29,1	20,0	41,4	4,8	7,7	-4,7	23,6	6,2	*499*
Koninklijke Ahold NV	EUR	5	Ba	Consumer, Non-cyclical	10,9	-15,4	43,6	13,5	166,2	79,6	285,2	53,6	155,3	81,6	277,1	53,2	*498*
Koninklijke Philips Electron	EUR	5	Baa	Industrial	-0,8	-17,8	8,4	3,8	37,2	30,6	54,7	4,9	38,0	23,9	64,4	7,3	*499*
Korea Development Bank	USD	5	A	Financial	1,9	-15,4	22,3	7,2	41,8	23,5	75,9	13,0	39,9	16,4	68,0	13,0	*497*
Kraft Foods Inc	USD	5	Baa	Consumer, Non-cyclical	6,8	-6,9	21,3	4,9	31,6	20,7	54,3	7,1	24,8	8,5	41,6	7,0	*493*
Lafarge SA	EUR	3	Baa	Industrial	4,4	-6,9	13,9	4,0	31,1	19,2	64,9	9,2	26,8	13,9	65,2	11,2	*462*
Lehman Brothers Holdings Inc	USD	5	A	Financial	8,4	-3,9	23,0	4,4	32,7	24,1	43,2	5,3	24,3	9,4	37,0	5,7	*499*
LVMH Moet Hennessy Louis Vui	EUR	5	Baa	Diversified	-0,1	-17,5	9,7	3,6	37,6	28,8	58,5	7,3	37,7	25,2	63,1	7,2	*500*
Malaysia Government Internat	USD	5	A	Government	4,9	-15,6	26,8	8,5	33,8	21,4	67,2	8,8	29,0	0,5	60,8	14,3	*500*
MBNA America Bank NA	USD	5	Baa	Financial	7,9	-10,6	31,8	7,2	34,6	10,0	57,8	14,1	26,7	3,5	46,0	11,8	*455*
Merrill Lynch & Co Inc	USD	3	Aa	Financial	12,3	0,9	34,6	5,2	19,4	11,5	33,5	5,4	7,1	-4,3	23,6	3,9	*489*
Merrill Lynch & Co Inc	USD	5	Aa	Financial	10,1	1,0	21,9	3,4	30,6	21,0	40,9	4,8	20,5	8,7	31,8	5,2	*500*
Metro AG	EUR	3	Baa	Consumer, Non-cyclical	-2,2	-20,2	10,4	4,6	34,9	20,6	67,9	10,7	37,1	18,1	86,5	13,8	*494*
Metro AG	EUR	5	Baa	Consumer, Non-cyclical	2,5	-13,1	11,7	3,6	49,6	38,0	78,3	8,2	47,1	32,1	86,5	9,6	*495*
Mexico Government Internatio	USD	3	Baa	Government	27,0	-1,8	63,7	11,4	65,2	36,3	139,5	18,0	38,2	6,3	81,2	18,0	*495*
Mexico Government Internatio	USD	5	Baa	Government	21,6	-6,4	52,4	11,7	100,1	58,3	200,6	25,4	78,4	19,7	176,9	27,5	*495*
Morgan Stanley	USD	3	Aa	Financial	1,4	-15,7	19,4	6,1	19,3	11,8	30,0	5,2	17,9	6,1	32,2	4,9	*494*
MTR Corp	USD	5	Aa	Industrial	-2,8	-18,0	12,4	5,9	19,8	10,3	39,3	7,3	22,6	0,9	47,7	11,4	*473*
National Grid PLC	EUR	5	Baa	Utilities	-1,9	-12,0	7,9	3,8	31,1	22,1	47,9	7,9	32,9	17,0	57,5	9,7	*498*
Peru Government Internationa	USD	3	Ba	Government	76,6	17,3	194,6	34,5	187,7	81,1	439,5	84,9	111,1	28,2	342,1	62,0	*489*
Peru Government Internationa	USD	5	Ba	Government	108,0	47,4	259,6	48,2	277,0	127,4	605,8	111,4	169,0	52,7	402,3	70,4	*489*
Peugeot SA	EUR	3	A	Consumer, Cyclical	3,3	-4,9	23,1	4,9	22,4	10,4	46,7	8,2	19,1	7,0	32,7	4,7	*499*
Peugeot SA	EUR	5	A	Consumer, Cyclical	5,0	-4,5	22,0	4,9	33,1	20,2	59,8	8,8	28,2	16,0	44,3	5,5	*500*
Philippine Government Intern	USD	5	Ba	Government	114,2	51,9	216,5	31,4	429,3	269,0	537,0	66,8	315,1	158,6	415,5	50,7	*501*
Philippine Government Intern	USD	10	Ba	Government	136,7	70,6	229,1	31,5	504,6	354,5	610,0	57,2	368,0	247,8	444,2	40,4	*436*
Poland Government Internatio	USD	10	A	Government	8,8	-5,2	25,1	6,4	31,8	17,4	63,3	11,6	23,0	0,8	57,0	13,2	*491*
Portugal Telecom SGPS SA	EUR	5	A	Communications	3,2	-11,6	14,0	4,2	31,8	17,2	49,4	8,4	28,6	13,2	45,7	7,7	*502*
PPR SA	EUR	5	Baa	Consumer, Cyclical	5,5	-6,8	25,4	7,0	96,5	56,9	182,0	34,5	91,0	51,2	165,8	29,3	*495*
Rabobank Nederland	EUR	5	Aaa	Financial	13,7	-4,7	42,6	8,6	8,2	6,8	10,3	0,6	-5,6	-34,5	12,5	8,5	*498*
Renault SA	EUR	3	Baa	Consumer, Cyclical	2,6	-6,9	12,4	3,2	28,1	17,0	48,2	6,9	25,6	13,4	44,3	7,3	*498*
Renault SA	EUR	5	Baa	Consumer, Cyclical	0,8	-11,3	12,6	4,2	40,8	30,0	62,3	6,9	40,0	22,5	63,6	9,3	*500*
Repsol YPF SA	EUR	3	Baa	Energy	1,5	-11,0	14,1	4,3	27,5	15,5	51,5	9,0	26,0	12,9	44,0	7,1	*499*
Republic of Chile	USD	3	A	Government	0,7	-25,2	19,8	8,0	20,2	11,3	38,5	6,2	19,5	-0,7	53,7	11,8	*469*
Republic of Chile	USD	5	A	Government	7,5	-10,8	27,7	7,4	31,5	16,5	61,9	12,2	23,9	1,8	52,4	10,8	*468*
Republic of Korea	USD	3	A	Government	20,0	-29,7	71,5	21,6	29,4	14,0	57,2	9,8	9,4	-52,2	69,3	30,0	*500*
Republic of Korea	USD	10	A	Government	19,2	-12,1	66,7	19,8	56,2	35,0	95,2	13,6	37,0	1,6	57,5	8,8	*441*
Republic of Turkey	USD	3	Ba	Government	45,8	-13,6	125,0	22,3	243,9	89,1	612,5	106,5	198,1	64,4	500,2	95,3	*496*
Republic of Turkey	USD	5	Ba	Government	65,9	15,1	126,8	22,7	319,4	152,8	687,5	109,2	253,5	98,1	562,4	97,8	*496*
Republic of Turkey	USD	10	Ba	Government	111,5	50,7	279,1	40,0	378,1	221,8	722,3	102,8	266,6	155,5	468,7	68,1	*481*
Rolls-Royce Group PLC	EUR	3	Baa	Industrial	3,2	-11,8	16,9	4,2	30,0	12,5	69,8	12,1	26,7	11,0	67,2	12,2	*498*
Royal KPN NV	EUR	5	Baa	Communications	4,7	-6,8	25,2	6,5	44,5	27,7	86,3	10,7	39,8	25,4	83,7	9,0	*502*
RWE AG	EUR	3	A	Utilities	3,8	-8,2	11,3	2,5	15,0	8,7	33,2	5,5	11,2	0,5	35,9	5,9	*497*
RWE AG	EUR	5	A	Utilities	5,1	-5,2	11,8	2,2	22,4	16,6	40,5	5,1	17,3	7,1	41,7	5,7	*498*
Siemens AG	EUR	3	Aa	Industrial	4,8	-6,5	17,1	4,2	13,9	7,8	24,5	4,2	9,2	-4,7	23,2	5,6	*498*
South Africa Government Inte	USD	5	Baa	Government	6,5	-18,8	29,4	6,6	79,2	40,8	164,3	28,4	72,6	30,4	151,1	27,7	*495*
South Africa Government Inte	USD	10	Baa	Government	26,1	-4,9	60,9	12,8	118,3	68,4	223,0	38,1	92,3	44,3	163,4	29,1	*454*
Suez SA	EUR	3	A	Utilities	5,1	-7,1	17,8	4,0	24,0	12,0	47,5	9,2	18,9	6,6	42,6	7,7	*498*
Suez SA	EUR	5	A	Utilities	4,3	-11,3	15,5	3,9	34,8	21,6	58,8	9,4	30,5	15,6	57,5	10,1	*498*
TDC A/S	EUR	5	Baa	Communications	-0,1	-32,2	45,8	11,4	90,9	28,3	328,3	81,8	91,0	27,1	302,5	72,7	*496*
Telecom Italia SpA	EUR	3	Baa	Communications	3,9	-11,4	19,7	5,9	40,5	19,0	80,3	11,7	36,6	16,2	86,4	12,7	*498*
Telecom Italia SpA	EUR	5	Baa	Communications	6,5	-6,0	18,7	4,6	57,3	34,0	98,6	10,5	50,8	33,0	95,4	10,5	*501*
Telecom Italia SpA	EUR	10	Baa	Communications	8,3	-8,2	20,0	5,1	84,5	55,0	123,3	9,6	76,2	49,8	112,7	9,5	*471*
Telefonica SA	EUR	3	A	Communications	7,9	-3,1	24,2	5,6	25,4	12,5	43,0	8,0	17,4	8,2	33,2	4,8	*499*
Telefonica SA	EUR	5	A	Communications	13,1	-3,5	25,9	4,7	38,3	23,5	57,9	8,2	25,3	14,4	44,3	5,1	*498*
Tesco PLC	EUR	5	A	Consumer, Non-cyclical	2,3	-10,2	16,7	4,3	19,7	16,2	24,9	2,1	17,4	6,0	27,0	3,7	*501*
ThyssenKrupp AG	EUR	5	Baa	Basic Materials	3,1	-12,5	22,7	6,7	87,2	43,1	146,3	26,9	84,1	33,9	156,6	26,4	*497*
Total SA	EUR	3	Aa	Energy	7,5	-1,8	16,1	2,8	8,0	6,0	10,8	1,0	0,5	-7,2	8,3	2,3	*498*
Total SA	EUR	5	Aa	Energy	6,9	-1,7	15,0	3,1	10,5	8,4	13,4	1,3	3,6	-5,2	12,0	3,5	*499*
Unilever NV	EUR	3	A	Consumer, Non-cyclical	4,4	-3,6	14,1	3,0	12,8	5,8	26,0	5,2	8,4	-3,7	19,8	4,1	*495*
Usinor SA	EUR	5	Baa	Basic Materials	0,1	-23,9	16,1	6,4	53,0	31,3	89,2	14,6	52,8	27,0	101,3	16,2	*477*
Vattenfall AB	EUR	3	A	Utilities	2,0	-9,9	9,8	2,9	18,9	11,2	32,3	5,4	16,9	4,1	31,1	6,4	*496*
Vattenfall AB	EUR	5	A	Utilities	3,4	-14,2	17,1	5,1	27,8	19,0	42,0	6,0	24,4	2,1	42,3	9,3	*497*
Veolia Environnement	EUR	5	Baa	Utilities	5,6	-12,6	21,2	5,2	37,3	23,8	63,5	9,4	31,8	11,6	64,0	10,4	*498*
Vodafone Group PLC	EUR	3	A	Communications	4,6	-8,3	16,5	4,2	20,3	10,3	37,7	7,3	15,7	3,6	42,5	8,4	*498*
Vodafone Group PLC	EUR	5	A	Communications	6,5	-5,8	17,9	4,1	30,4	19,2	48,6	6,8	23,9	11,9	47,4	7,0	*499*
Vodafone Group PLC	EUR	10	A	Communications	15,5	-7,5	27,5	4,8	48,4	34,7	64,3	6,3	32,9	17,2	55,2	7,0	*484*
Volkswagen AG	EUR	3	A	Consumer, Cyclical	9,8	2,1	21,2	4,1	41,9	24,5	70,4	10,5	32,1	14,0	52,3	9,4	*495*
Volkswagen AG	EUR	5	A	Consumer, Cyclical	13,6	0,6	27,0	4,2	59,6	42,9	93,2	9,8	46,0	27,9	79,9	8,6	*498*
Wal-Mart Stores Inc	USD	5	Aa	Consumer, Cyclical	8,7	-2,5	16,7	4,0	14,7	8,7	19,0	2,5	6,0	-5,9	21,1	5,3	*483*
Walt Disney Co	USD	3	Baa	Communications	5,2	-15,1	30,3	7,6	25,1	11,4	58,3	11,6	19,9	2,7	39,3	9,9	*486*
Washington Mutual Inc	USD	5	A	Financial	15,1	-0,5	39,3	7,4	42,2	27,9	60,7	5,9	27,2	11,3	42,7	6,3	*486*
Wells Fargo & Co	USD	5	Aa	Financial	13,5	1,9	25,2	4,1	18,3	10,2	27,5	4,5	4,8	-8,0	15,9	4,2	*481*

Appendix 2 – Descriptive basis statistics by subset of the dataset

(in basis points)

By rating

		Average	Minimum	Maximum	Standard Deviation	*pm: Number of observations*
2004-2005	Aaa	21,6	-4,7	44,0	8,2	*1.958*
	Aa	8,7	-18,0	34,6	6,2	*11.891*
	A	6,6	-29,7	71,5	8,6	*28.127*
	Baa	8,1	-49,1	188,6	16,3	*20.109*
	Ba	74,5	-76,0	279,1	52,8	*8.762*
2004	Aaa	19,2	-4,7	34,4	9,2	*948*
	Aa	7,8	-18,0	34,6	7,0	*5.772*
	A	5,4	-29,7	66,7	9,0	*13.602*
	Baa	6,0	-49,1	73,1	13,0	*9.785*
	Ba	80,8	-76,0	279,1	60,2	*4.253*
2005	Aaa	23,9	7,4	44,0	6,4	*1.010*
	Aa	9,5	-14,9	24,4	5,3	*6.119*
	A	7,7	-26,7	71,5	8,0	*14.525*
	Baa	10,1	-48,2	188,6	18,7	*10.324*
	Ba	68,7	-59,2	274,2	44,0	*4.509*

By sector

		Average	Minimum	Maximum	Standard Deviation	pm: Number of observations
2004-2005	Basic Materials	-0,1	-24,4	22,7	5,8	3.445
	Consumer, Cyclical	16,7	-59,2	221,4	34,0	7.414
	Consumer, Non-cyclical	5,8	-26,6	73,1	11,5	6.452
	Communications	6,6	-76,0	79,2	9,4	9.806
	Diversified	-0,1	-17,5	9,7	3,6	500
	Energy	5,3	-11,0	16,1	4,4	1.496
	Financial	15,4	-49,1	274,2	22,6	20.184
	Industrial	4,4	-22,1	31,2	7,8	4.921
	Utilities	4,7	-27,7	28,2	6,8	6.462
	Government	*54,2*	*-29,7*	*279,1*	*51,1*	*10.167*
2004	Basic Materials	-2,4	-24,4	18,4	6,3	1.682
	Consumer, Cyclical	19,1	-37,9	221,4	38,6	3.611
	Consumer, Non-cyclical	5,4	-26,6	73,1	11,7	3.139
	Communications	6,2	-76,0	79,2	11,5	4.749
	Diversified	-0,4	-17,5	8,5	3,8	243
	Energy	5,0	-11,0	16,1	4,9	727
	Financial	11,0	-49,1	58,6	10,7	9.853
	Industrial	2,6	-22,1	31,2	8,4	2.371
	Utilities	3,3	-27,7	28,2	7,9	3.140
	Government	*61,6*	*-29,7*	*279,1*	*61,7*	*4.845*
2005	Basic Materials	2,0	-9,3	22,7	4,3	1.763
	Consumer, Cyclical	14,4	-59,2	203,1	28,8	3.803
	Consumer, Non-cyclical	6,2	-16,8	62,5	11,2	3.313
	Communications	7,0	-32,2	45,8	7,0	5.057
	Diversified	0,1	-7,3	9,7	3,5	257
	Energy	5,6	-4,3	15,0	3,8	769
	Financial	19,6	-21,5	274,2	29,2	10.331
	Industrial	6,0	-10,9	23,9	6,8	2.550
	Utilities	6,1	-4,6	24,4	5,2	3.322
	Government	*47,4*	*-12,1*	*173,8*	*37,8*	*5.322*

By currency

		Average	Minimum	Maximum	Standard Deviation	*pm: Number of observations*
2004-2005	EUR	7,5	-76,0	221,4	17,4	*42.607*
	USD	29,3	-49,1	279,1	40,4	*28.240*
2004	EUR	6,8	-76,0	221,4	19,3	*20.692*
	USD	29,0	-49,1	279,1	44,9	*13.668*
2005	EUR	8,2	-59,2	203,1	15,3	*21.915*
	USD	29,5	-48,2	274,2	35,6	*14.572*

By term

		Average	Minimum	Maximum	Standard Deviation	*pm: Number of observations*
2004-2005	3	16,9	-76,0	274,2	32,1	*20.144*
	5	14,1	-48,2	259,6	26,8	*46.497*
	10	35,8	-26,7	279,1	51,0	*4.206*
2004	3	16,9	-76,0	221,4	34,6	*9.807*
	5	13,0	-29,5	259,6	29,4	*22.607*
	10	40,9	-17,9	279,1	58,1	*1.946*
2005	3	16,9	-59,2	274,2	29,6	*10.337*
	5	15,2	-48,2	254,0	24,0	*23.890*
	10	31,5	-26,7	173,8	43,4	*2.260*

Appendix 3 - Individual cointegration analysis and unit root testing

			Basis			CDS premium			Asset swap spread		
Entity	Currency	Term	test statistic	p-value	conclusion	test statistic	p-value	conclusion	test statistic	p-value	conclusion
ABN Amro Bank NV	EUR	5	-1,79	0,38	Not cointegrated	-0,64	0,86	Unit root***	-0,72	0,84	Unit root***
Koninklijke Ahold NV	EUR	5	-2,05	0,27	Not cointegrated	-1,56	0,50	Unit root***	-1,43	0,57	Unit root***
Akzo Nobel NV	EUR	5	-4,09	0,00	Cointegrated***	-0,09	0,95	Unit root***	-1,16	0,69	Unit root***
Alcatel SA	EUR	3	-2,81	0,06	Cointegrated*	-2,22	0,20	Unit root***	2,61	0,09	Unit root***
Allianz AG	EUR	3	-2,42	0,14	Not cointegrated	-1,16	0,69	Unit root***	-1,40	0,58	Unit root***
Allianz AG	EUR	5	-2,06	0,26	Not cointegrated	-1,51	0,53	Unit root***	-1,25	0,65	Unit root***
Assicurazioni Generali SpA	EUR	5	-1,51	0,53	Not cointegrated	-1,09	0,72	Unit root***	-1,63	0,47	Unit root***
American Express Co	USD	5	-2,97	0,04	Cointegrated**	-1,44	0,56	Unit root***	-2,68	0,08	Unit root**
Bank of America Corp	USD	5	-4,31	0,00	Cointegrated***	-1,21	0,67	Unit root***	-3,10	0,03	Unit root*
British American Tobacco PLC	EUR	5	-3,69	0,00	Cointegrated***	-1,26	0,65	Unit root***	-1,32	0,62	Unit root***
Bayer AG	EUR	3	-1,88	0,34	Not cointegrated	-1,18	0,69	Unit root***	-1,14	0,70	Unit root***
Bayer AG	EUR	5	-2,91	0,05	Cointegrated**	-1,30	0,64	Unit root***	-1,55	0,51	Unit root***
Banca Intesa SpA	EUR	5	-0,89	0,79	Not cointegrated	-1,00	0,75	Unit root***	0,01	0,96	Unit root***
Fortum Power & Heat AB	EUR	5	-2,75	0,07	Cointegrated*	-1,97	0,30	Unit root***	-1,23	0,66	Unit root***
Bayerische Motoren Werke AG	EUR	5	-2,31	0,17	Not cointegrated	-0,62	0,86	Unit root***	-1,27	0,64	Unit root***
Bouygues	EUR	5	-2,53	0,11	Not cointegrated	-0,81	0,81	Unit root***	-1,88	0,34	Unit root***
Brazilian Government Interna	USD	3	-3,51	0,01	Cointegrated***	-0,75	0,83	Unit root***	-1,33	0,62	Unit root***
Brazilian Government Interna	USD	5	-2,00	0,29	Not cointegrated	-0,71	0,84	Unit root***	-0,72	0,84	Unit root***
Bear Stearns Cos Inc/The	USD	5	-3,31	0,01	Cointegrated**	-1,16	0,69	Unit root***	-3,05	0,03	Unit root*
Groupe Danone	EUR	3	-1,51	0,53	Not cointegrated	-0,65	0,86	Unit root***	-1,24	0,66	Unit root***
Carrefour SA	EUR	5	-2,49	0,12	Not cointegrated	-1,46	0,55	Unit root***	-2,90	0,05	Unit root*
Casino Guichard Perrachon SA	EUR	3	-3,00	0,04	Cointegrated**	-2,91	0,05	Unit root*	-1,74	0,41	Unit root***
Casino Guichard Perrachon SA	EUR	5	-2,68	0,08	Cointegrated*	-2,20	0,21	Unit root***	-1,23	0,66	Unit root***
Comcast Cable Communications	USD	5	-4,29	0,00	Cointegrated***	-1,25	0,65	Unit root***	-1,12	0,71	Unit root***
Countrywide Home Loans Inc	USD	5	-2,48	0,12	Not cointegrated	-2,29	0,18	Unit root***	-3,53	0,01	Stationary
Citigroup Inc	USD	3	-3,92	0,00	Cointegrated***	-1,25	0,65	Unit root***	-3,28	0,02	Unit root*
Citigroup Inc	USD	5	-4,86	0,00	Cointegrated***	-0,91	0,78	Unit root***	-2,61	0,09	Unit root**
Republic of Chile	USD	3	-3,33	0,01	Cointegrated**	-2,89	0,05	Unit root*	-1,89	0,34	Unit root***
Republic of Chile	USD	5	-3,67	0,00	Cointegrated***	-2,65	0,08	Unit root**	-1,11	0,71	Unit root***
CIT Group Inc	USD	5	-3,51	0,00	Cointegrated***	-1,49	0,54	Unit root***	-2,85	0,05	Unit root**
Commerzbank AG	EUR	5	-2,45	0,13	Not cointegrated	-0,86	0,80	Unit root***	-0,93	0,78	Unit root***
Capital One Bank	USD	5	-2,56	0,10	Not cointegrated	-1,33	0,62	Unit root***	-2,10	0,24	Unit root***
Colombia Government Internat	USD	3	-1,34	0,61	Not cointegrated	-0,84	0,81	Unit root***	-2,07	0,26	Unit root***
Colombia Government Internat	USD	5	-1,79	0,38	Not cointegrated	-0,93	0,78	Unit root***	-0,94	0,78	Unit root***
Deutsche Bank AG	EUR	5	-0,93	0,78	Not cointegrated	-1,76	0,40	Unit root***	-0,42	0,90	Unit root***
DaimlerChrysler AG	EUR	3	-3,34	0,01	Cointegrated**	-2,46	0,13	Unit root***	-2,15	0,22	Unit root***
DaimlerChrysler AG	EUR	5	-2,74	0,07	Cointegrated*	-2,52	0,11	Unit root***	-3,06	0,03	Unit root*
DaimlerChrysler AG	USD	5	-4,26	0,00	Cointegrated***	-2,02	0,28	Unit root***	-2,19	0,21	Unit root***
Deere & Co	USD	5	-4,45	0,00	Cointegrated***	-1,45	0,56	Unit root***	-2,90	0,05	Unit root*
John Deere Capital Corp	USD	5	-7,23	0,00	Cointegrated***	-1,86	0,35	Unit root***	-2,77	0,06	Unit root**
Walt Disney Co	USD	3	-2,14	0,23	Not cointegrated	-1,54	0,51	Unit root***	-1,73	0,41	Unit root***
Deutsche Telekom AG	EUR	10	-3,74	0,00	Cointegrated***	-1,98	0,29	Unit root***	-2,10	0,24	Unit root***
Deutsche Telekom AG	EUR	3	-1,86	0,35	Not cointegrated	-1,22	0,67	Unit root***	-0,86	0,80	Unit root***
Deutsche Telekom AG	EUR	5	-2,19	0,21	Not cointegrated	-1,68	0,44	Unit root***	-1,66	0,45	Unit root***
Electricite de France	EUR	5	-1,44	0,56	Not cointegrated	-0,68	0,85	Unit root***	-0,37	0,91	Unit root***
Enel SpA	EUR	5	-0,73	0,84	Not cointegrated	-0,93	0,78	Unit root***	-1,58	0,49	Unit root***
Energias de Portugal SA	EUR	5	-2,12	0,24	Not cointegrated	-1,13	0,71	Unit root***	-0,72	0,84	Unit root***
Freddie Mac	USD	5	-2,82	0,06	Cointegrated*	-0,02	0,96	Unit root***	-2,18	0,22	Unit root***
Fiat SpA	EUR	3	-2,80	0,06	Cointegrated*	-2,24	0,19	Unit root***	-1,60	0,48	Unit root***
Fiat SpA	EUR	5	-2,23	0,20	Not cointegrated	-2,09	0,25	Unit root***	-1,27	0,65	Unit root***
Ford Motor Credit Co	EUR	5	-1,74	0,41	Not cointegrated	-0,94	0,77	Unit root***	-0,73	0,84	Unit root***
Ford Motor Credit Co	USD	3	0,18	0,97	Not cointegrated	1,84	1,00	Unit root***	-0,17	0,94	Unit root***
Ford Motor Credit Co	USD	5	-1,34	0,61	Not cointegrated	-0,59	0,87	Unit root***	-0,36	0,91	Unit root***
Fannie Mae	USD	5	-3,91	0,00	Cointegrated***	-0,54	0,88	Unit root***	-1,95	0,31	Unit root***
Fortis Bank SA/NV	EUR	5	-3,06	0,03	Cointegrated**	-3,32	0,01	Unit root*	-0,52	0,88	Unit root***
France Telecom SA	EUR	10	-4,25	0,00	Cointegrated***	-1,87	0,35	Unit root***	-3,09	0,03	Unit root*
France Telecom SA	EUR	3	-3,76	0,00	Cointegrated***	-1,91	0,33	Unit root***	-2,05	0,27	Unit root***
France Telecom SA	EUR	5	-1,56	0,50	Not cointegrated	-1,75	0,41	Unit root***	-1,53	0,52	Unit root***
General Electric Co	USD	5	-4,24	0,00	Cointegrated***	-1,65	0,46	Unit root***	-3,06	0,03	Unit root*
General Motors Acceptance Co	EUR	5	-3,10	0,03	Cointegrated**	-1,62	0,47	Unit root***	-1,42	0,57	Unit root***
General Motors Acceptance Co	USD	3	-2,14	0,23	Not cointegrated	-1,51	0,53	Unit root***	-1,31	0,62	Unit root***
General Motors Acceptance Co	USD	5	-1,91	0,33	Not cointegrated	-1,43	0,57	Unit root***	-1,46	0,55	Unit root***
Cie de Saint-Gobain	EUR	5	-2,17	0,22	Not cointegrated	-1,22	0,67	Unit root***	-2,12	0,24	Unit root***
Goldman Sachs Group Inc	USD	3	-2,91	0,04	Cointegrated**	-1,51	0,53	Unit root***	-3,58	0,01	Stationary
Goldman Sachs Group Inc	USD	5	-4,91	0,00	Cointegrated***	-2,16	0,22	Unit root***	-2,90	0,05	Unit root*
GlaxoSmithKline PLC	EUR	5	-2,20	0,21	Not cointegrated	-1,60	0,48	Unit root***	-1,79	0,39	Unit root***
HBOS PLC	EUR	5	-2,03	0,28	Not cointegrated	-1,75	0,41	Unit root***	-1,94	0,31	Unit root***
Honeywell International Inc	USD	5	-4,17	0,00	Cointegrated***	-0,84	0,81	Unit root***	-2,39	0,15	Unit root***
Bayerische Hypo-und Vereinsb	EUR	5	-3,19	0,02	Cointegrated**	-0,67	0,85	Unit root***	-0,76	0,83	Unit root***
Iberdrola SA	EUR	5	-4,49	0,00	Cointegrated***	-1,39	0,59	Unit root***	-2,20	0,21	Unit root***
International Lease Finance	USD	5	-3,37	0,01	Cointegrated**	-1,52	0,47	Unit root***	-2,34	0,16	Unit root***
ING Bank NV	EUR	5	-2,70	0,07	Cointegrated*	-0,98	0,76	Unit root***	-1,77	0,40	Unit root***
JPMorgan Chase & Co	USD	5	-4,53	0,00	Cointegrated***	-2,03	0,27	Unit root***	-2,31	0,17	Unit root***
Korea Development Bank	USD	5	-3,19	0,02	Cointegrated**	-1,00	0,75	Unit root***	-1,41	0,58	Unit root***
Kraft Foods Inc	USD	5	-3,19	0,02	Cointegrated**	-1,19	0,68	Unit root***	-2,92	0,04	Unit root*
Royal KPN NV	EUR	5	-1,92	0,32	Not cointegrated	0,79	0,99	Unit root***	1,81	1,00	Unit root***
Republic of Korea	USD	10	-1,75	0,40	Not cointegrated	-1,17	0,69	Unit root***	-3,92	0,00	Stationary
Republic of Korea	USD	3	-1,24	0,66	Not cointegrated	-1,32	0,62	Unit root***	-0,75	0,83	Unit root***
Lafarge SA	EUR	3	-3,02	0,03	Cointegrated**	-0,96	0,77	Unit root***	-0,52	0,88	Unit root***
Lehman Brothers Holdings Inc	USD	5	-3,77	0,00	Cointegrated***	-1,31	0,63	Unit root***	-2,07	0,26	Unit root***
Arcelor	EUR	3	-3,52	0,00	Cointegrated***	-1,42	0,57	Unit root***	-1,77	0,39	Unit root***
Arcelor	EUR	5	-2,61	0,09	Cointegrated*	-1,59	0,49	Unit root***	-1,93	0,32	Unit root***
Suez SA	EUR	3	-3,23	0,02	Cointegrated**	-0,40	0,91	Unit root***	-1,99	0,29	Unit root***
Suez SA	EUR	5	-4,05	0,00	Cointegrated***	-0,24	0,93	Unit root***	-1,74	0,41	Unit root***
MBNA America Bank NA	USD	5	-2,89	0,05	Cointegrated**	-0,46	0,89	Unit root***	-1,30	0,63	Unit root***
Merrill Lynch & Co Inc	USD	3	-2,87	0,05	Cointegrated**	-2,32	0,17	Unit root***	-2,90	0,05	Unit root*
Merrill Lynch & Co Inc	USD	5	-4,98	0,00	Cointegrated***	-1,46	0,55	Unit root***	-2,58	0,10	Unit root**
Mexico Government Internatio	USD	3	-3,64	0,00	Cointegrated***	-1,41	0,58	Unit root***	-2,61	0,09	Unit root**
Mexico Government Internatio	USD	5	-3,23	0,02	Cointegrated**	-1,67	0,44	Unit root***	-1,43	0,57	Unit root***
Compagnie Generale des Etabl	EUR	5	-2,50	0,12	Not cointegrated	-2,47	0,12	Unit root***	-2,02	0,28	Unit root***
Malaysia Government Internat	USD	5	-2,50	0,12	Not cointegrated	-1,29	0,64	Unit root***	-1,31	0,63	Unit root***
Altria Group Inc	USD	3	-3,17	0,02	Cointegrated**	-0,84	0,81	Unit root***	-1,12	0,71	Unit root***
LVMH Moet Hennessy Louis Vui	EUR	5	-3,49	0,01	Cointegrated***	-0,61	0,87	Unit root***	-1,88	0,34	Unit root***
MTR Corp	USD	5	-4,33	0,00	Cointegrated***	-1,04	0,74	Unit root***	-2,00	0,29	Unit root***
Metro AG	EUR	3	-2,91	0,05	Cointegrated**	-1,45	0,56	Unit root***	-0,39	0,91	Unit root***
Metro AG	EUR	5	-4,13	0,00	Cointegrated***	-1,75	0,41	Unit root***	-0,76	0,83	Unit root***
Morgan Stanley	USD	3	-4,78	0,00	Cointegrated***	-1,68	0,44	Unit root***	-4,95	0,00	Stationary
National Grid PLC	EUR	5	-3,23	0,02	Cointegrated**	-1,20	0,68	Unit root***	-1,21	0,67	Unit root***
Peru Government Internationa	USD	3	-2,35	0,16	Not cointegrated	-0,45	0,90	Unit root***	-2,04	0,27	Unit root***
Peru Government Internationa	USD	5	-0,96	0,77	Not cointegrated	-0,54	0,88	Unit root***	-1,70	0,43	Unit root***
Peugeot SA	EUR	3	-2,72	0,07	Cointegrated*	-1,88	0,34	Unit root***	-1,62	0,47	Unit root***
Peugeot SA	EUR	5	-2,34	0,16	Not cointegrated	-1,70	0,43	Unit root***	-1,92	0,32	Unit root***
Koninklijke Philips Electron	EUR	5	-3,93	0,00	Cointegrated***	-0,65	0,86	Unit root***	-1,23	0,66	Unit root***
Philippine Government Intern	USD	10	-1,82	0,37	Not cointegrated	-0,71	0,84	Unit root***	-1,09	0,72	Unit root***
Philippine Government Intern	USD	5	-2,06	0,26	Not cointegrated	-0,09	0,95	Unit root***	-0,57	0,87	Unit root***
Poland Government Internatio	USD	10	-2,77	0,06	Cointegrated*	-2,05	0,27	Unit root***	-0,78	0,82	Unit root***
Portugal Telecom SGPS SA	EUR	5	-2,65	0,08	Cointegrated*	-0,14	0,94	Unit root***	-1,51	0,53	Unit root***
PPR SA	EUR	5	-1,95	0,31	Not cointegrated	-0,56	0,87	Unit root***	-1,01	0,75	Unit root***
Rabobank Nederland	EUR	5	-0,64	0,86	Not cointegrated	-2,35	0,16	Unit root***	-0,59	0,87	Unit root***
Renault SA	EUR	3	-4,60	0,00	Cointegrated***	-1,83	0,36	Unit root***	-2,18	0,21	Unit root***
Renault SA	EUR	5	-3,18	0,02	Cointegrated**	-1,79	0,39	Unit root***	-1,71	0,43	Unit root***
Repsol YPF SA	EUR	3	-2,46	0,12	Not cointegrated	-1,07	0,73	Unit root***	-1,56	0,50	Unit root***
Rolls-Royce Group PLC	EUR	3	-3,41	0,01	Cointegrated**	-1,16	0,69	Unit root***	-1,30	0,63	Unit root***
RWE AG	EUR	3	-5,81	0,00	Cointegrated***	-0,07	0,95	Unit root***	-1,71	0,42	Unit root***
RWE AG	EUR	5	-6,23	0,00	Cointegrated***	0,11	0,97	Unit root***	-1,67	0,45	Unit root***
Siemens AG	EUR	3	-1,83	0,36	Not cointegrated	-1,25	0,65	Unit root***	-1,00	0,75	Unit root***
South Africa Government Inte	USD	10	-3,09	0,03	Cointegrated**	-0,71	0,84	Unit root***	-0,93	0,78	Unit root***
South Africa Government Inte	USD	5	-5,11	0,00	Cointegrated***	-0,64	0,86	Unit root***	-1,35	0,61	Unit root***
TDC A/S	EUR	5	-1,67	0,45	Not cointegrated	-0,45	0,90	Unit root***	-0,17	0,94	Unit root***
Total SA	EUR	3	-2,70	0,07	Cointegrated*	-2,16	0,22	Unit root***	-3,62	0,01	Stationary
Total SA	EUR	5	-2,53	0,11	Not cointegrated	-1,01	0,75	Unit root***	-2,36	0,15	Unit root***
ThyssenKrupp AG	EUR	5	-2,86	0,05	Cointegrated*	-1,66	0,45	Unit root***	-1,65	0,45	Unit root***
Telecom Italia SpA	EUR	10	-3,44	0,01	Cointegrated***	-3,05	0,03	Unit root*	-3,23	0,02	Unit root*
Telecom Italia SpA	EUR	3	-2,51	0,11	Not cointegrated	-2,00	0,29	Unit root***	-1,38	0,59	Unit root***
Telecom Italia SpA	EUR	5	-3,27	0,02	Cointegrated**	-2,24	0,19	Unit root***	-1,91	0,33	Unit root***
Telefonica SA	EUR	3	-1,75	0,41	Not cointegrated	-0,74	0,83	Unit root***	-1,87	0,34	Unit root***
Telefonica SA	EUR	5	-3,03	0,03	Cointegrated**	-0,61	0,87	Unit root***	-1,79	0,39	Unit root***
Tesco PLC	EUR	5	0,13	0,97	Not cointegrated	-1,95	0,31	Unit root***	-1,52	0,53	Unit root***
Republic of Turkey	USD	10	-2,52	0,11	Not cointegrated	-1,65	0,46	Unit root***	-1,48	0,55	Unit root***
Republic of Turkey	USD	3	-4,62	0,00	Cointegrated***	-1,25	0,65	Unit root***	-1,19	0,68	Unit root***
Republic of Turkey	USD	5	-3,12	0,03	Cointegrated**	-0,67	0,85	Unit root***	-0,98	0,76	Unit root***
Unilever NV	EUR	3	-3,09	0,03	Cointegrated**	-0,94	0,77	Unit root***	-1,10	0,72	Unit root***
Usinor SA	EUR	5	-3,35	0,01	Cointegrated**	-1,01	0,75	Unit root***	-1,97	0,30	Unit root***
Vattenfall AB	EUR	3	-3,85	0,00	Cointegrated***	-0,79	0,82	Unit root***	-1,59	0,49	Unit root***
Vattenfall AB	EUR	5	-2,35	0,16	Not cointegrated	-1,46	0,55	Unit root***	-0,38	0,91	Unit root***
Veolia Environnement	EUR	5	-2,32	0,17	Not cointegrated	-1,70	0,43	Unit root***	-2,03	0,27	Unit root***
Vodafone Group PLC	EUR	10	-3,92	0,00	Cointegrated***	-2,71	0,07	Unit root**	-1,16	0,69	Unit root***
Vodafone Group PLC	EUR	3	-3,05	0,03	Cointegrated**	-0,74	0,83	Unit root***	-1,32	0,62	Unit root***
Vodafone Group PLC	EUR	5	-2,04	0,27	Not cointegrated	-1,70	0,43	Unit root***	-0,88	0,79	Unit root***
Volkswagen AG	EUR	3	-4,32	0,00	Cointegrated***	-1,87	0,35	Unit root***	-1,67	0,44	Unit root***
Volkswagen AG	EUR	5	-3,31	0,01	Cointegrated**	-1,98	0,29	Unit root***	-2,62	0,09	Unit root**
Wells Fargo & Co	USD	5	-5,00	0,00	Cointegrated***	-1,06	0,73	Unit root***	-3,82	0,00	Stationary
Washington Mutual Inc	USD	5	-3,62	0,00	Cointegrated***	-1,59	0,49	Unit root***	-3,78	0,00	Stationary
Wal-Mart Stores Inc	USD	5	-3,81	0,00	Cointegrated***	-2,00	0,29	Unit root***	-2,91	0,05	Unit root*

For the CDS and asset swap unit root tests, unit root*, unit root** and unit root*** mean that the null hypothesis cannot be rejected at the 1%, 5% or 10% level, respectively. For the basis unit root tests, cointegration*, cointegration** and cointegration*** mean that the null of a unit root is rejected at the 10%, 5% or 1% level, respectively.

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