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CASH-FlOW MATURITY AND RISK PREMIA IN CDS MARKETS

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Dedicated to Patricia, my love, to Leticia, my beloved sister, and my parents Lair and Manuel, for everything.

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Abstract

I study the returns of portfolios of credit default swaps (CDS) of different maturities, leveraged to have the same risky durations. I find that average returns decrease with maturity. This variation in expected returns is captured by betas with respect to one factor: a portfolio that sells short-maturity CDSs and buys long-maturity CDSs. The CDS-market betas are high when the price of CDS-market risk is high, but low otherwise. Consistent with the beta dynamics, a conditional CDS market model explains the cross-sectional variation in returns by maturity. I develop a parsimonious model of credit risk that matches the fact that short-term CDSs are riskier, as well as the maturity-related beta dynamics.

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Chapter 1

Introduction

The relation between cash-flow maturity and risk premia is a key issue in asset pricing. The price of any asset is the present value of each of its cash flows discounted at an appropriate rate. Implicit in any valuation, is, therefore, an assumption of how discount rates vary with maturity.

In economic terms, the relation between risk premia and maturity informs us about the persistence of the shocks that command a risk premium. Intuitively, a high risk premium for short-term assets suggests that investors demand risk premiums from shocks that die out quickly. This insight is featured in a growing literature that relates risk premium and maturity in equity markets (Lettau and Wachter [2007], van Binsbergen et al. [2012], Binsbergen et al. [2011], Hansen et al. [2008]). In this literature, the key question is about the persistence of (dividend- or consumption-) growth shocks that investors are concerned with and demand a risk premium to bear.

Economic growth has been in the center of macroeconomics for decades, but more recently, another class of macroeconomic shocks has been in the spotlight, these are the so-called uncertainty shocks. Shifts in some measure of aggregate uncertainty have been put in the center of business cycles (Bloom [2009]); have been linked to business cycles, aggregate stocks market returns, risk premia and the quantity of risk in the economy (Baker et al.

[2013], Pastor and Veronesi [2012, 2013]); have been evoked to explain the cross-section of equity returns (Ang et al. [2006]) and why value stocks overperform growth ones (Bansal et al. [2012]Campbell et al. [2011]).

In this paper, I keep the focus on maturity, but instead of investigating growth-sensitive assets, I study uncertainty-sensitive ones, and, in this way I will shed light on the horizon of uncertainty that investors fear. Namely, I study how risk premia varies with maturity in the large, liquid, and term-structure-data-rich Credit Default Swap (CDS) market.

Credit default swaps are derivatives that work as insurance against the default of a corporation. A buyer of running-spread CDSs makes periodic payments – the CDS spread – in exchange for being compensated by the loss in bond value (compared to par) when there is a default. In other words, a buyer of CDS pays for somebody else to bear credit risk for them.

In Merton [1974] seminal work, the credit risk of firm is a function of its leverage and asset return volatility. Intuitively buying a defaultable bond is like writing a put on the total value of the assets of a firm and buying a treasury. Hence, the credit spread of a portfolio of bonds should be and empirically is (Campbell and Taksler [2003], Zhu [2009]) closely linked to the uncertainty about the values of those firms in the portfolio. Hence learning about the relation between maturity and risk premia in those markets sheds light on the horizons of uncertainty investors fear.

To study the term structure of risk premia, I construct holding-period returns of constant-duration CDS (CD CDS) portfolios of different maturities. The returns of CD-CDS portfolios are equal to the returns of CDS portfolios, scaled by a measure of their CDS spread sensitivity – like duration is for risk-free bonds.[1] In this way, for short holding periods, CD-CDS returns of various maturities just differ in the maturity of the realized CDS *spreads* to which they are sensitive, but *do not differ* in the *size* of this sensitivity. Hence, the cross-section of

[1] I consider two measures of this sensitivity. The first measure is the lagged risky-duration, which is the risky-bond analogous of risk-free-bond duration and can be calculated from CDS spreads. The second measure is just the CDS return volatility, which I show is empirically equivalent to an average risky-duration scaling.

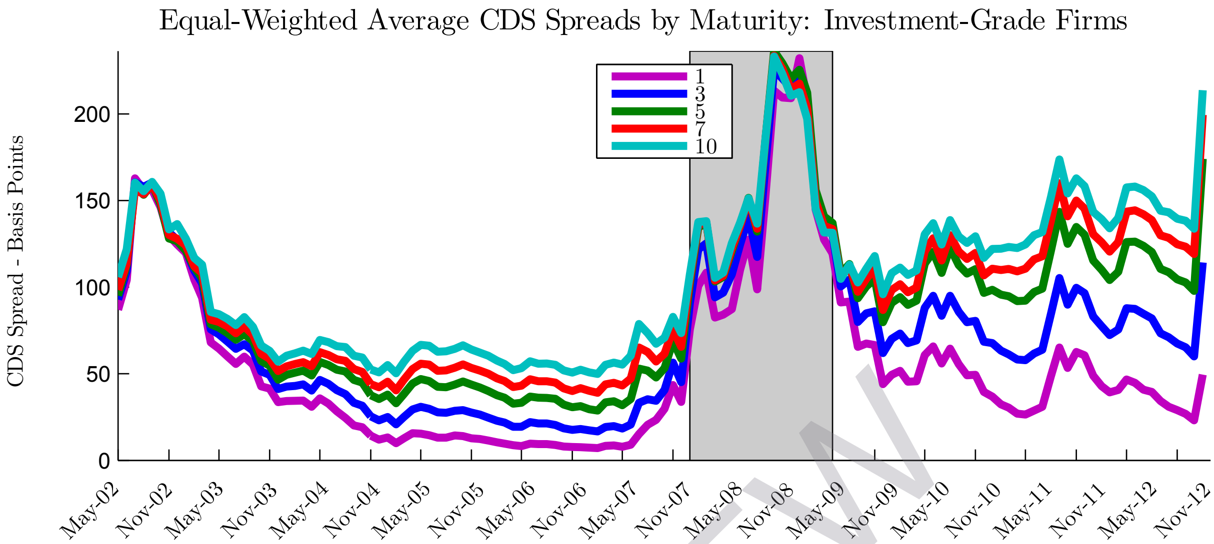
risk premia of CD-CDS portfolios is directly related to the prices of *shocks to average CDS spreads of various maturities*. The pricing of those shocks informs us about the risk premia earned by CDS portfolios cash flow across maturities.

I first examine the relationship between average returns and maturity among several groups of CDSs: single-name CDSs of BBB-rated firms, single-name CDSs of lower- and higher-yielding firms, the index of U.S. investment grade CDS (CDX-NAIG index), and among the index of mostly European corporates (the ITRAXX-Europe). Within each of those groups of CDS, the average one-month returns of selling CD CDSs are decreasing in maturity. For example, within the universe of CDSs written on BBB-rated firms in the United States from April of 2002 to February of 2013, a strategy that sells short-maturity CD CDSs and buys long-maturity CD CDSs had an annualized Sharpe ratio of 0.95. I call this portfolio "LSM": *long and short maturity*.

Second, I study the shocks to which short- and long-maturity CDS portfolio returns are differentially exposed. CD-CDSs of different maturities have similar unconditional betas on a market portfolio of CD CDS, and thus, an unconditional CDS market model fails. However, the LSM portfolio prices the cross-section of CD CDS portfolios sorted on maturity. The betas on the LSM portfolio explain the variation in expected returns by maturity not only among portfolios of CDSs of BBB-rated firms but also among both lower- and higher-yielding firms. In other words, the *risk premium on exposures to LSM* carries similar prices among low- and high-yielding CDSs. This first exercise reduces the problem of understanding the exposures of an entire cross-section of CDS portfolios of different maturities to understanding the exposures of the LSM.

To understand what drives LSM, I plot the time series of the term structure of average CDS spreads of BBB-rated firms in Figure 1.1. In calm times, short-maturity spreads are lower and less volatile than are long-maturity spreads. In turbulent periods, which include 2002 and the financial crisis beginning in 2007, short-maturity spreads are higher and more volatile than long-maturity spreads.

Figure 1.1: Average CDS Spreads of Investment-Grade Firms
The plot shows average CDS spreads of investment-grade firms for various maturities.



From this behavior of CDS spreads over time, we can learn a lot about CDS curve steepeners. Those steepeners, of which the LSM is an example, are bets that the CDS curve will get steeper. By definition, the LSM takes short-term spread risk by selling short-maturity CDS portfolios and hedges long-term spread risk by buying long-maturity CDS portfolios.

In *calm times*, the fact that short-term spreads do not move as much as long-term spreads implies the *LSM is a hedge* to overall increases in credit spreads, because long-term CDS spreads drive those increases. In *turbulent times*, the fact that short-term spreads become more volatile than long-term spreads means the *LSM* is *no longer a hedge* to across-the-board increases in CDS spreads: it is now vulnerable to across-the-board increases in spreads or, equivalently, it loads on CDS-market risk. This change in sensitivities follows from the fact that, during those turbulent times, the short-maturity spreads are moving even more than long-maturity spreads.

If the price of CDS-market risk is higher during turbulent periods than it is during calm periods, the dynamics of LSM CDS-market betas naturally suggest that a conditional CDS market model may price the cross-section of CD-CDS across maturities. Using the five-year average CDS spread of BBB-rated firms to capture time variation in the CDS-market risk premium, I show that a conditional CDS market model indeed prices the cross-section of CD CDS portfolio returns sorted on maturity as accurately as the LSM model.

To understand what those empirical results imply about the characteristics of asset prices in the economy, and in particular to the horizon of uncertainty investors are concerned with, I build a parsimonious structural credit risk model and calibrate it to match my empirical results.

The model is a CAPM and it has *three* key ingredients that vary over time: risk premia, the volatility of the return on assets of a typical BBB-rated firm, and its default boundary. One state variable drives them all. When the state is high, the economy is bad – risk premia, volatilities, and the default boundaries are all high – and vice-versa when the state is low. This one-factor model means that average CDS spreads of BBB-rated firms of any maturity also depend on just this single state variable. In this aspect, this model is analogous to that of Chen et al. [2009].

This model reduces to Merton [1974]'s model if the single state variable is constant over time. In such a world, the average CDS spread of BBB-rated firms is constant. To produce interesting dynamics, I assume that the state variable has persistent dynamics. Now, BBB CDS spreads of all maturities vary over time. In particular, they all increase when the economy deteriorates. The size of the increase across maturity, however, depends on the persistence of the state variable. *If the economy is weakly persistent, long-maturity CDS spreads rise faster than short-maturity CDS spreads in good times, but short-maturity spreads rise faster than long-maturity spreads in bad times.*

On the one hand, this dynamic of CDS spreads implies that when the economy deteriorates from a healthy starting point, both the level and the slope of the term structure of CDS spreads rise together. In terms of the returns that I study, when the economy is healthy, the LSM is a hedge to CDS-market returns. The intution for this *negative* correlation is that in good times, the fact that the economy mean reverts implies long-maturity assets are risky even if the short-term outlook is good, whereas short-term assets are relatively safe given such an outlook. On the other hand, in a bad economy, the level and the slope of the term structure of CDS spreads move in opposite directions. When the economy is bad, the LSM loads up on CDS-market risk. The intution for this *positive* correlation is that in bad times, the fact that the economy mean reverts implies that long-maturity assets are less risky than what the gloomy short-term outlook suggests, whereas short-term assets are as risky as the short-term outlook suggests.

The LSM is risky in the model because the shocks to the state variable are priced high when the state is high (and low otherwise) and these high prices coincide with LSM's high exposures. All the model's ingredients as well as the low-persistence state dynamics play an important role in obtaining those results. If default boundaries are constant and volatility dynamics realistic, the short-maturity CD CDS will always be safer than the long-maturity ones. If risky premia are constant, LSM's risk premium will be smaller or even negative. If the economy is too persistent, the LSM will be a hedge to deteriorations in economic conditions for most of the state space.

Chapter 2

Data

In this Chapter, I first describe the data sources that I use and give an overview of the data. In the last part, I describe how I compute the returns of writing a CDS. I leave to the on-line appendix a discussion of the insitutional details of the CDS market.

2.1 Description of Data Sources

I use CDS spread quotes for single names and credit indexes from Markit, stock return information from CRSP, balance sheet information from Compustat, and default date and recovery rate information from Moody's, CRSP, Compustat and Creditex. The first three default databases are standard in studies of corporate default (Duffie et al. [2007]). The last database, Creditex, is not. This database contains the outcome of CDS settlement auctions. These auctions take place shortly after a credit event and their outcome is a price for the defaulted bonds. This price serves as a reference for the payoffs of CDSs. Thus, this database is the most precise regarding CDS return computations. Finally, from Datastream, I obtain data on several Barclays government and corporate bond portfolios, and from Optionmetrics I obtain data on the risk-free term structure.

For single names, I use mid-price quotes on dollar-denominated Credit Default Swaps of documentation clause XR. I use those quotes at tenors 1, 3, 5, 7, and 10 years. Documentation clauses specify what happens with the CDS in case of a debt restructuring. XR CDSs are not triggered in a debt restructuring. This type of documentation clause is the standard type for United States corporates after 2009. Before, the MR documentation clause was the standard. MR CDSs are triggered in restructurings, but only bonds with remaining time to maturity below thirty months can be traded for par in those circumstances.

For credit indexes, I use mid-price quotes on the same tenors and across all series and versions of the index.

2.2 Summary Statistics of Yields

Panel A of Figure 2.1 displays investment-grade single-name data. The left plot displays the average CDS spreads of investment grade public corporations at various maturities, and the right plot shows several measures of the steepness the term structure of CDS spreads. CDS spreads of all maturities spike on three separate occasions: at the beginning of the sample in late 2002, during the financial crisis around late 2008 and early 2009, and more recently in late 2011 and early 2012. At the first two times average CDS spreads increase considerably, the slopes of term structure of CDS spreads flatten. These patterns about the steepness of the term structure are clearest in the second plot, which has the slope of the term structure at various points as well as forward CDS rates computed the same way as risk-free forwards.[1] Long-term forward rates are generally higher than short-term ones, but during crisis episodes, the gap between short-term and long-term forwards closes. Likewise, the slopes of the term structure of CDS spreads are generally positive, but during crisis, they fall to zero or even negative. Later, I will show there is a rich time-varying relation between the steepness of the term structure of credit spreads and its level.

Panel B displays the average spreads of two CDS index: a U.S. corporate credit index – CDX-NAIG – and a mainly European one – ITRAXX-Europe. The European and U.S

[1]This approximation can be justified by a linearization around zero risk-free interest rates and risk-neutral default probabilities.