DO WE NEED TO WORRY ABOUT CREDIT RISK CORRELATION?

Yes, we do!

Abel Elizalde
CEMFI, Madrid
www.abelelizalde.com

• A **single**, countercyclical risk **factor** representing the credit cycle drives default correlations, which account for most of firms' credit risk.

• Empirical analysis of a sample of **bonds** for 14 **US firms** during **2001-2003**: Owens, CSC, Comcast, Disney, Ford Credit, GM, Hertz, Marriott, Norfolk, Sears, TCI, Warner, USX, and Union Pacific.

• On average, **68% of firms' credit risk is explained by an unobservable common single risk factor**, strongly negatively correlated with S&P and Dow Jones indexes and which resembles the evolution of US credit risk levels.

Venice, September 2005

1.- Introduction

➢ There is a **need for a deeper understanding** of the **main drivers of** firms' **default correlations** and their **relative importance**.

➢ Understanding firms' **credit risk correlation structure is key** in pricing multiname credit derivatives, management of debt portfolios, and banking capital requirements (Basel II).

➢ We provide an **analysis of the importance and drivers of credit risk correlations**.

How much of the firms' credit risk (priced in the bonds market) can be explained by common credit risk factors? What are those?

➢ The **credit risk** spread of each firm, represented by its default hazard rate multiplied by the loss given default, is **decomposed in different Vasicek unobservable risk factors**:

- ➢ One **common** to all firms, but **affecting each firm differently**.
- ➢ One common to all firms in the same sector, different across sectors.
- ➢ One idiosyncratic across firms.

➢ We also consider an alternative specification including 3 common risk factors: two of them extracted from the term structure of interest rates (representing its slope and level) and an additional one (independent of the previous two) ⇒ Analysis of the **impact of interest rates on credit risk**.

➢ **We estimate the realization of each factor and its impact on each firm's credit risk.**

➢ **The common factors are intended to capture the credit risk correlation structure.**

➢ **Results: default correlations account, through a single risk factor, for most of the analysed firms' credit risk.**

Related Literature

➢ Duffee (2002): The only two common factors considered are those extracted from interest rates (level and slope) ⇒ Do they capture all the credit risk correlation structure? **No**.

➢ Driessen (2005): 4 common factors considered, but affecting equally all firms with the same rating ⇒ It assumes same rating firms are affected equally by all common factors ⇒ Do they? **No**.

2.- Reduced Form Model

➢ Risk neutral pricing. Firm i's instantaneous credit spread:

$s_{t,i}$ = Default hazard rate * Loss given default (Market value)

$s_{t,i}$ incorporates both components of credit risk: probability and severity of default.

➢ **No exogenous assumption about recovery rates**, they are part of the extracted credit risk.

➢ **Zero-coupon bond price** of firm i (Duffie and Singleton 1999) :

$$E[\exp(-\int_t^T (r_u + s_{u,i})du)]$$

r_t : risk free short rate.

➢ **Vasicek unobservable independent risk factors** X's and Z.

TWO DIFFERENT SPECIFICATIONS TO CAPTURE CREDIT RISK CORRELATIONS

➢ **Including interest rate risk factors:**	➢ **Not Including interest rate risk factors**
$r_t = X_{1,t} + X_{2,t}$	
$s_{t,i} = a_{1,i}X_{1,t} + a_{2,i}X_{2,t} + a_{3,i}X_{3,t} + a_{4,i}X_{4,t} + X_{5,i,t}$	$s_{t,i} = b_i Z_t + a_{4,i}X_{4,t} + X_{5,i,t}$

- ➢ $X_{1,t}$ and $X_{2,t}$: common (to all firms) risk factors extracted from the term structure of interest rates.
- ➢ $X_{3,t}$: common (to all firms) risk factor.
- ➢ $X_{4,t}$: sector risk factor, different for each sector.
- ➢ $X_{5,i,t}$: idiosyncratic risk factor.

- ➢ Z_t: common (to all firms) risk factor.
- ➢ $X_{4,t}$: sector risk factor.
- ➢ $X_{5,i,t}$: idiosyncratic risk factor.

➢ **Liquidity?** It gets included in $s_{t,i}$ or in the estimation errors. Its impact on $s_{t,i}$ is found very small.

➢ The **common and sector risk factors affect each firm differently**.

➢ **Closed form solutions** for (defaultable and default-free s_t =0) bond prices as functions of the risk factors and the model parameters.

3.- Data

➢ July 2001 – November 2003. Daily data.

➢ Default-free rates to estimate $X_{1,t}$ and $X_{2,t}$: **6 different maturities of US Treasury rates**, in order for $X_{1,t}$ and $X_{2,t}$ to incorporate information about the whole term structure of int. rates.

➢ Defaultable bonds: **14 US firms**. **At least two bonds of each firm**. Most of them BBB.

Credit risk is firm-specific: bonds of the same firm have the same credit risk.

4.- Estimation Procedure

➢ **To estimate: realization of all risk factors + model parameters.**

➢ Sequential Quasi-Maximum Likelihood using **Kalman Filters**.

1. **First specification (with common interest rate risk factors)**:
   - ➢ Using default-free rates (6 maturities) we estimate the realization of $X_{1,t}$ and $X_{2,t}$. Results:
     - ➢ **$X_{1,t}$** represents the long-term interest rate ⇒ **interest rates level**.
     - ➢ **$X_{2,t}$** represents the **slope** of the term structure of interest rates.
   - ➢ Using the defaultable bonds and $X_{1,t}$ and $X_{2,t}$ as given:
     - ➢ We estimate, *sequentially*, the realization of the risk factors $X_{3,t}$, $X_{4,t}$ and $X_{5,i,t}$ and the factor loadings $a_{1,i}$, $a_{2,i}$, $a_{3,i}$ and $a_{4,i}$.
2. **Second specification specification (without common interest rate risk factors)**:
   - ➢ We estimate, *sequentially*, the realization of the risk factors Z_t, $X_{4,t}$ and $X_{5,i,t}$ and the factor loadings b_i, $a_{3,i}$ and $a_{4,i}$.

"Sequentially": the realization and factor loadings of each factor are estimated (one factor at a time) by (i) taking as given previously estimated factors and their factor loadings, and (ii) only using data for the firms affected by such factor.

➢ Three sectors considered: Railroad (Norfolk + Union P.), Film (Disney + Warner), and Cable TV (CSC + Comcast). No sector factor for the other 8 firms.

➢ **Objective: What is the importance of each factor on the firms' credit risk?**

5.- Main Results: Role of Common Credit Factors

➢ Average (across time and all bonds of the same firm) **percentage of credit risk explained by common credit risk factors:**

	Rating	Including int. rate factors $X_{1,t}$, $X_{2,t}$, $X_{3,t}$	Not including int. rate factors Z_t
Owens	B	82.89	80.59
CSC	BB	89.82	82.70
Comcast	BBB	82.13	64.16
Disney	BBB	61.81	78.87
Ford Credit	BBB	81.65	87.13
GM	BBB	85.92	91.26
Hertz	BBB	85.61	88.73
Marriott	BBB	43.39	15.25
Norfolk	BBB	60.20	37.78
Sears	BBB	68.50	72.12
TCI	BBB	72.27	57.93
Warner	BBB	80.18	61.57
USX	BBB	69.78	77.11
Union	BBB	47.37	56.45
Mean		**72.25**	**68.02**
Std. Dev.		14.57	21.37

➢ **One factor, Z_t, explains more than 50% of all, but two, of the firms' credit risk.**

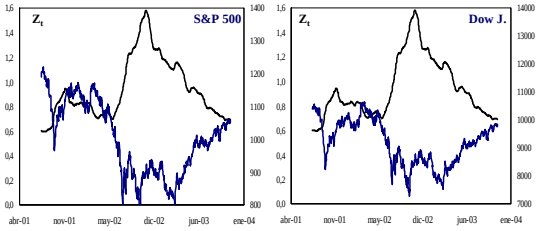
➢ The two factors coming from the term structure of interest rates $X_{1,t}$ and $X_{2,t}$ are, on average, of less importance than $X_{3,t}$ on most firms' credit risk.

➢ Z_t incorporates information about $X_{1,t}$ and $X_{2,t}$, but it mostly represents $X_{3,t}$ (corr 0.53).

➢ **Z_t drives default correlations, which explain most of firms' credit risk.**

➢ Z_t **resembles** the evolution of variables directly related with **credit risk levels in the US** economy: credit spreads over government bond yields, profit warnings, number of defaults, ...

➢ It is **negatively correlated** (-0.8) with major **stock indexes,** as well as with US real **GDP** changes.



➢ Liquidity does to contaminate our estimation of $s_{t,i}$: regressing it against liquidity measures (bid-ask, age, notional, time to maturity) yields an R^2 of 7%.

➢ We also derive the importance of sector and idiosyncratic risk factors on credit risk. Using all risk factors the model explains (on average) around 85% of the firms' credit risk.