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Valuation of systematic risk in the cross-section of credit default swap spreads

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ABSTRACT

We analyze the pricing of systematic risk factors in credit default swap (CDS) contracts in a two-stage empirical framework. Firstly we estimate contract-specific sensitivities (betas) to several systematic risk factors by time-series regressions using quoted CDS spreads of 339 U.S. entities from January 2004 to December 2010. Secondly, we show that these contract-specific sensitivities are cross-sectionally priced in CDS spreads after controlling for individual risk factors. We find that the credit market climate, the Cross-market Correlation, and the market volatility explain CDS spread changes and that their corresponding sensitivities (betas) are particularly priced in the cross-section. Our basic risk factors explain about 83% (90%) of the CDS spreads prior to (during) the crisis.

1. Introduction

During the global financial crisis (GFC) the spreads of credit default swaps (CDS) heavily increased across most CDS dealings on corporate debt claims, which was at least partly triggered by the high numbers of corporate defaults on bonds and loans. This increase was more pronounced for CDS spreads (multiple of 8.95) than for real-world default rates (multiple of 3.52). In fact, the rate of increase of CDS spreads on high-rated debt claims became much higher than on lower-rated credit assets, although there was any default of the highest rated issueres. For example, the average CDS spread for 'AAA'-rated bonds increased by a multiple of 37.67, while the average CDS spread for 'B'-rated bonds multiplied only by 6.75.

On the corporate debt market this phenomenon takes part in the so-called credit spread puzzle, addressing the mismatch between prices for the product's physical default risk, e.g., justified by historical default rates, and the risk neutral valuation of the product's total risk (compare Amato & Remolona, 2003; Chen, 2010). An understanding of this puzzle helps to determine appropriate risk premia and avoid possible negative outcomes from mispriced spreads. The latter, we may have seen in the spring of 2007, when financial markets, and in particular, derivative markets were calm and did not anticipate the crisis (compare Mendel & Shleifer, 2012).

Therefore, apart from addressing corporate default risk (Giesecke, Longstaff, Schaefer, & Strebulaev, 2011), several empirical studies looked beyond theoretical contingent claims and accounted for other pricing factors such as liquidity (Bongaerts, Jong, & Driessen, 2011; De Jong & Driessen, 2012; Dick-Nielsen, Feldhütter, & Lando, 2012; Friewald, Jankowitsch, & Subrahmanyam, 2012; Tang & Yan, 2010). As suggested by Chen (2010), Collin-Dufresne, Robert, Goldstein, and Martin (2001) and Iannotta and Pennacchi (2011) for corporate debt, other authors also identified systematic risk factors driving CDS spreads Amato (2005), Arora, Gandhi, and Longstaff (2012), Blanco, Brennan, and Marsh (2005), Wang, Zhou, and Zhou (2013). Most of the recent studies analyze time-series properties of credit spreads or credit spread changes by focusing on time-series regressions. In summary, the current literature on both bond and CDS markets focuses on the identification of credit spread drivers and aims to answer the question of how these determinants are priced.

Our paper provides the following contributions: firstly, we address systematic risk exposures of CDS contracts and identify at least three systematic risk factors as important drivers for CDS spread changes. We identify the *Credit Market Climate*, the *Market Volatility* and the *Cross-market Correlation* as common determinants of CDS spread changes. Secondly, based on our CDS database from

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2004 to 2011 containing weekly spread data of 339 U.S. firms we confirm that credit ratings do not sufficiently cover the overall credit risk priced in CDS spreads. We find that systematic risk is generally priced beyond the ratings of U.S. firms located in numerous economic sectors, e.g., financial, industrial and consumer goods. Thirdly, we find that these determinants of CDS spread changes are priced across several economic sectors, particularly in times of financial distress. The results of the cross-section regressions show that our set of variables allows us to explain about 80% of the observed CDS spreads in normal market environments and 90% during economic downturns. Furthermore, the OLS regression results are robust with respect to the inclusion of the Fama-French factors and other firm-specific factors such as the firm's leverage ratio and market capitalization.

Our empirical findings are of practical importance for at least three fields. Firstly, the contributions are relevant for asset pricing as they identify new variables and their proxies which determine spreads of swap contracts referring to credit risky assets. Secondly, CDS prices reflect systematic risk, while for regulatory capital models banks require idiosyncratic probability of default, which are then stressed via a worst case default rates concept. Thus, measuring and controlling for the systematic component from CDS prices is important. Thirdly, our findings might be important for pricing structured finance securities such as Collateralized Debt Obligations (CDOs). Since, for example, synthetic CDOs such as single-tranche CDOs (STCDOs) take on credit exposures through including CDS contracts, this work may also provide first insight into the valuation of such structured products, which are particularly exposed to systematic risk.

The remainder of the paper is organized as follows. In Section 2, we present the identified systematic and firm-specific spread determinants, including their used proxies. In Section 3, we introduce the regression models within the two-pass approach, provide our results and check the robustness of our findings. Section 4 concludes.

2. Determinants of credit default swap spreads

2.1. Theoretical spread determinants

The credit risk literature differentiates between structural and reduced-form models. The latter treat default as an exogenous event modeled by a hazard-rate process (Duffee, 1998; Duffie & Singleton, 1999), while in structural models (Merton, 1974) the default event is triggered when the firm's assets fall below a critical threshold. The value of a firm's asset is modeled by a stochastic process and the default threshold is a function of the amount of debt outstanding. The values of debt claims are determined under the risk-neutral measure by computing the present value of their expected future cash flows discounted at the risk-free rate. As resulting advantage, structure models provide theoretical insights about the firm's default risk and the its relation to external risk factors and firm's fundamentals (compare Collin-Dufresne et al. (2001)). Since a credit default swap extracts and transfers the default risk of corporate debt, CDS investors – in their role as protection seller – periodically receive a premium payment (premium leg) for covering losses in underlying debt claims (protection leg). In the absence of arbitrage and in the presence of risk-neutral valuation, the present value (PV) of the premium leg equals the PV of the protection leg. Hence, depending on the underlying debt claim future expected cash flows – namely the protection and premium payments – of the related CDS are analogously discounted to determine the fair CDS spread.

Therefore, motivated by Merton (1974) and Collin-Dufresne et al. (2001), we describe a CDS spread $S_{\vartheta,t}$ of contract ϑ at time t through (1) the price of underlying debt claims, (2) its related contractual cash flows, (3) the time-specific risk-free rate r_t, (4) common state variables $\mathcal{Y}_t$, which cross-sectionally affect all credit spreads simultaneously and (5) individual state variables $\mathcal{V}_{\vartheta,t}$, which are firm-specific. This leads to

$$S_{\vartheta,t} := S_{\vartheta,t}(C_{\vartheta,t}(F_{\vartheta,t}), r_t, \mathcal{Y}_t, \mathcal{V}_{\vartheta,t}), \quad (1)$$

with contractual payments $C_{\vartheta,t}$ depending on the firm value $F_{\vartheta,t}$. We suppose that credit spread changes are determined given the current values of the time-specific variables $\mathcal{Y}_t$ and $\mathcal{V}_{\vartheta,t}$ respectively. Also referring to the structural framework, we may predict (i) determinants of CDS spread changes and (ii) whether changes in these variables should be positively or negatively correlated with changes in the CDS spreads. Consistent with literature, we propose the following common state variables reflecting systematic risk:

1. *Changes in the Spot Rate*. In theory, the static effect of a higher spot rate is to increase the risk-neutral drift of the firm value process (Duffee, 1998; Longstaff & Schwartz, 1995). The higher drift reduces the firm's probability of default and thus the price of related derivatives offering protection against default losses. We therefore expect that CDS spreads are negatively correlated with the risk-less interest rate.
2. *Changes in the Slope of the Yield Curve*. Independent from the structural framework, some authors argue that the interest term-structure is upon other factors mainly driven by (i) the interest level and (ii) the slope characteristics (Blanco et al., 2005).

   The slope of the yield curve is often seen as an indicator of economic wealth: while a positive slope indicates a prosperous economy, a negative one reflects expectations of an economic downturn. Hence, the CDS spread may decrease if an increasing slope of the interest curve indicates higher expected short rates, as also argued by Collin-Dufresne et al. (2001) for credit spreads. By contrast, a decreasing term-structure may indicate an economic downturn leading to higher losses given default since recoveries are assumed to be negatively correlated to the macroeconomy (Altman, 2008; Bade, Rösch, & Scheule, 2011; Frye, 2000). As a consequence, the liquidation risk for corporate debt may be higher leading to widening CDS spreads.
3. *Changes in the Market Volatility*. Since debt claims exhibit characteristics similar to a short position in a put option, it follows from the option-pricing framework that option prices increase with increasing volatility (Merton, 1974). Intuitively, with an increase of volatility, the firm's default probability increases and thus the related CDS spread increases due to the higher default risk (compare Ericsson, Jacobs, and Oviedo (2009)).
4. *Changes in the Credit Market Climate*. The *Credit Market Climate* may reflect the market view of the overall credit risk. If the global economy is turning down in line with decreasing recoveries, the weakening market conditions should increase the firms' default risk as well as related losses. Thus, the increased credit risk on credit markets may lead to an increase of the overall credit spread level (compare Collin-Dufresne et al. (2001)). The *Credit Market Climate* can be seen as a common market factor similar to the market index in the CAPM. It should be strongly affected by economic conditions. We expect a cross-sectional increase of default risk due to weakening economic conditions leading to increased CDS spread levels. Hence, the CDS spreads should be positively correlated with the *Credit Market Climate*.
5. *Changes in the Cross-market Correlation.* Foresi and Wu (2005) argue that downside movements in any equity index are likely to be highly correlated with those in other markets as a result of global contagion. Expanding this argument to credit markets, we expect higher CDS spreads if Cross-market Correlations increase, because the prospects for risk diversification on global