Cross-Sectional Dispersion and Expected Returns

Thanos Verousis[*] and Nikolaos Voukelatos

[*]Newcastle University Business School, Newcastle University

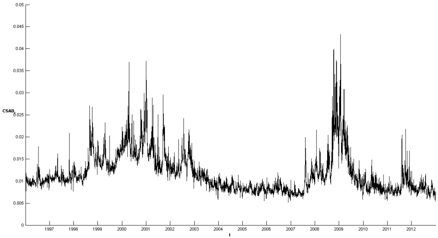
Dispersion

$$CSAD_t = \frac{\sum_{i=1}^{N} |r_{i,t} - r_{mkt,t}|}{N-1}$$

- Cross-sectional dispersion measures the extent to which individual stock returns cluster around (or diverge from) the market consensus
- It represents a natural measure of heterogeneity at the aggregate market level

Dispersion

Figure: Time-series of $CSAD$



- Cross-section of US equity market
  - Jan 1996 to Dec 2012

Scope

- We are pursuing a single research question:

  Is cross-sectional dispersion a priced state variable?

Summary of Results

Cross-sectional dispersion seems to be a priced systematic factor

- Significant negative premium associated with exposure to dispersion risk
- A zero-cost "1-5" spread portfolio offers 11.3% per annum
  - Risk-adjusted return (alpha) is 6.6% per annum
- The associated premium is -1.32% per annum in the cross-section
- This premium is robust to a large set of
  - Idiosyncratic characteristics
  - Other systematic factors

Theoretical Motivation

- Dispersion could represent a state variable that is *negatively* correlated with investment and consumption opportunities
  - Affecting investors' future total welfare
  - Commanding a negative risk-premium
- This negative relationship could stem from
  - Aggregate idiosyncratic shocks
  - Efficiency of index-based cross-hedging

Idiosyncratic Shocks

- Cross-sectional dispersion is, almost by definition, driven by idiosyncratic shocks
- Idiosyncratic risk could be priced (in addition to systematic risk)
  - Some investors hold undiversified portfolios (because of transaction costs, taxes, private information etc.)
  - Goyal and Santa-Clara (2003), Malkiel and Xu (2005)
- Undiversified investors would prefer to hold assets that offer their highest returns when aggregate idiosyncratic risk (and dispersion) is high
- As a result, assets that covary positively with dispersion would be more valuable, offering the lowest expected returns
  - They would act as hedges against (undesirable) increases in dispersion

Cross-Hedging

- Cross-hedging with index derivatives is a fairly common approach in managing the risk of a portfolio in incomplete markets
  - This creates basis risk
- Basis risk is more likely to be higher the more individual stocks offer returns that differ from the index's return (i.e. when dispersion increases)
- Investors would prefer to hold assets that offer their highest returns when the efficiency of cross-hedging is low (and dispersion is high)
- As a result, assets that covary positively with dispersion would be more valuable, offering the lowest expected returns

Portfolio Formation

- At the beginning of every month, we estimate the stocks' sensitivities to changes in dispersion by running

$$r^e_{i,t} = \alpha + \beta_{i,MKT} MKT_t + \beta_{i,\Delta CSAD} \Delta CSAD + \epsilon_{i,t}$$

  - Daily observations over the previous month
  - Only two factors in the pre-formation regressions (Ang et al., 2006)
- Then, we sort stocks into quintiles
  - From lowest (most negative) to highest (most positive) dispersion betas
- We also sort stocks into portfolios according to the betas' sign (N and P)
- Value-weighted time-series of portfolio returns

Portfolio Returns

The portfolio returns are consistent with a negative dispersion premium

- Mean returns decrease monotonically as dispersion betas increase
- A zero-cost “1-5” spread portfolio earns 0.94% per month
- A “N-P” spread portfolio earns 0.52% per month

Portfolio Returns

Table: Returns of sorted and spread portfolios

	Mean	St.Dev.	Pre-formation $\beta_{\Delta CSAD}$	Post-formation $\beta_{\Delta CSAD}$	Mkt Share (%)
			Panel A: Sorted Portfolios		
1	0.0137	0.0739	-6.85	-0.03	0.14
2	0.0118	0.0752	-2.19	0.06	0.22
3	0.0076	0.0464	0.06	0.10	0.25
4	0.0065	0.0496	2.30	0.19	0.24
5	0.0043	0.0649	6.71	0.22	0.15
			Panel B: Spread Portfolios		
1-5	0.0094				
	(2.82)				
N-P	0.0049				
	(2.28)				

Accounting for Systematic Factors

- Could the significant returns of the "1-5" spread portfolio represent compensation for exposure to another source of risk?
- We regress "1-5" returns on a set of well-known systematic factors

$$r_{p,t} = \alpha_p + \beta'_{p,syst} F_t + \epsilon_{p,t}$$

  - The set F_t consists of the 3 Fama-French factors (MKT, SMB, HML) and the Carhart Momentum factor (MOM)
- Alpha is 0.55% (per month) and statistically significant
  - The "N-P" portfolio's alpha is statistically insignificant, though
- The negative dispersion premium is still significant

Accounting for Stock Characteristics #1

We employ a two-pass approach (Goyal and Saretto, 2009)

- We obtain individual stocks' alphas by regressing monthly excess returns against systematic factors (full-sample)

$$r^e_{i,t} = \alpha_i + \beta_i' F_t + \epsilon_{i,t}$$

- We then regress the risk-adjusted returns against a set of idiosyncratic characteristics
  - Characteristics are lagged by one month
  - One cross-sectional regression per month (reporting the mean coefficients)

$$r^e_{i,t} - \hat{\beta}_i' F_t = \gamma_{0,t} + \gamma_{1,t}' Z_{i,t-1} + u_{i,t}$$

- Significantly negative dispersion betas
  - Stocks with higher dispersion betas tend to earn lower returns, after accounting for several other stock characteristics

Accounting for Stock Characteristics #1

Table: Risk-adjusted stock returns controlling for stock characteristics: Two-pass regressions

constant	0.0077
	(2.14)
$\beta_{\Delta CSAD}$	-0.0001
	(-2.28)
size	0.0000
	(-2.54)
r_{MOM}	0.0009
	(0.47)
std.dev.	0.0420
	(0.36)
skewnes	-0.0001
	(-0.96)
kurtosis	0.0000
	(-0.22)
forecast dispersion	0.0001
	(1.18)
liquidity	-5.6118
	(-0.87)
systematic risk %	0.0189
	(1.90)
co-skewness	-0.0022
	(-2.47)
idiosyncratic volatility	-0.0143
	(-0.50)
$Adj.R^2$	0.26

Accounting for Stock Characteristics #2

- We construct double-sorted portfolios
  - First sort on a particular idiosyncratic characteristic (quintiles)
  - Second sort on the dispersion beta (quintiles)
  - We average the monthly returns of the dispersion-based portfolios across each characteristic-based quintile
  - This ensures that the dispersion-based quintiles are not overpopulated by stocks with specific characteristics
- The mean returns of the "1-5" portfolios exhibit some variability across the double sorts
- However, dispersion betas are still significantly related to expected returns
  - Always in excess of 0.59% per month
- The negative monotonic relationship between dispersion betas and portfolios' expected returns holds across all double sorts

Accounting for Stock Characteristics #2

Table: Stock returns controlling for stock characteristics: Double-sorted portfolios

	1-5	N-P
β_{MKT}	0.0086	0.0053
size	0.0110	0.0060
r_{MOM}	0.0076	0.0026
std.dev	0.0078	0.0056
skewness	0.0064	0.0033
kurtosis	0.0101	0.0051
forecast dispersion	0.0109	0.0073
liquidity	0.0103	0.0029
systematic risk %	0.0070	0.0037
co-skewness	0.0059	0.0029
idiosyncratic volatility	0.0084	0.0034

Robustness

- We re-compute the returns of the “1-5” spread portfolio under various alternative settings
  - Longer portfolio formation periods
  - Positive vs negative excess market returns
  - Positive vs negative dispersion changes
  - $\Delta CSAD$ computed through a AR(1) model
  - Industry groupings
- We obtain similar results

The Price of Dispersion Risk

- We need to create an investible portfolio that captures the time variation of $\Delta CSAD$
  - We follow Lamont (2001) and Ang et al. (2006)
- We regress dispersion changes against the returns of the quintile portfolios (every month using daily data)

$$\Delta CSAD_t = c + b' P_t + \epsilon_t$$

- We create a dispersion-mimicking factor as

$$FCSAD = \hat{b}' P_t$$

The Price of Dispersion Risk

We compute the price of dispersion risk in the cross-section through the standard Fama-MacBeth (1973) two-pass methodology

1. Construct a set of 25 test assets
   - That differ in terms of sensitivity to dispersion
   - Double-sorted portfolios (market beta and dispersion beta)
2. Regress excess returns of the 25 assets against a set of systematic factors
   - Obtain sensitivities to aggregate sources of risk
3. Regress mean excess returns against the previously obtained betas

$$\bar{r}_p^e = \lambda_0 + \lambda' \beta'_{p,syst} + u_p$$

The Price of Dispersion Risk

The set of systematic factors consists of

- The three Fama and French (1993) factors MKT, SMB, HML
- The Carhart (1997) momentum factor MOM
- Our aggregate dispersion factor FCSAD
- The Pastor and Stambaugh (2003) aggregate liquidity factor FLIQ
- The market's implied volatility index FVIX (Ang et al., 2006)
- The mean dispersion of analysts' earnings forecasts FFDISP
- The mean stock variance FSVAR (Guo, 2006; Welch and Goyal, 2009)
- The macroeconomic uncertainty index FUNC (Bali et al., 2015)

The Price of Dispersion Risk

- Dispersion earns a significantly negative risk premium in the cross-section
  - -0.11% per month (-1.32% per annum)
  - Distinct from premia commanded by other systematic factors

The Price of Dispersion Risk

Table: The price of cross-sectional dispersion risk

	I	II	III	IV	V	VI
constant	-0.011	-0.018	-0.018	-0.010	-0.011	-0.017
	(-0.55)	(-1.36)	(-1.39)	(-0.66)	(-0.71)	(-0.66)
MKT	0.141	0.154	0.153	0.125	0.127	0.140
	(4.35)	(5.30)	(5.88)	(3.69)	(3.79)	(2.44)
SMB	0.135	0.129	0.129	0.086	0.083	0.086
	(2.24)	(3.86)	(3.03)	(1.56)	(1.25)	(1.27)
HML	0.032	-0.009	-0.010	-0.049	-0.051	-0.040
	(0.68)	(-0.26)	(-0.30)	(-1.31)	(-1.22)	(-0.70)
MOM	0.286	0.254	0.256	0.234	0.227	0.213
	(2.92)	(4.53)	(3.83)	(3.19)	(2.30)	(2.04)
$FCSAD$	-0.10	-0.10	-0.10	-0.11	-0.11	-0.11
	(-2.44)	(-2.45)	(-2.68)	(-2.81)	(-3.17)	(-3.22)
$FLIQ$		0.151	0.135	0.123	0.134	0.105
		(2.24)	(1.14)	(0.83)	(1.01)	(1.14)
$FVIX$			-0.117	-0.101	-0.099	-0.098
			(-1.47)	(-1.26)	(-1.12)	(-1.47)
$FFDISP$				-0.018	-0.018	-0.017
				(-1.97)	(-1.49)	(-0.63)
$FSVAR$					-0.022	-0.006
					(-0.39)	(-0.35)
$FUNC$						-0.563
						(-1.12)
$Adj.R^2$	0.89	0.90	0.90	0.90	0.90	0.90

Conclusions

- Cross-sectional dispersion represents a good candidate for a priced state variable
  - Idiosyncratic risks in undiversified portfolios
  - Efficiency of cross-hedges
  - A negative risk premium is expected
- The empirical results confirm this hypothesis
  - Stock returns decrease monotonically as their sensitivity to dispersion changes increases
  - A "1-5" spread portfolio earns statistically and economically significant returns (6.6% per annum risk-adjusted)
  - The risk-premium in the cross-section is -1.32% per annum
  - These results are robust to a large set of idiosyncratic characteristics and systematic risk factors