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Searching for the Credit Risk Premium

Measurement, Interpretation & Portfolio Allocation

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PLEASE SEE ANALYST CERTIFICATION(S) AND IMPORTANT DISCLOSURES STARTING AFTER PAGE 33

The Credit Risk Premium

- Corporate excess return (the credit risk premium) figures prominently in investor decision making:
  - Asset Allocation
  - Alpha overlay strategies
  - Risk Parity

- However, there are many ways to define corporate excess return, and they have different
  - Interpretations
  - Returns
  - Correlations with other assets

- Our goal is to highlight and discuss these differences, and explore how they might impact asset allocation

A Credit Risk Premium: 1989 – 2011

IG Non-Call Corp Barclays Index Data: 7/1989 – 12/2011

Average ExRet	= 1.9bp/m	Annual. Sharpe Ratio	= 0.03
Annual ExRet (GM)	= 14.2bp/y	ρ(Corp ExRet, Tsy Ret)	= -0.33
St Dev ExRet	= 118bp/m	Average index duration	= 5.69

Source: Barclays Research

- **Shouldn't the credit risk premium over the past 22 years be higher?**
  - ✓ Perhaps Index constraints/rules caused Index ExRet to be understated?
    - A Fully-Tolerant (FT) or Downgrade-Tolerant (DGT) corporate Index[1] ➔ add back ≈ 19bp/y
  - ✓ Perhaps realized defaults were excessively large?
    - Not really. Realized defaults over the period were ≈ 25bp/y
  - ✓ Perhaps we were not using the "right" duration measure and, so, subtracted the wrong Tsy return?
    - The Index's OAD measure may have been "too high", so ExRet was understated during the down yield cycle
    - Perhaps another duration measure would have been more appropriate? We will investigate this.
  - ✓ Perhaps even with the "right" duration, we should expect low ExRet when Tsy yields fall?
    - Are chgs in default probabilities "naturally" negatively correlated with chgs in Tsy yields?
    - If so, then the 675bp decline in Tsy yields over the period would have strongly dampened reported Index ExRet
    - If and when Tsy yields increase, then won't Index ExRet increase significantly? We will investigate this.
  - ✓ Perhaps we should expect low corporate ExRet in any yield environment?
    - Corporates may have an observed "hedging" benefit for FI portfolios that is likely to reduce ExRet demanded by investors to hold corporates, in either a rising or falling Tsy yield environment

[1] "Capturing Credit Spread Premium", K. Y. Ng and B. Phelps, Barclays Research, 2010

Our Objectives

- We present and interpret various Corporate Index excess return measures
  - Many investors measure corporate ExRet using “analytical” duration (e.g., Barclays Index ExRet)
    - $ExRet^{analyt}$ appear to be very sensitive to movements in Tsy yields
    - There are other $ExRet^{analyt}$ measures. Would these have changed the ExRet story?
  - Another measure of excess return attempts to remove all Tsy related components of returns
    - What are the best ways to compute “empirical” ExRet measures?
    - How do these “empirical” ExRet measures compare to the “analytical” measures?

- Investors are recently drawn to corporate excess return because of worries about rising interest rates
  - How might ExRet perform in a rising yields environment?
  - We present long-term ExRet data from 1973 to 1989, covering periods of sharply rising Tsy yields
  - What are the fundamental drivers of the relationship between Tsy and corporate ExRet?

- What is the relationship between Corp ExRet and other risk premia?
  - What is the historically optimal combination of credit risk premium and Tsy risk premia?
  - Are corporates a substitute for equity risk exposure in a Tsy & equity portfolio?

Credit Risk Premium

$$\text{Corp Total Ret}_t = f(\text{chg Tsy rates, chg in default probabilities, chg in liquidity...})$$

$$\text{Corp ExRet}_t = \text{Corp Total Ret}_t - X\ \text{Tot Ret}_t$$

- A credit risk premium measures the additional return from investing in credit assets
  - But additional to what? There are myriad possibilities.
  - The credit risk premium depends on the risk(s) to which the investor wishes to remain exposed
  - Consequently, the magnitude of the premium will depend, in part, on how this source of return is related to other risk exposures an investor may have

- Typically, the credit risk premium is measured against a benchmark (e.g., a "matched"-Tsy return)
  - But how to measure this Tsy return?

Some Credit Risk Premium Measures

- **$ExRet^{analyt}$: Corp Total Ret_t – Matched-<u>analytical</u> duration Tsy Total Ret_t**
  - **<u>Fully exposed to changes in *default probabilities*</u>**
  - Low performance over long periods
  - Negatively correlated with Tsy returns; ρ(ExRet, Tsy Ret) ≈ -0.3 ➔ hedging benefit for a FI portfolio
  - Not a measure of "credit alpha" because of the negative correlation to Tsy Ret
  - What is the nature of the negative exposure to yields? Is OAD the proper "analytical" duration measure?
  - Should be close to CDS total returns (ignoring any liquidity effects) as CDS returns have little exposure to Tsy yields
  - **<u>What type of investors would use Corporate $ExRet^{analyt}$?</u>**
    - Those who take fundamental views on changes in defaults; macro oriented
    - Understand that changes in defaults are likely to be correlated with changes in Tsy yields

- **$ExRet^{emp}$: Corp Total Ret_t – Matched-<u>empirical</u> duration Tsy Total Ret_t**
  - **<u>Only exposed to changes in *default probs* that are uncorrelated with changes in *Tsy yields*</u>**
  - This ExRet is unrelated to Tsy returns; Remove any macro effect on *def probs* that is also reflected in yields
  - Given their desired statistical property, such durations are typically estimated empirically
  - A measure of "credit alpha" over Treasuries (but not over equities!)
  - **<u>What type of investors would use Corporate $ExRet^{emp}$?</u>**
    - Alpha-only seekers: Those who wish to add a "pure credit overlay" to their existing portfolio
    - $ExRet^{emp}$ is potentially much higher than $ExRet^{analyt}$ since it does not include a hedging component
    - Credit PMs who are not permitted to have positions with any interest rate sensitivity

Analytical Corporate Excess Returns ($ExRet^{analyt}$)

Traditional Corporate Valuation Model – "OAD"

- Recognizes that promised cash flows are risky, but recovery rate upon default is assumed to be zero
  - This model assumes we lose a fixed fraction of each promised cashflow to defaults, without changing the timing of those cash flows[1]
    - This implies that in the event of default the recovery value is assumed to be zero

- This is the common analytical OAD duration
  - This is the duration used by the Index and its ExRet calculations[2]

$$\mathrm{Dur}^{\mathrm{OAD}} = \sum_{i} i \times \frac{c_i}{(1+r+s)^i} \div P_{\mathrm{corp}}$$

- $\mathrm{ExRet}^{\mathrm{OAD}}$ equals the corporate Total Ret less the component of return from a matched-$\mathrm{Dur}^{\mathrm{OAD}}$ Tsy portfolio

[1]This is sometimes referred to as a one-factor model because only short-term rates have a stochastic dynamic (also called the "BK1" model). See Claus M. Pedersen, "Explaining the Lehman Brothers Option Adjusted Spread of a Corporate Bond," *QCR Quarterly*, vol. 2006-Q1

[2] Since 2000, the Index uses KRDs, not OADs, for excess return calculations. In this study we use OAD excess returns throughout to generate a consistent long-term time series of excess returns. In practice, KRD-based ExRets are very close to OAD-based ExRets.

Default-Adjusted Corporate Valuation Model – "DefAdj"

- Another valuation approach, which is consistent with pricing other credit risky assets, assumes promised cash flows are risky, but recovery value may be non-zero[1]
  - In event of default, we receive a (possibly large) recovery amount at default[2]
  - In contrast, the OAD model does not recognize the possibility of a large cash flow before maturity
  - Due to the possibility of receiving recovery before maturity, $\text{Dur}^{\text{DefAdj}}$ is almost always ≤ Dur^{OAD}

$$\text{Dur}^{\text{DefAdj}} = Avg(\text{Dur}^{\text{Zero-recovery Component}}, \text{Dur}^{\text{Recovery Component}}) \leq \text{Dur}^{\text{Zero-recovery Component}} \approx \text{Dur}^{\text{OAD}}$$

- The "default-adjusted" duration has the same interpretation as traditional OAD (*i.e.,* weighted time of cash flows), except that the weights are the probability-weighted PV of cash flows[3]
- $\text{ExRet}^{\text{DefAdj}}$ equals the corporate Total Ret less the component of return from a matched-$\text{Dur}^{\text{DefAdj}}$ Tsy portfolio

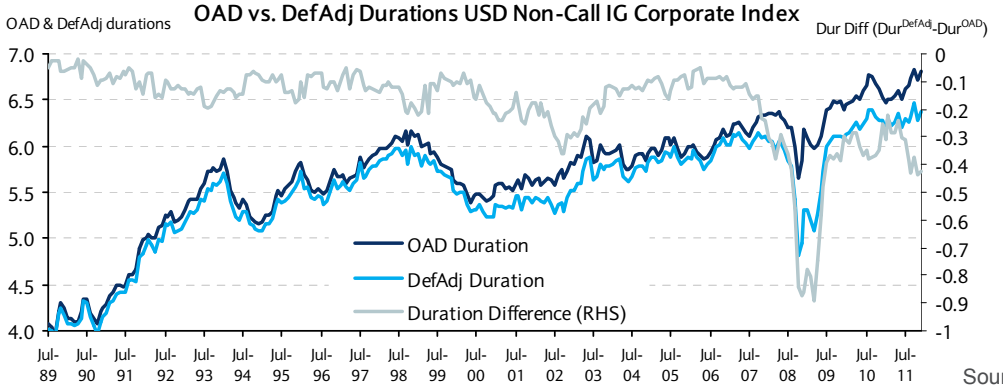
[1] At Barclays, this model is sometimes referred to as the two-factor "BK2" model because of the stochastic dynamic of both the short-term rates and defaults. Arthur M. Berd, Roy Mashal, and Peili Wang, "Consistent Risk Measures for Credit Bonds," *QCR Quarterly*, vol. 2004-Q3/Q4, and Claus M. Pedersen, forthcoming, Barclays, 2012.

[2] At default, we assume the recovery R is a constant percentage of the $\text{PV}_{\text{at default}}$ of the principal amount.

[3] We assume there default probabilities (h) and recovery value (R) are unaffected by interest rate (r) changes. The model can accommodate default probabilities being correlated with changes in Tsy yields, *i.e.,* ρ(r, h) < 0 (which has been true recently in real life!). However, there is little impact on $\text{Dur}^{\text{DefAdj}}$.

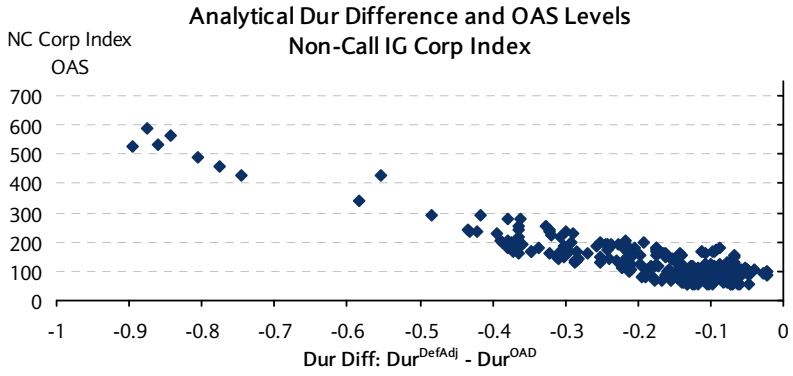
Comparing Corporate Dur^{OAD} vs. Dur^{DefAdj}

- Generally, Dur^{OAD} and Dur^{DefAdj} were reasonably close from July 1989 to Dec 2011
  - Avg(Dur^{DefAdj} – Dur^{OAD}) = -0.18, or ≈ 3% of the reported index OAD
  - Max[Dur^{DefAdj} – Dur^{OAD}] was -0.90 (or, 15% of the reported index OAD) in March 2009

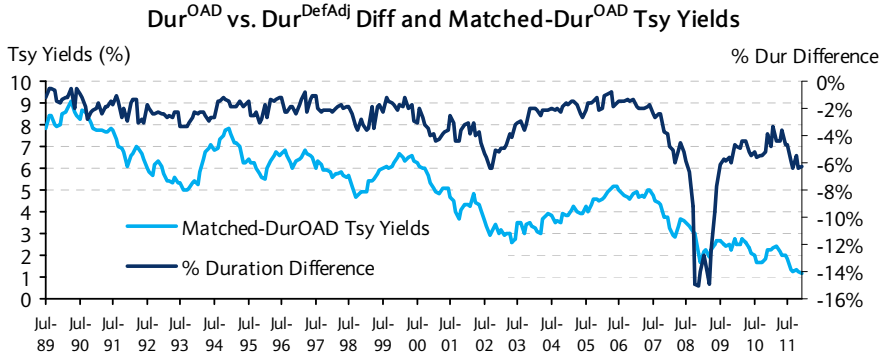


Source: Barclays Research

- When credit spreads (i.e., default probs) rise, Dur^{DefAdj} shortens versus Dur^{OAD}
  - ρ(Δ(Dur^{DefAdj}/ΔDur^{OAD}), OAS) = -0.93
  - Also, ρ(Δ(Dur^{DefAdj}/Dur^{OAD}), ΔTsy yields) = 0.65 ➔ ρ(chg def probs, chg Tsy yields) < 0



Source: Barclays.



Source: Barclays Research

➔ Perhaps, with the secular decline in yields over the past 22 years, $ExRet^{DefAdj}$ will be much larger than $ExRet^{OAD}$?

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$ExRet^{analyt}$: $ExRet^{OAD}$ vs. $ExRet^{DefAdj}$

- The difference in duration is, on average, relatively small (i.e., 3%)
- However, it makes a noticeable ExRet difference because of the excellent performance of Tsy and the timing of the duration differences

7/1989 – 12/2011:[1]	Non-Call IG Corporate		Non-Call DGT Corporate	
	Dur^{OAD}	Dur^{DefAdj}	Dur^{OAD}	Dur^{DefAdj}
Average ExRet	1.9bp/m	2.9bp/m[1]	3.5bp/m	4.5bp/m[2]
Annual ExRet (GM)	14.2bp/y	27.4p/y	32.8bp/y	44.7bp/y
St Dev ExRet	118bp/m	115bp/m	125bp/m	122bp/m
Annualized Sharpe	0.03	0.07	0.08	0.11
ρ(Corp ExRet, Tsy Ret)	-0.33	-0.28	-0.34	-0.30
Average Dur^{analyt}	5.69	5.51 (97%)	5.67	5.50 (97%)

Source: Barclays Research

- $ExRet^{DefAdj}$ is greater than $ExRet^{OAD}$
  - This pickup reflects a corporate valuation model that adjusts duration to reflect changes in default probabilities
  - Attributes more return to changes in credit and less to changes in Tsy yields

- However,
  - $ExRet^{DefAdj}$ is very negatively correlated to Tsy Ret
  - Also, $ExRet^{DefAdj}$ remains low in absolute terms
  - Maybe the low $ExRet^{analyt}$ is the "natural" state of affairs for corporate bonds when Tsy yields decline?

[1] We use the Non-Callable IG Corporate and the Non-Callable Downgrade-Tolerant IG Corporate Index for analysis due to the difficulty of generating default-adjusted duration measures historically for callable bonds.

[2] Index $ExRet^{OAD}$ (bucket method) assumes, by definition, that the market value of Treasuries sold equals the market value of Corporates. With Dur^{DefAdj} (and Dur^{emp}), however, this may not be so. Consequently, we adjust excess returns for any borrowing/lending that may be necessary to be market value neutral.

Negative Correlation of ExRet^{analyt} and Tsy Returns

- It may surprise some investors that corporate ExRet^{analyt} are negatively correlated with Tsy returns
  - After all, are we not hedging out yield exposures?

- If changes in macro conditions[1] drive Tsy yields and default probabilities in opposite directions, then we would naturally expect: ρ(ExRet^{analyt}, Tsy Ret) < 0

Average Monthly ExRet (%)
Non-Call IG Corp Index
7/1989-12/2011

	ΔTsy yields > 0	ΔTsy yields ≤ 0
ExRet^{OAD}	0.38	-0.26
ExRet^{DefAdj}	0.35	-0.21
ExRet Diff	-0.03	0.05

Source: Barclays Research

- We also see this negative correlation in CDX Ret and Tsy Ret:
  - ρ(CDX Ret, Tsy Ret) < 0 is closest to ρ(ExRet^{DefAdj}, Tsy Ret)

	Correlations w/ Tsy Ret			
Period	**CDX**	**ExRet, Emp**	**ExRet, OAD**	**ExRet, DefAdj**
2004Q2-2007Q2	-7%	15%	-24%	-16%
2007Q3-2009Q2	-39%	-15%	-43%	-37%
2009Q3-2012Q3	-67%	2%	-64%	-61%

Source: Barclays Research

- Negative ρ(ExRet^{analyt}, Tsy Ret) suggests:
  - Corps have "hedging properties" in a FI portfolio
  - ExRet^{analyt} is not a "pure" credit alpha since the embedded exposure to Treasury yields is a hedging exposure

- Investors using ExRet^{analyt} in asset allocation analysis need to be aware of:
  - Their sensitivity to changes in Treasury yields
  - Low potential returns if used alone; but offer valuable diversification benefits in a FI portfolio

[1]See, for example, Darrell Duffie and Kenneth Singleton, *Credit Risk*, Ch. 7., Princeton University Press, 2003.

Empirical Corporate Excess Returns ($ExRet^{emp}$)

Empirical Corporate Excess Returns (ExRet^{emp})

- Investors can forego the hedging benefits of corporates by constructing ExRet unrelated to Tsy returns
  - Will they see higher potential excess returns?

- Such corporate ExRet requires a duration measure that includes the entire impact of changes in Tsy yields on corporate returns, both from discounting and the relationship between default probabilities and yields
  - This is typically called an "empirical duration" (Dur^{emp})

$$\text{Corp Total Ret} = \alpha + \beta_{\text{emp}} \times \text{Tsy Total Ret} + \varepsilon$$

$$\text{Dur}^{\text{emp}} \equiv \hat{\beta}_{\text{emp}} \times \text{Dur}^{\text{analyt}}$$

- ExRet^{emp} equals the corporate Total Ret less the component of return from a matched-Dur^{emp} Tsy portfolio
  - ExRet^{emp} is a pure credit "alpha"[1]:
    - reflects idiosyncratic issuer events; and
    - reflects the incremental effect of all macro factors on default probabilities that cannot be explained by changes in yields
  - Expect to observe ρ(Corp ExRet^{emp}, Tsy Ret) ≈ 0

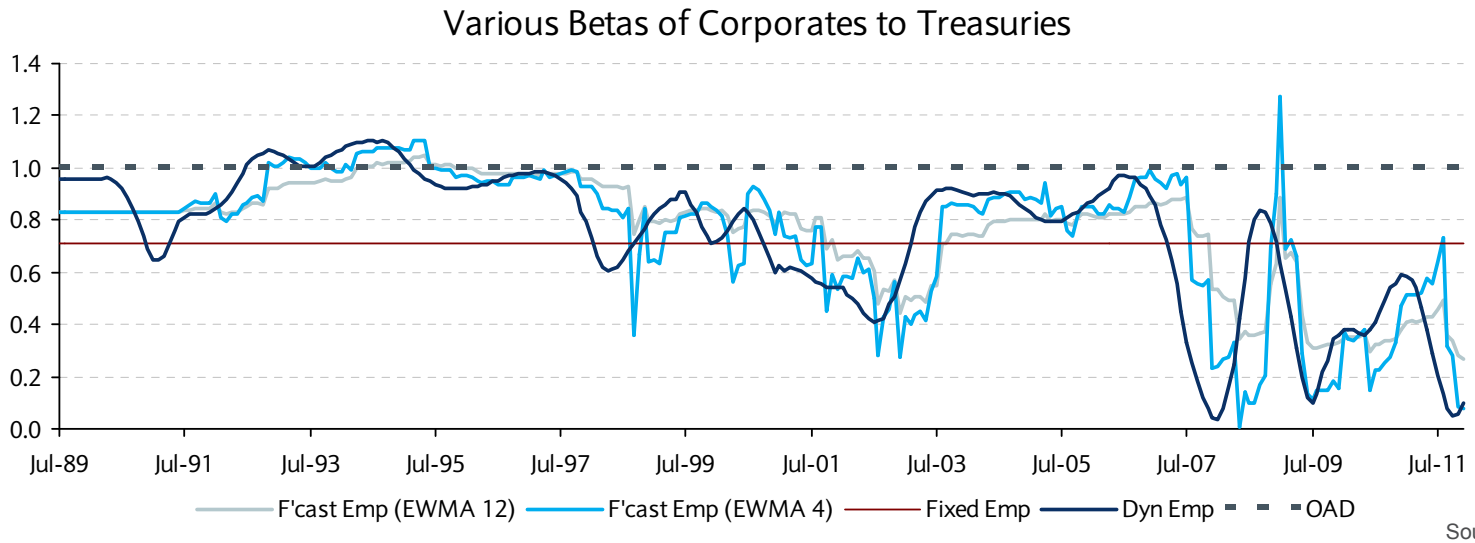
[1]Assuming a pure fixed-income portfolio. Ignores any equity exposure.

Constructing a Dur^{emp} Measure

- In-sample empirical measures use forward-looking information
  - These measures provide an upper-bound on what a forecast model might be able to achieve
  - **"Fixed"** (i.e., one beta for the entire sample) or **"Dynamic"** (i.e., a time-varying beta using a weighting scheme)
  - While a Fixed model is more stable (by definition), a dynamic model contains more relevant information

- Dynamic, in-sample Dur^{emp} uses forward- & backward-looking information
  - Weighting follows a bell-shape centered on current obs, with std dev of 3.5m
  - Optimized to make the rolling $\rho(ExRet^{emp}, Tsy\ Ret) \approx 0$
  - The ratio of Dur^{OAD} to Dur^{emp} is not as tied to the OAS level: $\rho(\Delta(Dur^{OAD}/Dur^{emp}), \Delta OAS) = -0.52$ (versus -0.93)
  - Varies significantly. Its average of 0.77, higher than the fixed beta of 0.71

- Forecast Dur^{emp} uses only backward information
  - Longer weighting schemes produce smoother & less extreme betas (*e.g.,* compare EWMA 12 vs. EWMA 4)
  - Shorter weighting schemes produce a beta closer to the in-sample beta



Source: Barclays Research

The forecast model may be improved (smoother & more responsive) with higher frequency data, *e.g.,* weekly. Currently under investigation.

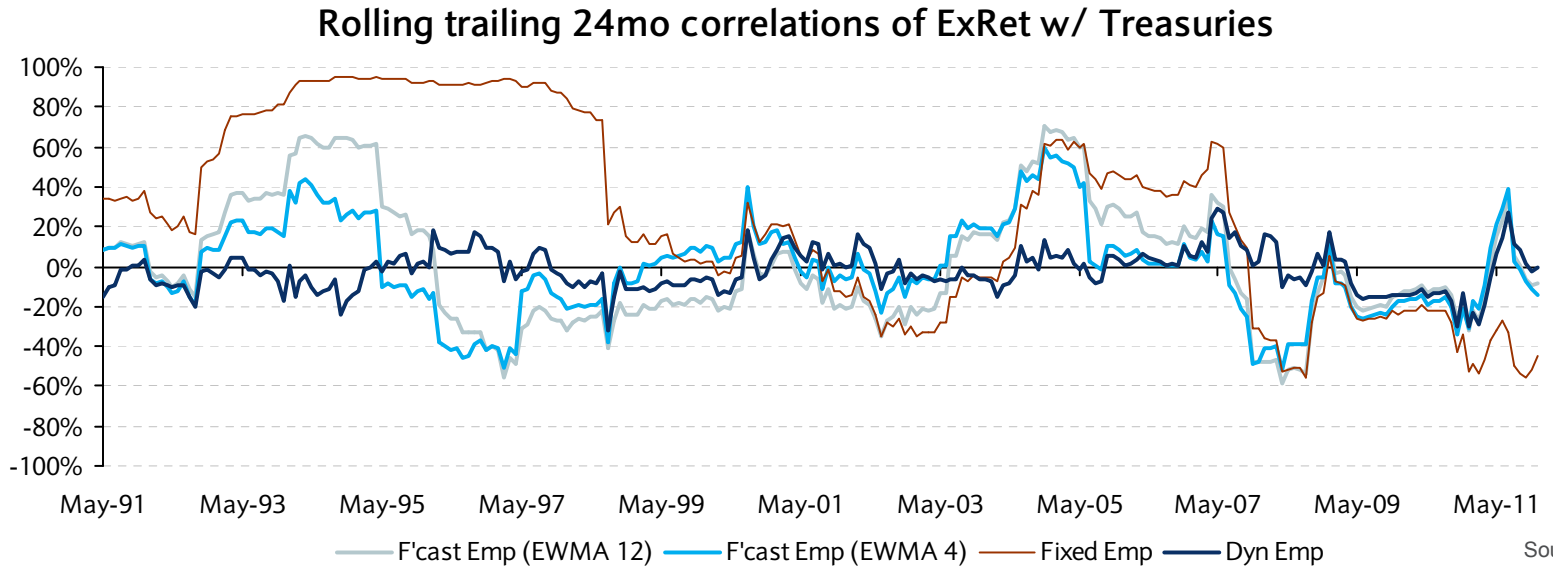
Selecting the "Best" Dur^{emp} Measure

- Dur^{emp} should result in a $ExRet^{emp}$ with low volatility and with zero correlation with Tsy
  - These qualities should be observed also in sub-samples
  - 24mo trailing correlations with Tsy should be [-40%, 40%], 95% of the time, if "true" correlation is zero
  - Look also at min & max, average of absolute values on upside and downside, MSE

- Fixed in-sample betas can result in periods with large positive & negative $\rho(ExRet^{emp}$, Tsy Ret)
  - Realized ExRet volatility is also higher (4.1%/y) than dynamic in-sample ExRet volatility (3.7%/y)
  - This suggests that a dynamic beta is a better approach

- Dynamic in-sample beta produces $\rho(ExRet^{emp}$, Tsy Ret) ≈ 0, even in sub-samples
  - Optimal bell-shaped weighting scheme has a std dev of 3.5 months

- Data suggest that a good forecast model must be "aggressive", e.g., EWMA with 4m half-life
  - More aggressive models result in more volatile $ExRet^{emp}$
  - Transaction costs may be a consideration for models too dynamic. Fortunately, we are working with Tsy.



Source: Barclays Research

Corporate (dynamic, in-sample) ExRet^{emp}

7/1989 – 12/2011:

NC IG Corp Index

	Dur^{OAD}	Dur^{DefAdj}	Dur^{emp}
Avg ExRet	1.9bp/m	2.9bp/m	**12.8bp/m**
Avg ExRet (GM)	14.2bp/y	27.4bp/y	**148.9bp/y**
St Dev ExRet	118bp/m	115bp/m	**102bp/m**
Annualized Sharpe	0.03	0.07	**0.42**
ρ(ExRet, Tsy Ret)	-0.33	-0.28	**-0.03**
Avg duration	5.69	5.51	**4.35**

NC DGT Corp Index

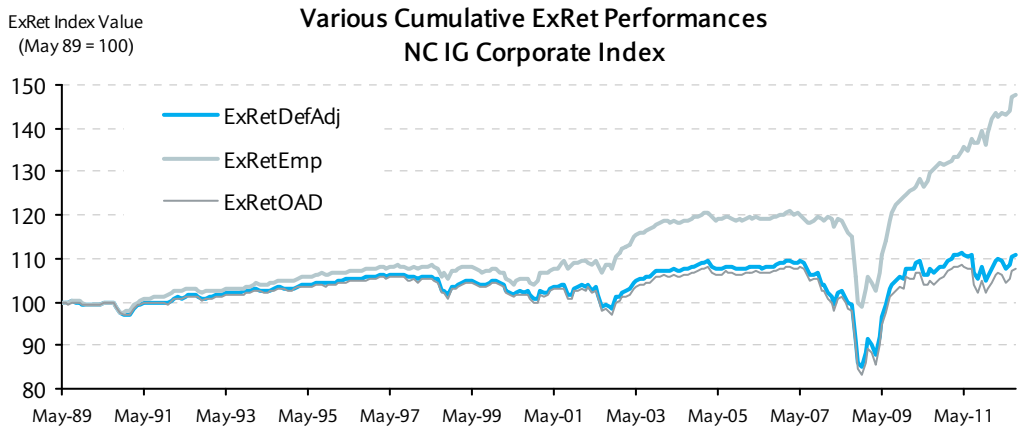
	Dur^{OAD}	Dur^{DefAdj}	Dur^{emp}
Avg ExRet	3.5bp/m	4.5bp/m	**15.5bp/m**
Avg ExRet (GM)	32.8bp/y	44.7bp/y	**180.1bp/y**
St Dev ExRet	125bp/m	122bp/m	**108bp/m**
Annualized Sharpe	0.08	0.11	**0.48**
ρ(ExRet, Tsy Ret)	-0.34	-0.30	**-0.03**
Avg duration	5.67	5.50	**4.16**

Source: Barclays Research

- Average ExRet^{emp} (12.8bp/m) are much larger than ExRet^{DefAdj} (2.9bp/m) or ExRet^{OAD} (1.9bp/m)
  - During periods of declining Tsy yields, shorter Dur^{emp} helps boost ExRet^{emp} relative to ExRet^{analyt}
  - ExRet^{emp} is a measure of the credit "alpha" which is not reduced by any "hedging benefit"
- Realized ρ(ExRet^{emp}, Tsy Ret) ≈ 0.0, as expected

Average Monthly ExRets (%): 1989 – 2011

	ΔTsy yields > 0	ΔTsy yields ≤ 0	ρ(ExRet, Chg Tsy yields)
ExRet^{OAD}	0.38	-0.26	0.33
ExRet^{DefAdj}	0.35	-0.21	0.29
ExRet^{emp}	0.19	0.08	0.07



Source: Barclays Research

Summary

1. There is no “single” corporate spread premium measure. The “right” measure
   - Depends on the risks to which the investor wishes to remain exposed

2. $ExRet^{analyt}$
   - Is not as low as it appears; need to adjust for defaults, index rules, and spread changes from declining Tsy yields
   - $ExRets^{OAD}$ has considerable yield exposures from ρ(chg def probabilities, chg Tsy yields) < 0
   - $ExRet^{DefAdj}$ improves on $ExRet^{OAD}$ by avoiding excessive short yield exposures at critical times
   - May still seem low to some investors; but must recognize that it includes an embedded Tsy hedge

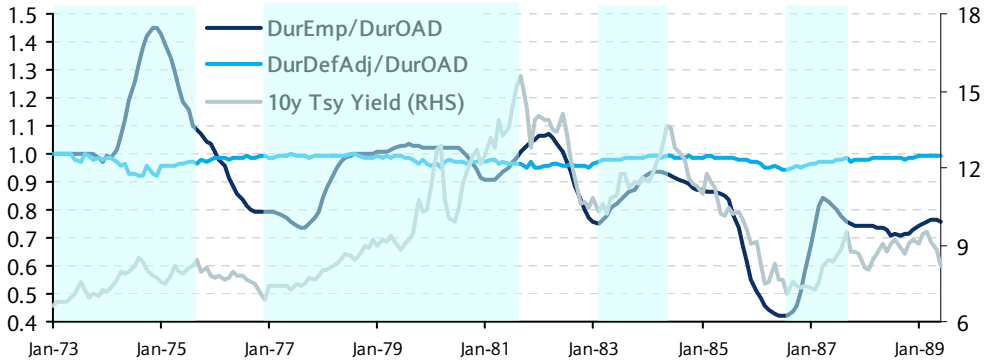
3. $ExRet^{emp}$
   - Measures the corporate spread premium that is unrelated to yields
   - Captures the credit alpha and does not have the embedded hedging benefit of $ExRet^{analyt}$
   - Is typically greater than $ExRet^{analyt}$ as it transforms into performance the hedging benefit of $ExRet^{analyt}$
   - Investors wishing this type of credit exposure may wish to consider using (Corp Index – **Emp Mirror Tsy Index**)

The Long-Term Credit Risk Premium: January 1973 – December 2011

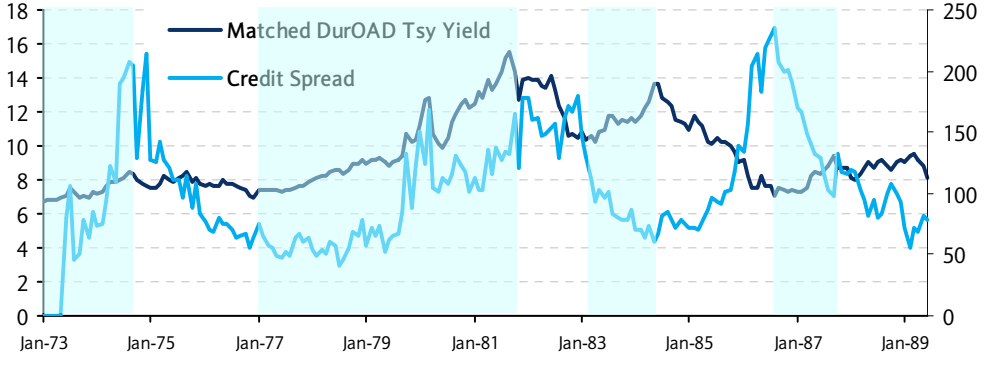
Long-Term Comparison of Dur^{emp} and Dur^{analyt}

- So far, we have examined Corp ExRet from 1989-2011, when Tsy yields had a huge secular decline
- To examine periods of rising Tsy yields, we examine Dur^{OAD}, Dur^{DefAdj} and Dur^{emp} from 1973 to 1989
  - As expected, the ratio of Dur^{DefAdj} to Dur^{OAD}, which is closely related to spreads, was always ≤ 1, ranging from 0.9 to 1.0
  - For Dur^{emp} we use the dynamic in-sample measure described in the previous slides
  - We see that the Dur^{emp} to Dur^{OAD} ratio ranges widely from roughly 0.4 to 1.4, as during the 1989-2011 period
- Dur^{emp}/Dur^{OAD} was sometimes ≥ 1, usually when spreads and Tsy yields moved in the same direction

Duration Ratios: IG Corporate Index



Relationship between Corporate Spreads & Matched Dur^{OAD} Tsy Yields



Source: Barclays Research

Shaded regions indicate periods of rising Tsy yields prior to 1989

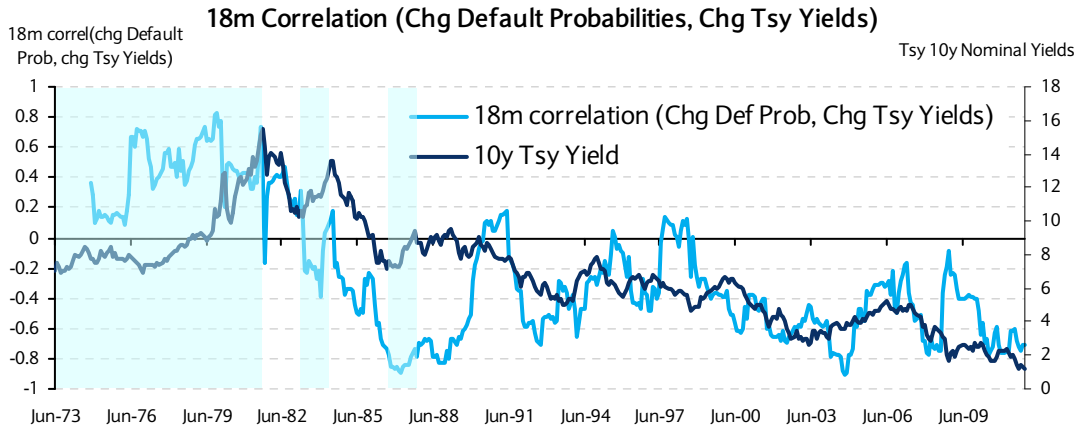
Is There L-T Stability of ρ(chg spreads, chg Tsy yields) < 0?

- For January 1973-September 1981, we see ρ(chg Corp spreads, chg Tsy yields) > 0, unlike 1989-2011
  - This was a period of sharply rising real (+395bp) and nominal (+930bp) Tsy yields
  - Declining growth

- Why the change in the correlation pattern?
  - Conjecture: Inflation drives Tsy nominal yields while Real GDP growth drives credit spreads

1953-2010 Annual Data	Inv Grade Defaults	Chg 10y Tsy	Equity returns
Corr w/ growth	-41%	28%	33%
Corr w/ infl	-9%	28%	-29%

Source: Moody's, Barclays Research, Federal Reserve



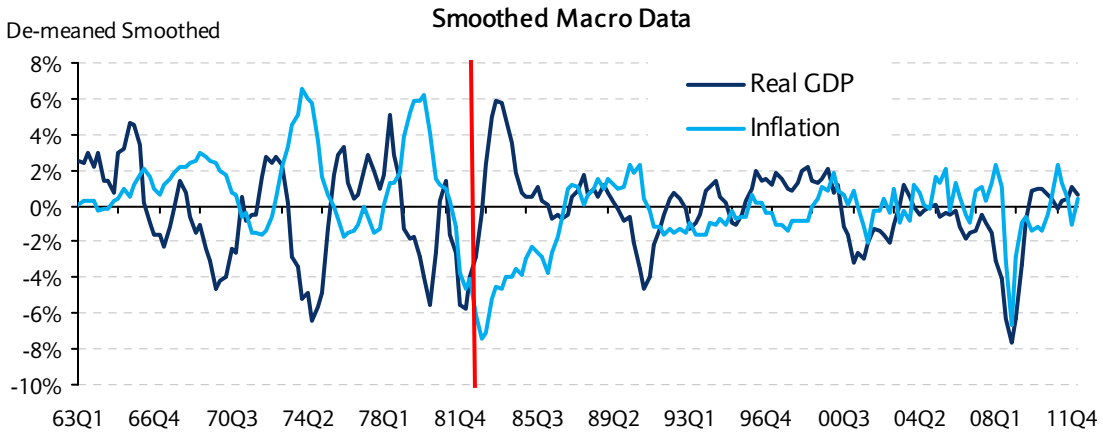
Source: Barclays Research

- From 1973 to September 1981, ρ(GDP growth, inflation) = -0.70; as macro shocks were predominantly supply shocks (commodities)

  ➔ ρ(chg Corp spreads, chg Tsy yields) > 0

- After September 1981, Fed controls inflation expectations; ρ(GDP growth, inflation) = -0.03, with some notable periods of very positive correlations as demand shocks predominated

  ➔ ρ(chg Corp spreads, chg Tsy yields) < 0



Source: Barclays Research

Some Historical Lessons for Today's Investor

- We generated $ExRet^{DefAdj}$, $ExRet^{OAD}$, and $ExRet^{emp}$ for the IG Credit Index from 1973 to 1989

- Jan 1978 - Sept 1981: Sharply rising Tsy yields, nominal and real, declining growth:
  - $ExRet^{analyt}$ would have expected to be very positive based on July 1989-December 2011 experience
    - However, $ExRet^{analyt}$ was negative due to a "reversal" in the spread-Tsy yield correlation
    - Somewhat offsetting this, the lack of a "hedging" benefit would tend to increase the $ExRet^{analyt}$ demanded by investors
    - A cautionary tale for today's credit investor worried about rising interest rates and expecting large $ExRet^{analyt}$
  - $ExRet^{emp}$ also suffered and had similar performance as $ExRet^{analyt}$
    - Default probabilities increased faster than would have been expected given the increase in Tsy yields

Jan 1978-Sept 1981	Corp TotRet - Cash	Tsy TotRet - Cash	$ExRet^{emp}$	$ExRet^{OAD}$	$ExRet^{DefAdj}$	Cash	Chg 10y Tsy (bp)
Annual Ret	-12.9%	-12.3%	-0.9%	-0.7%	-0.9%	11.6%	806
Volatility	11.7%	11.4%	2.2%	2.3%	2.3%		
Sharpe Ratio	-1.10	-1.08	-0.40	-0.29	-0.39		**Chg 10y Real Yield**
Correl w/ Tsy Ret	0.98	1.00	0.01	0.03	0.20		432

Source: Barclays Research

- July 1975 – June 1978: Flat Tsy yields, but high growth:
  - Corp Total Ret was positive while Tsy Total Ret was flat, despite very strong positive correlation
    - $ExRet^{emp}$ was very positive, with a Sharpe close to 2, and zero correlation to Tsy
    - $ExRet^{analyt}$ also performed well, despite negative correlation to Tsy
    - During periods of flat yields, both ExRet measures can perform well with very low volatility
    - Investors should be aware that Corps can have a huge alpha over Tsy, and that both ExRet measures can move similarly

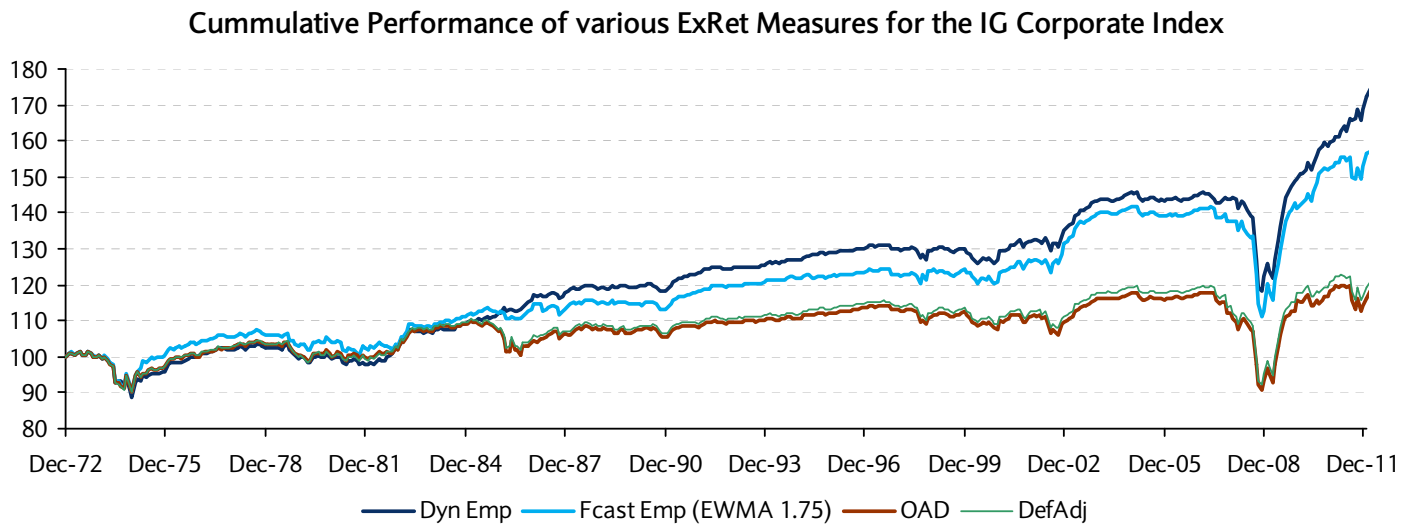
Jul 1975-Jun 1978	Corp TotRet - Cash	Tsy TotRet - Cash	$ExRet^{emp}$	$ExRet^{OAD}$	$ExRet^{DefAdj}$	Cash	Chg 10y Tsy (bp)
Annual Ret	2.7%	0.1%	2.7%	2.6%	2.6%	6.2%	38
Volatility	5.0%	5.1%	1.4%	1.6%	1.6%		
Sharpe Ratio	0.55	0.02	1.94	1.64	1.66		**Chg 10y Real Yield**
Correl w/ Tsy Ret	0.86	1.00	0.05	-0.26	-0.21		5

Source: Barclays Research

Summary

- ExRet^{analyt}:
  - Will not necessarily perform well in rising Tsy yield environments
  - Overall, has relatively low performance (although we are not including the benefits of the index being "fully tolerant")
  - However, has a hedging benefit when added to a Tsy portfolio

- ExRet^{emp}:
  - Over the past 39 years, ExRet^{emp} has been much larger at approximately 1.3% per year
  - With a Sharpe Ratio of 0.43; compares favorably with the Tsy risk premium
  - Its additional performance is a measure of the hedging benefits of ExRet^{analyt} in a portfolio with Tsy



Jan 1973-Dec 2011	Corp TotRet - Cash	Tsy TotRet - Cash	ExRet^{emp}	ExRet^{OAD}	ExRet^{DefAdj}	Cash	Chg 10y Tsy (bp)
Annual Ret	2.1%	1.6%	1.4%	0.4%	0.4%	6.1%	-490
Volatility	7.4%	7.2%	3.3%	3.8%	3.8%		
Sharpe Ratio	0.28	0.22	0.43	0.10	0.12		**Chg 10y Real Yield**
Correl w/ Tsy Ret	0.86	1.00	0.03	-0.23	-0.18		-272

Source: Barclays Research

Optimal Combination of IG Corporates & Treasuries

Allocate to $ExRet^{analyt}$ or $ExRet^{emp}$ in FI Portfolios?

- Treasuries are the centerpiece of any fixed income allocation
  - Is it worth adding corporates?
  - How well are investors compensated for default risk?

- Should we use $ExRet^{analyt}$ or $ExRet^{emp}$ when analyzing whether to add corporates?

  - $ExRet^{analyt}$
    - For investors that have macro views and forecast changes in default probabilities
      - Easy to incorporate these views in the portfolio
    - The tricky part is that $\rho(ExRet^{analyt}, \text{Tsy Ret})$ may be changing with Tsy Ret
      - If it is desired to convert embedded hedging benefits into returns, use a dynamic correlation forecast
      - Dynamic correlations make results closer to $ExRet^{emp}$
    - Difficult to use history to form a base-case view of expected $ExRet^{analyt}$ performance

  - $ExRet^{emp}$
    - For investors that have no views on defaults or the macro economy, but expect corporates to have some positive return
      - Difficult to incorporate any specific views that the PM might have
    - Assume $\rho(ExRet^{emp}, \text{Tsy Ret}) = 0$, by construction
      - Must use a dynamic model to define $ExRet^{emp}$ in the first place
    - Historically it has been reasonable to go with base-case view of equal Sharpe Ratios for both $ExRet^{emp}$ and Tsy

  - For comparison, we also construct Corp & Tsy portfolios using Corp Total Ret

Constructing Optimal Portfolio of Corps & Tsy

- We investigate in-sample optimal portfolios of Treasuries and corporates (NC DGT Corp Index)
  - Use simple mean-variance set-up with fixed portfolio inputs over the entire period
  - Portfolio weights *w*: $\boxed{w = \Lambda^{-1}\Omega^{-1}S}$ $\Lambda = \text{Volatilities};\ \Omega = \text{Correlation Matrix};\ S = \text{Sharpe Ratios}$

- Portfolio construction assumptions:

  - Expected returns (= Sharpe ratios). Choices are:[1]
    - Historical (**MVO**)→ portfolio performance is less sensitive to the definition of Corp ExRet
    - Equal (**MSR**)→ for $ExRet^{emp}$ this is a reasonable assumption as Corp $SharpeR^{emp}$ is close to that for Tsy SharpeR; for $ExRet^{analyt}$ this is not reasonable as it generally much lower reflecting its historical hedging role
    - Views (not using) → particularly well suited for $ExRet^{analyt}$ as they are intuitive for PMs and closely tied to economic growth

  - Correlations. Choices are:
    - For total returns: fixed correlations are not historically justified; also, small errors may have large impacts on solution
    - For $ExRet^{emp}$ we assume zero correlation (by design) so effectively we are incorporating dynamic correlations between total returns and Tsy
    - For $ExRet^{analyt}$ correlations are macro regime dependent, so use either dynamic historical correlations or incorporate views (if you have them)

  - Volatilities:
    - We use in-sample historical fixed, but their dynamics can be reasonably well forecasted

[1]See "Investing with Risk Premia Factors: Return Sources, Portfolio Construction, and Tail Risk Management," R. Gabudean, A. Staal and A. Lazanas, Barclays Research, July 2012.

Results: Portfolios Using ExRet^{analyt}

- We compare a pure Tsy allocation with portfolios of both Tsy and Corporate NC DGT ExRet^{analyt} for 1989-2011
- Given Corp Total Ret SR > Tsy Total Ret SR, adding corps to Tsy has the potential to boost portfolio's SR
  - In-sample historical MVO (i.e., fixed correlation) produces a fixed Corp/Tsy allocation of 56/44
  - Corp Total Ret diversification potential is limited by their 67% Tsy Ret correlation
- ExRet^{OAD} produces the same results as using Corp Total Ret because analytical duration beta is fixed at one
- However, since ExRet^{DefAdj} reflects a dynamic beta to Tsy, historical net allocation[1] to Tsy is time-varying
- Assuming equal SR (MSR) for Corp Total Ret rather than relying on the in-sample performance (MVO)
  - Reduces the allocation to corporates to 48% because in MVO corporates get credit for their higher realized SR vs. Tsy
  - Returns also suffer

	Corp DGT		Portfolios of Corp with Tsy				
MVO	TotRet - Cash	Tsy Ret - Cash	TotRet - Cash	Dyn Emp	Fcast Emp	OAD	DefAdj
Annual Ret	3.53%	3.11%	3.37%	2.47%	2.44%	2.17%	2.22%
Volatility	5.47%	5.14%	4.87%	3.08%	3.34%	3.12%	3.16%
Sharpe Ratio	**0.65**	**0.61**	**0.69**	**0.80**	**0.73**	**0.70**	**0.70**
Weight Corps		0%	56%	53%	44%	36%	37%
Avg Net Weight Tsy		100%	44%	8%	22%	28%	28%
Corr w/ Corp TR	100%	67%	94%	96%	94%	94%	94%
Correl w/ Tsy Ret	67%	100%	88%	77%	84%	88%	88%
Correl w/ ExRet				62%	51%	14%	18%
MSR							
Annual Ret	3.53%	3.11%	3.34%	2.40%	2.25%		
Volatility	5.47%	5.14%	4.84%	3.01%	3.16%		
Sharpe Ratio	**0.65**	**0.61**	**0.69**	**0.80**	**0.71**		
Weight Corps		0%	48%	58%	56%		
Weight Equity		0%	0%	0%	0%		
Avg Net Weight Tsy		100%	52%	-1%	2%		
Correl w/ Corp TR	100%	67%	91%	96%	97%		
Correl w/ Tsy Ret	67%	100%	91%	70%	70%		
Correl w/ ExRet				70%	70%		

Note: MSR assumption about equal Sharpe Ratios does not make sense for ExRet^{analyt}

Source: Barclays Research

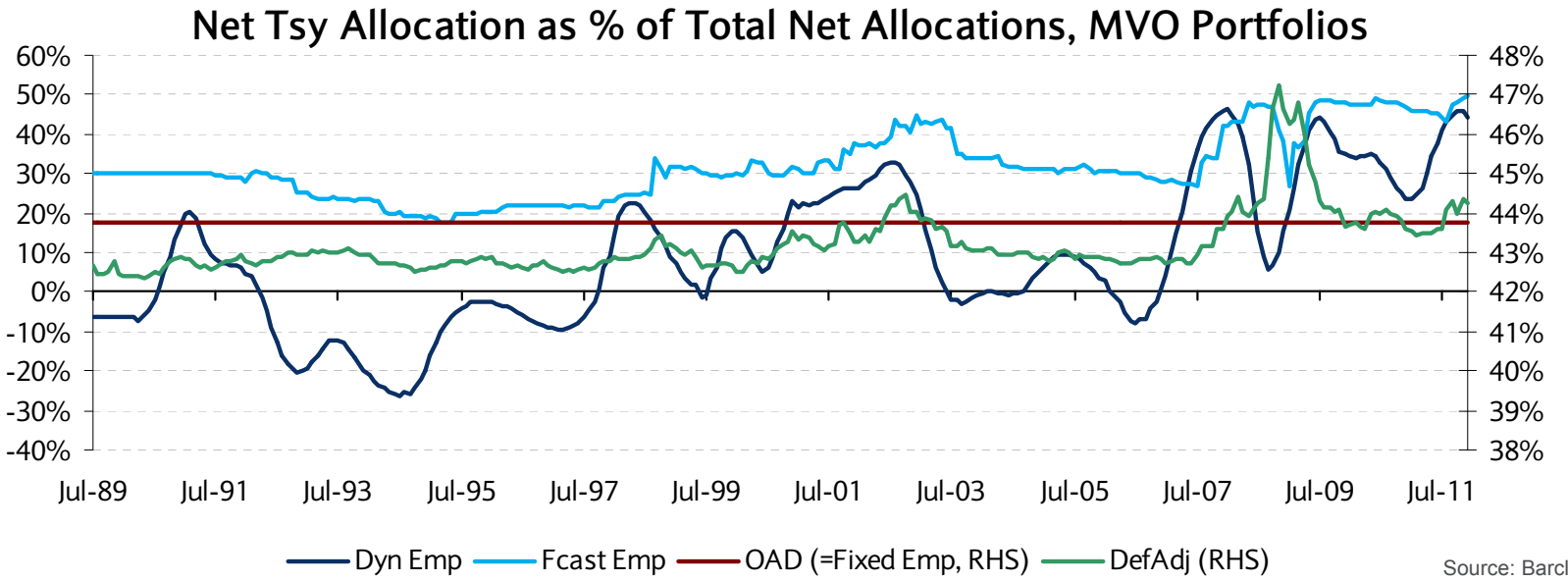
[1]Construction of ExRet from Corporate bonds presumes reducing the Tsy position. For example, for the MVO "Dyn Emp" portfolio we allocate 53% to ExRet and 100%-53% = 47% to Tsy. The 53% allocation to ExRet implies a –Beta^{emp} x 53% allocation to Tsy, reducing the Tsy allocation to 8% from 47% on average. Beta^{emp} varies over time. Alternatively, ExRet can be thought of as allocation to a funded CDX position.

Results: Portfolios Using ExRet^{emp}

- The potential advantage of ExRet^{emp} over ExRet^{analyt} is the implicit use of dynamic correlations
  - SR increases by 0.1
  - On average, we allocate 90/10, but with large swings in between: when Corp/Tsy correlations are ≈ 0 we allocate 20-50% to Tsy

- The benefits of ExRet^{emp} can be partially achieved with a simple forecasting model for empirical beta
  - We use an exponentially decaying weighting scheme with a 4m half-life
  - The optimum allocation to Tsy is higher on average than for dynamic in-sample ExRet^{emp}, but it may have more sudden moves due to the aggressive nature of the forecasting model

- Assuming equal SR (MSR) rather than relying on the in-sample performance (MVO):
  - This is a portfolio with no in-sample data for key parameters: zero correlation, Sharpe Ratios are assumed equal
  - Further increases the allocation to Corporates in the "Dyn Emp" portfolio, keeping the same performance
  - Increases the allocation to Corporates in the "Fcast Emp" to an average of 100%



Source: Barclays Research

Summary

- Historically, adding corporates to a Tsy portfolio has improved the portfolio's Sharpe Ratio
  - Dynamic correlations further improved performance
    - ➔ should be used for $ExRet^{analyt}$; already embedded in $ExRet^{emp}$
  - Best MSR, forecast empirical FI portfolio: a SR of 0.71, versus a SR of 0.61 for Tsy alone
    - On average, we only hold corporate bonds

- The optimal Corp/Tsy fixed allocation from 1989-2011 was 55/45

- Based on its inferior historical performance, $ExRet^{analyt}$ should be used only if the PM has a good view of its future Sharpe Ratio
  - DefAdj analytics may slightly increase the allocation to Tsy when spreads are high

- The optimal combination of Corp & Tsy varies dramatically depending on the investor's approach and views

Portfolio Allocation: Treasuries, Corp ExRet and Equity

The Case for Corps in a Tsy & Equity Portfolio

- Do Corp ExRet contribute anything "new" to a Tsy & equity portfolio?
  - As we saw earlier, Corps give exposure to economic growth
  - But equities are also exposed to growth
- Inflation may affect equities and Corp ExRet^{analyt} differently
  - Inflation makes debt service easier, leading to lower default probabilities and higher ExRets^{analyt}
  - High inflation may be more detrimental to equities because of uncertainty and potential Fed response
- Case study: July 1975-June 1978, when growth and inflation were high
  - Real and nominal yields were flat, but growth was strong
  - Inflation was high
  - Equities underperformed cash, but Corp ExRet performed very well
- Corporates (ExRet^{analyt}) can be a useful addition to a balanced portfolio as a better targeted view on growth

Jul 1975-Jun 1978	Corp TotRet - Cash	Tsy TotRet - Cash	Equity - Cash	ExRet^{emp}	ExRet^{OAD}	ExRet^{DefAdj}	Cash	Chg 10y Tsy (bp)	Chg Real GDP (%/yr)
Annual Ret	2.7%	0.1%	-3.6%	2.7%	2.6%	2.6%	6.2%	38	5.6
Volatility	5.0%	5.1%	13.7%	1.4%	1.6%	1.6%		**Chg 10y Real**	
Sharpe Ratio	0.55	0.02	-0.26	1.94	1.64	1.66		**Yield**	**Chg CPI**
Correl w/ Tsy Ret	0.95	1.00	0.47	0.05	-0.26	-0.21		5	6.7

Source: Bloomberg, Barclays Research

Optimal Portfolios of Corps, Tsy & Equity

- We use the same set-up as we did earlier for optimal Corp & Tsy portfolios; 1989-2011
- Tsy & equity together have an optimal portfolio with a SR of 0.74, higher than a Tsy & Corp portfolio SR of 0.69
- Using Corp Total Ret in long-term MVO portfolios substitute out twice more Tsy than equities (vol adjusted)
  - Tsy allocation is still higher than corporates, in contrast to a pure FI portfolio
  - If we assume equal SRs, we penalize Corps, as it is the only asset positively correlated with the other two
  - In this setting of fixed weights/correlations, using $ExRet^{analyt}$ produces the same result
- Using Corp $ExRet^{emp}$ (*i.e.,* dynamic in-sample correlations with Tsy) improve SR significantly
  - Most allocation is to corporates, but Tsy are higher than a FI portfolio and equities are > 0
  - The MSR (*i.e.,* equal SR) portfolio also offers large improvement and keeps a large allocation to corporates
- Using forecast $ExRet^{emp}$ provides half of the additional benefits of $ExRet^{emp}$, even with a no-view SR

	Tsy Ret -	Equity Ret -	Portfolio of	Portfolios of Corp with Tsy & Equity			
MVO	Cash	Cash	Tsy&Eqt - Cash	TotRet - Cash	Dyn Emp	Fcast Emp	OAD
Annual Ret	3.11%	4.49%	3.56%	3.58%	2.74%	2.88%	2.88%
Volatility	5.14%	15.32%	4.83%	4.77%	3.30%	3.69%	3.83%
Sharpe Ratio	**0.61**	**0.29**	**0.74**	**0.75**	**0.83**	**0.78**	**0.75**
Weight Corps			0%	24%	44%	31%	20%
Weight Equity			18%	14%	6%	9%	11%
Avg Net Weight Tsy			82%	62%	17%	36%	50%
Correl w/ Corp TR	67%	33%	77%	87%	95%	91%	87%
Correl w/ Tsy Ret	100%	-8%	83%	82%	74%	79%	82%
Correl w/ Equity Ret	-8%	100%	49%	48%	44%	46%	48%
Correl w/ ExRet					59%	48%	13%
MSR							
Annual Ret	3.11%	4.49%	3.73%	3.72%	2.89%	2.80%	
Volatility	5.14%	15.32%	5.22%	5.32%	3.57%	3.70%	
Sharpe Ratio	**0.61**	**0.29**	**0.71**	**0.70**	**0.81**	**0.76**	
Weight Corps			0%	-13%	42%	39%	
Weight Equity			25%	27%	12%	12%	
Avg Net Weight Tsy			75%	86%	16%	19%	
Correl w/ Corp TR	67%	33%	73%	67%	91%	91%	
Correl w/ Tsy Ret	100%	-8%	68%	67%	62%	62%	
Correl w/ Equity Ret	-8%	100%	68%	67%	62%	62%	
Correl w/ ExRet					62%	62%	

MSR assumption about Sharpe Ratios does not make sense for $ExRet^{analyt}$

Source: Bloomberg, Barclays Research

Summary

- Corporates provide exposure to growth, while being less influenced by inflation compared to equities
  - Corporates are potentially valuable in a high-inflation, high-growth scenario

- Optimum Corp/Tsy/Equities fixed in-sample allocation from 1989-2011 is 25% / 60% / 15%
  - Having equities in the portfolio makes Tsy more valuable, reducing allocation to Corporates
  - For dynamic correlations Corp & Tsy, Corporates remain the dominant component of the portfolio

- A large part of the additional benefit from Corporates comes from using a dynamic correlation to Tsy
  - It may increase by 100bp/y the performance of an equity & Tsy portfolio with a 10%/y volatility (1989-2011)
  - The portfolio may benefit from dynamic correlations between equities and treasuries as well (to be explored)

- The optimal combination of Corp, Equity, and Tsy varies dramatically depending on the investor's approach and his view of the world
  - But in all of them Corporates should be given as much of a consideration as Equity and Tsy

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