TOBAM*
CORE INVESTMENTS

DIVERSIFICATION DASHBOARD

January 2017

Diversification Ratios®

TOBAM's Diversification Ratio® (DR) measures to what extent a portfolio is diversified. The DR² (square of the diversification ratio) measures the number of effective degrees of freedom to which a portfolio is exposed. As the table shows, the "broad market" indices leave diversification on the table. In addition to a snapshot of each market's DR², the table shows the DR² of a well-diversified portfolio, and the fraction of available diversification used by the index.

Universes	DR² Index diversification	DR² Maximum diversification®	% diversification used by index
MSCI All Countries World	4.44	14.07	31.5%
MSCI World	4.23	12.23	34.6%
MSCI Canada	4.11	10.42	39.4%
MSCI US Equity	3.29	8.21	40.0%
MSCI Emerging Markets	3.54	6.96	50.9%
MSCI Pacific Ex-Japan	2.34	5.73	40.8%
MSCI UK Equity	2.69	4.07	66.0%
MSCI Japan	1.83	3.74	49.0%
MSCI EMU	1.98	3.67	54.0%
BofA Merrill Lynch US Corporate & High Yield	3.62	4.66	77.6%

Source: TOBAM, figures as of December 30, 2016.

Credit default concentration

This dashboard presents some properties and applications of a risk measure particularly suited to corporate bonds, namely DTS (Duration Times Spread).

The DTS measure provides many useful insights when dealing with corporate bonds. It is for example a better estimator of risk compared to *past* realized volatility. Furthermore, corporate bonds prices can be relatively sparse, making volatility very challenging to estimate.

We first present the use of DTS as a useful estimate of corporate bond risk, and show that it allows estimating the volatility of bond spread *differences*.

The second part of this note considers the Bank of America-Merrill Lynch (BoA-ML) US High-Yield index (HWUS). We make the case that weighting issuers in proportion to their total debt results into large sector bets demonstrating that this index' DTS-adjusted sector weights can be at times as large as 25% for an index that comprises as many as 18 sectors.

Finally, we show that a few important sectors that presented in the past significant DTS-adjusted sector weights have subsequently experienced a significant number of defaults.

1. Duration times spread measure

Decomposing fixed-income portfolios into buckets (e.g. sectors or ratings) is standard practice. Duration can then be attributed to these buckets: market value weights are multiplied by duration at bond level, then aggregated into buckets. The main drawback of this approach is that credit spreads, which embody the idea of specific risk exposure, are not taken into account.

Theory:

This section is devoted to the concept of Duration Times Spread (DTS), introduced in Ben Dor et al. (2007), which is a better credit risk representation for fixed-income portfolios.

Let us investigate the return of a bond due strictly to the change in spread. Denote by S its spread and by D its duration, the return R_S of the bond due to a shift δS of the spread reads

$$R_S = -D \times \delta S.$$

This equation relates the return R_S to the duration and spread and can be interpreted as the sensitivity to an **absolute** change in spread. Note that this representation is valid whether we work with a given security or a given bucket.

We infer from the above equation that the volatility σ_{R_S} of the bond returns R_S is given by

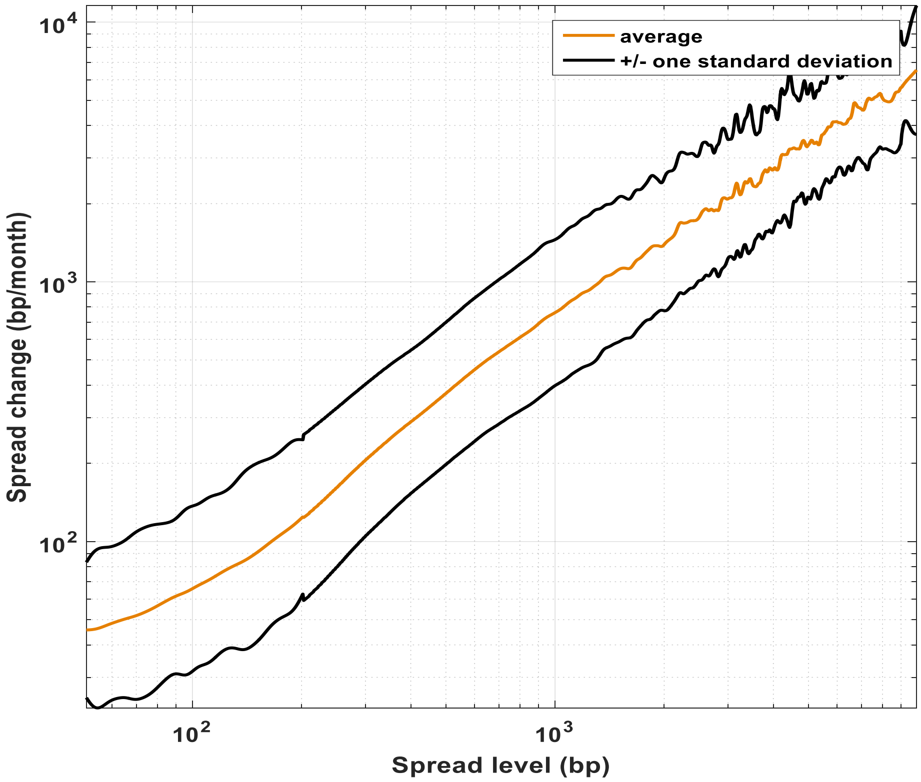
$$\sigma_{R_S} = D \times \sigma_{\delta S} \, ,$$

where $\sigma_{\delta S}$ is the volatility of relative change in spread. We shall see that there is a strong link between spread volatility $\sigma_{\delta S}$ and spread level. More specifically, the spread volatility of a corporate bond turns out to be essentially proportional to its spread level.

Practice:

In order to illustrate that spread volatility is essentially proportional to the spread level, we plot in Figure 1 on the following page the spread volatility as a function of the spread level based on BoA-ML HWUS bonds from 2005 to 2016. Note that all the illustrations in the current dashboard use the BoA-ML HWUS index but the following results hold for European HY bonds as well.

Figure 1: Spread volatility as a function of spread level using BoA-ML HWUS bonds from 2005 to 2016



Source: TOBAM.

We observe in Figure 1 a nearly linear relationship between those two quantities with unit slope. We also notice that the standard deviation band width is independent of the spread level (in log-scale).

Consequently, we may approximate a corporate bond spread change volatility with: $\sigma_{\delta S} \approx \theta \times S$ where θ is the slope that is nearly equals to unity regardless of the spread level. Hence, recalling the expression of the volatility of the change in value, we observe that the volatility σ_{R_S} of the bond returns is proportional to $D \times S$…which is exactly the DTS measure.

Conclusion: the DTS risk measure constitutes the best alternative to the indirect measure of corporate bond volatility which is difficult to estimate in practice. Nevertheless, keep in mind that both measures are closely related, so that the notion of volatility for equity managers to measure mark to market risk is essentially the same as DTS for fixed income managers.

2. Application to credit default concentration

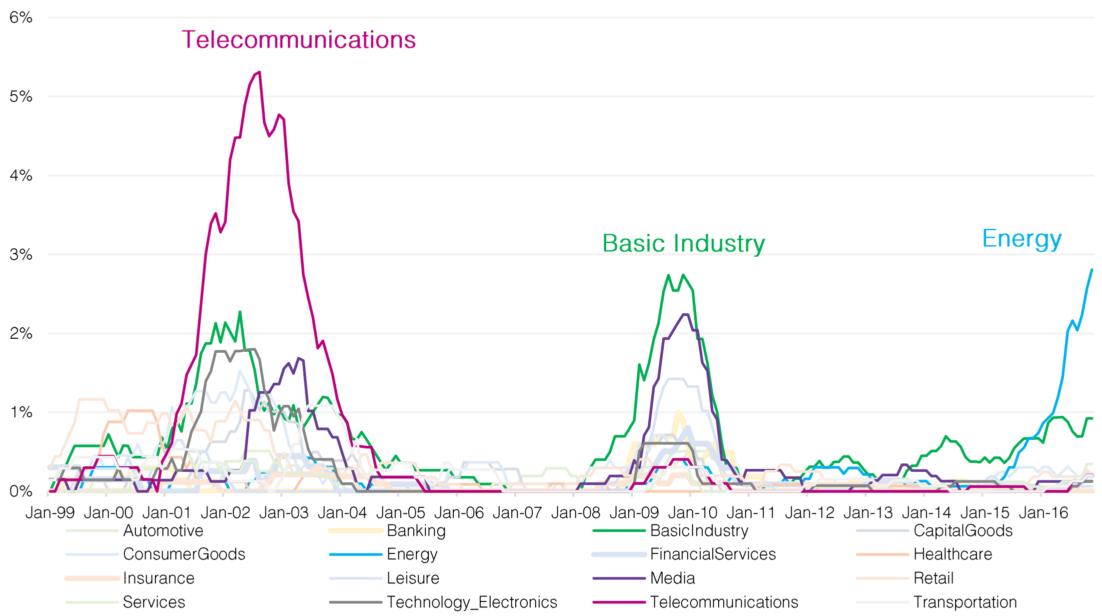
We further explore empirical evidences to show how the DTS concept can help fixed-income asset managers dealing with credit default concentration.

Historical Default Rates at the Sector Level

Corporate issuer default is defined as an event whereby a bond leaves the index before its maturity, with a spread greater than 20%. Note also that we will display the issuer default probabilities using sector buckets and we stress that all values follow a standard "LTM" (Last Twelve Months) averaging as it enables one to observe smoothed and annualized default rates.

We clearly notice in Figure 2 that default rates have concentrated during 3 distinct periods within specific sectors. During the first period the telecommunication sector suffered the highest default rates of any other sector following the collapse of the internet bubble. We also observe the well-known default concentration in the basic industry sector from 2009 to 2011 and finally the increase in default rates in the energy sector with the oil crisis that started in mid-2015.

Figure 2: Annual issuer default rate split by sector
(trailing 12M as a percentage of all BoA-ML HWUS issuers)



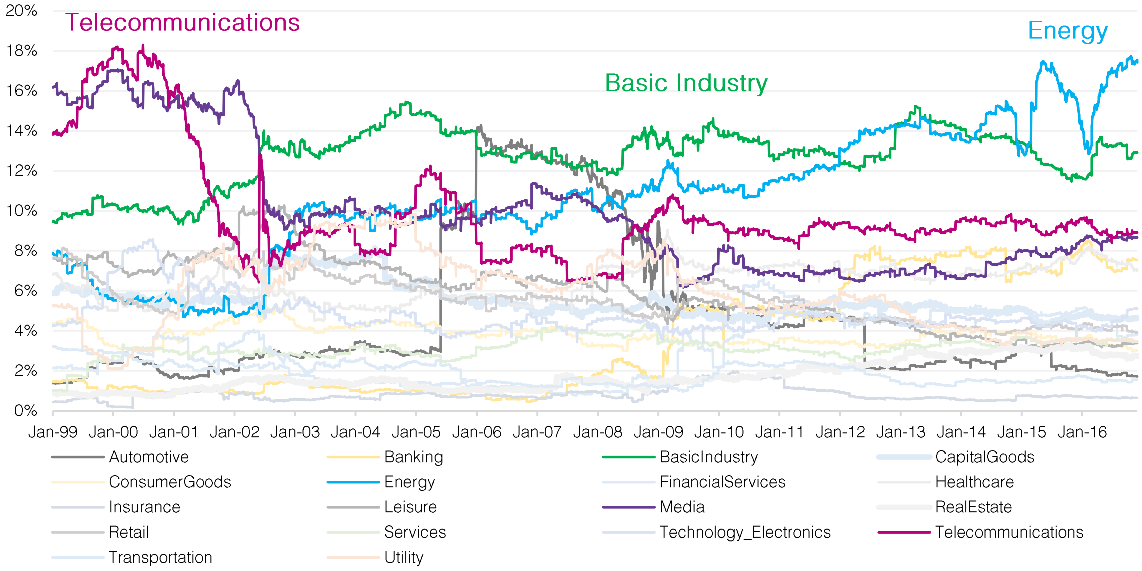
Source: TOBAM.

Historical Sector Weights

In Figure 3 on the following page, we present the historical sector weights of the BoA-ML HWUS index which appear already relatively large in the aforementioned sectors (Telecommunications, Basic industry and Energy) before defaults actually happen.

However, some sectors which have large weights did not experience major subsequent defaults. This is not a surprise since this view does not take into account risk but is solely about notional exposure. For instance, the media sector contributes as much as the telecommunications sector right before the internet bubble. The same remark applies to Energy/Basic industry from 2014 onwards.

Figure 3: Sector's debt-contribution weights of all BoA-ML HWUS issuers



Source: TOBAM.

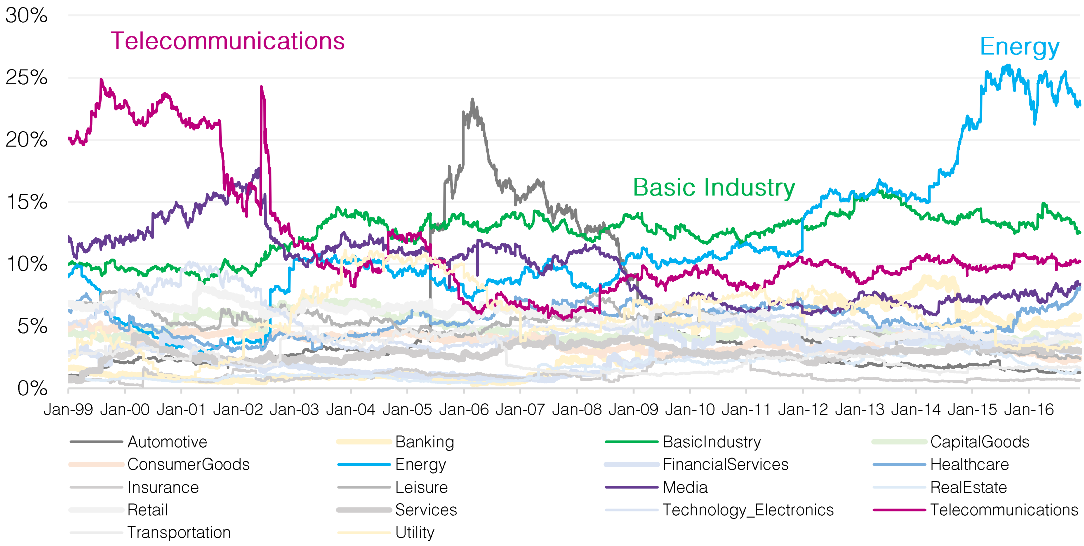
Historical Sector DTS-adjusted Weights

In light of the previous observations, it is natural to consider at this point sector weights that are DTS-adjusted, defined as

$$w_i^r = \frac{w_i \times DTS_i}{\sum_j w_j \times DTS_j},$$

where w_i is the ith sector weight and DTS_i its corresponding Duration Times Spread. We reproduce the same chart in Figure 3 but now use w_i^r.The new results are presented in Figure 4.

Figure 4: Sector's risk-weighted contribution of all BoA-ML HWUS issuers



Source: TOBAM.

We observe from Figure 4 that the DTS-adjusted sector weights put more emphasis on implicit default risk with some of them that can be at times as large as 25% for an index that comprises as many as 18 sectors, resulting on disproportionally large sector bets. Moreover, some of these very large sector bets are actually the ones in which a significant number of defaults happen as shown by Figure 2. For instance, the energy sector clearly dominates during the period from 2014 onwards, meaning that we are able to isolate this sector risk more efficiently than in Figure 3. The same remark goes for the Telecom sector in 1999.

3. Conclusion

The conclusion of this analysis is that **DTS-adjusted weights provide a good measurement of the credit default concentration risk.** Indeed, if we reconsider the energy sector crisis in the US observed in 2016 in Figure 2, we see that its corresponding DTS-adjusted weight significantly dominates the index since mid-2013, whereas the default rate starts to rise at the beginning of 2015. A typical case where credit default concentration risk rises before default actually happen.

Even if this conclusion does not hold in all cases, see e.g. automotive or basic industry sectors, it is clear that it is a better alternative compared to using a simple weighting scheme -duration weighted or not - in order to measure concentration risk.

4. References

Arik Ben Dor, Lev Dynkin, Jay Hyman, Patrick Houweling, Erik van Leeuwen, & Olaf Penninga, DTS (duration times spread), Journal of Portfolio Management, 2007, Winter.

For more information

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