Are Disagreements Agreeable? Evidence from Information Aggregation

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Time-Series Return Predictability

- Return predictability is as central as it is old:

$$R_{t+1} = \alpha + \beta Z_t + \varepsilon_{t+1}.$$

- Welch and Goyal (2008): out-of-sample (OOS) forecasting
  - In-sample forecasting $\neq$ OOS (i.e., profitability)
  - Traditional predictors, such as $r_{f,t}$ and d/p_t, do not have OOS power
  - Possible reason: parameter uncertainty and model instability
- Some promising economic predictors:
  1. Output gap (Cooper and Priestley, 2009)
  2. Ene-of-the-year economic growth (Møller and Rangvid, 2015)
  3. Aggregate short interest (Rapach, Ringgenberg, and Zhou, 2016)
  4. Variance risk premium (Pyun, 2018JFE)

Economic variables can predict stock returns out-of-sample!

How about Investor Disagreement as a Predictor?

- Stock prices are driven by both fundamentals and investors' belief (Shiller, 1981).
- Disagreement is one dimension to capture investors' belief.
- Without disagreement, it is difficult to explain why investors would trade (Milgrom and Stockey, 1982).
- Disagreement has been explored as early as Miller (1977).
- Its effect is widespread:
  1. Stock return and volatility
  2. Liquidity
  3. Trading volume
  4. Government bond
  5. Firm investment

Disagreement represents "the best horse" for behavioral finance to obtain as much insights as classical asset pricing theories (Hong and Stein, 2007).

Disagreement Generates Predictability

1. Theoretically
   - –Miller (1977)
   - –Banerjee (2011)
   - –Atmaz and Basak (2018)
2. Empirically
   - –Yu (2011): analyst forecast dispersion
   - –Carlin, Longstaff, and Matoba (2014): disagreement on mortgage prepayment

Can disagreement predict stock returns OOS?

Many Proxies: Unobservable

1. Professional forecast-based
   - Gross domestic production forecast dispersion (D^{GDP})
   - Gross domestic production growth forecast dispersion (D^{GDPg})
   - Industrial production forecast dispersion (D^{IP})
   - Industrial production growth forecast dispersion (D^{IPg})
   - Unemployment forecast dispersion (D^{UEP})
   - Investment forecast dispersion (D^{INV})
   - Investment growth forecast dispersion (D^{INVg})
   - Consumer price index forecast dispersion (D^{CPI})
   - 3-month T-bill forecast dispersion (D^{TBL})
   - Value-weighted analyst forecast dispersion (D^{Yu})
   - Beta-weighted analyst forecast dispersion (D^{HS})
2. Household forecast-based
   - Realized personal financial improvement dispersion (D^{RPF})
   - Expected personal financial improvement dispersion (D^{EPF})
   - Business condition dispersion (D^{BC})
   - Unemployment condition dispersion (D^{UC})
   - Interest rate condition dispersion (D^{IRC})
   - Vehicle purchase condition dispersion (D^{VPC})
3. Market information-based
   - Standardized unexplained volume (D^{SUV})
   - Idiosyncratic volatility (D^{IVOL})
   - OEX call/put open interest difference (D^{OID})

Predictive Ability of Disagreement Proxies

$$R_{t+1}^{\text{S\&P500}} = \alpha + \beta D_t + \varepsilon_{t+1} \quad \text{(monthly)}$$

Disagreement	β	t-stat	R^2	R^2_{OS}
D^{GDP}	−0.15	−0.73	0.12	−1.69
D^{GDP_g}	−0.29	−1.60	0.43	−3.01
D^{IP}	−0.11	−0.60	0.06	−2.33
D^{IP_g}	−0.01	−0.05	0.00	−2.13
D^{UEP}	0.13	0.59	0.08	−0.35
D^{INV}	−0.21	−1.16	0.24	−2.69
D^{INV_g}	0.20	1.19	0.22	−0.68
D^{CPI}	−0.36	−1.62	0.71	−5.44
D^{TBL}	−0.66***	−2.57	2.37	−3.60
D^{Yu}	−0.32	−1.71	0.66	−3.08
D^{HS}	−0.14	−0.67	0.14	−2.80
D^{RPF}	−0.20	−1.01	0.22	−2.57
D^{EPF}	−0.22	−1.01	0.25	−3.05
D^{BC}	−0.24	−1.25	0.31	−4.26
D^{UC}	−0.05	−0.23	0.01	−2.02
D^{IRC}	−0.23	−0.99	0.28	−1.74
D^{VPC}	−0.14	−0.69	0.11	−1.89
D^{SUV}	−0.27	−1.61	0.40	−2.44
D^{IVOL}	−0.20	−1.02	0.21	−3.36
D^{OID}	−0.20	−0.56	0.08	−2.12

This Paper

Attempts to construct a disagreement index that

1. can significantly predict the market, and
2. is consistent with the implications of theories on disagreement.

Our Method: Aggregating Info by Eliminating Noise

- Weak performance may be due to
  1. too much noise in individual proxies
  2. pockets of predictability (Farmer, Schmidt, and Timmermann, 2018)
- If proxies measure disagreement, they should have a common factor.
- Three information shrinkage approaches
  1. Equal-weighting (EW) $\rightarrow D^{\mathrm{EW}}$
  2. Principal component analysis (PCA) $\rightarrow D^{\mathrm{PCA}}$
  3. Partial least squares (PLS) $\rightarrow D^{\mathrm{PLS}}$
- Sample period: 1968:12–2016:12

Predictive Ability of Our Disagreement Indexes

$$R^{\text{S\&P500}}_{t,t+h} = \alpha + \beta D_t + \varepsilon_{t+1}$$

Disagreement	β	t-stat	R^2	R^2_{OS}
Panel A: $h = 1$				
D^{EW}	-0.62^{***}	-3.09	1.53	0.13
D^{PCA}	-0.35^{**}	-2.02	0.56	-0.24
D^{PLS}	-0.83^{***}	-3.69	2.59	1.94^{**}
Panel B: $h = 3$				
D^{EW}	-0.61^{***}	-3.30	4.31	1.41^{**}
D^{PCA}	-0.35^{**}	-2.15	1.57	0.00
D^{PLS}	-0.80^{***}	-3.72	6.93	5.29^{***}
Panel C: $h = 12$				
D^{EW}	-0.56^{***}	-3.24	6.97	6.89^{***}
D^{PCA}	-0.24^{*}	-1.77	2.77	-0.38
D^{PLS}	-0.67^{***}	-4.81	18.53	14.32^{***}

PLS seems the most efficient approach for information aggregation in predictability (Kelly and Pruitt, 2013): Target driven

Economic Gain from Disagreement Forecasting

An mean-variance investor's optimal portfolio on the risky asset is

$$w_t = \frac{1}{\gamma} \frac{\hat{R}_{t+1}}{\hat{\sigma}^2_{t+1}}.$$

1. Believes predictability: $\hat{R}_{t+1} = \hat{\alpha} + \hat{\beta} D_t$
2. Doesn't believe predictability: $\hat{R}_{t+1}$ is the sample mean

	No transaction cost		50 bps transaction costs	
	CER gain (% per year)	Sharpe ratio	CER gain (%)	Sharpe ratio
Panel A: Risk aversion $\gamma = 3$				
D^{EW}	0.50	0.10	−0.01	0.08
D^{PCA}	−0.34	0.08	−0.50	0.08
D^{PLS}	4.39^{***}	0.18^{***}	3.58^{**}	0.16^{**}

4.39 means that the investor can earn 4.39% more certainty-equivalent returns (CER) if believing predictability

Top 3 Weights (in %) on Individual Disagreement Proxies

		EW	PCA	PLS
D^{IP}	industrial production forecast dispersion	5.00	8.11	2.00
D^{TBL}	T-bill forecast dispersion	5.00	2.85	15.91
D^{Yu}	value-weighted forecast dispersion	5.00	9.63	9.46
D^{HS}	β-weighted forecast dispersion	5.00	10.12	4.55
D^{SUV}	standardized unexplained volume	5.00	2.96	8.60

Disagreement Predicts the Market Because It Predicts Future Economic Activities

1. Disagreement represents uncertainty, and high uncertainty leads to cautious investment and hiring (Bloom, 2009; Bachmann et al., 2013).
2. Disagreement amplifies investors' optimism, boosting current economic activities and dampening future's (Baker, Hollifield, and Osambela, 2016; Atmaz and Basak, 2018).

Disagreement should negatively predict future economic activities.

Disagreement Predicts the Market Because It Predicts Future Economic Activities Cont'd

$$y_{t+1} = \alpha + \beta D_t^{\mathrm{PLS}} + \sum_{i=1}^{12} \lambda_i y_{t-i+1} + \epsilon_{t+1},$$

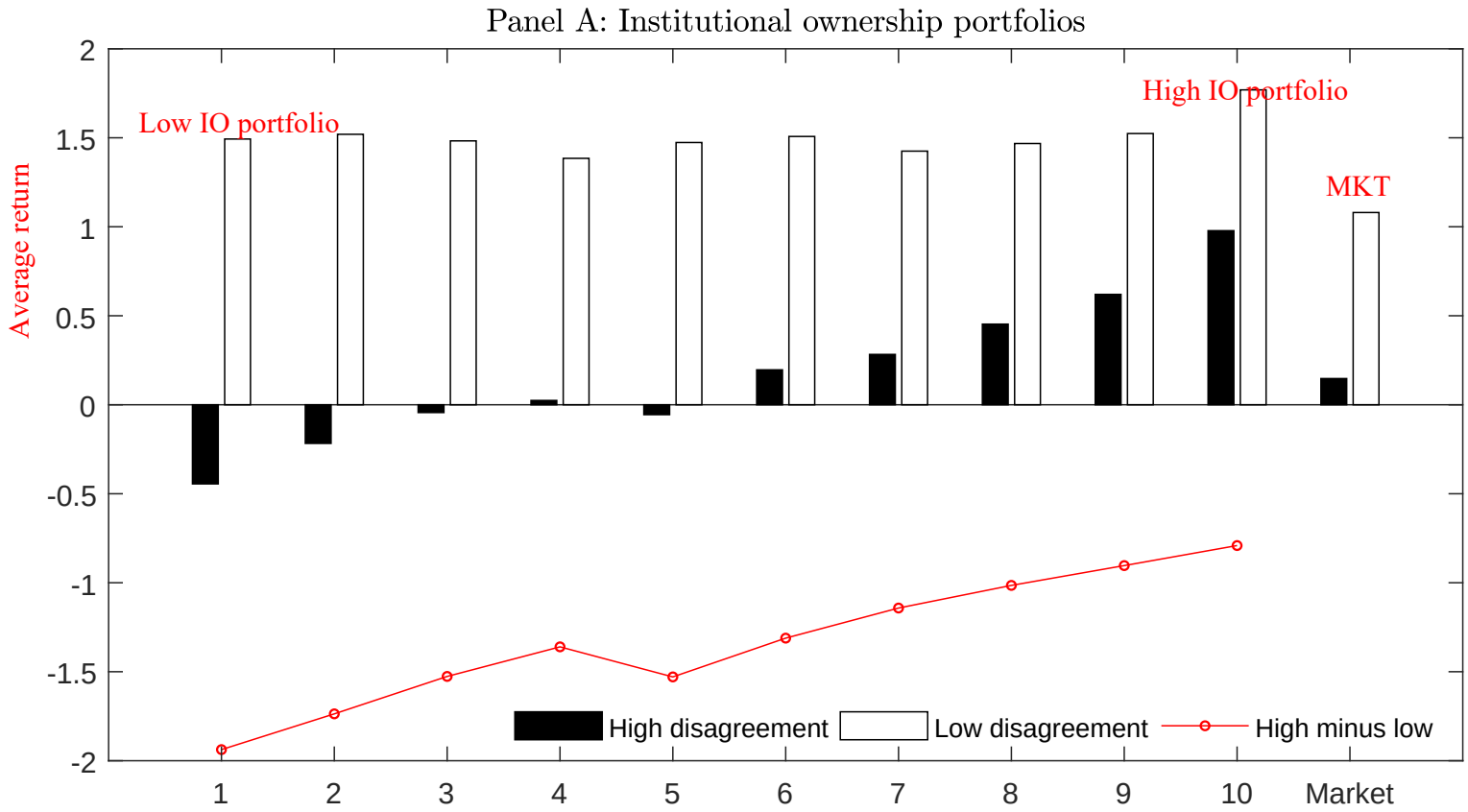
$$y_{q+1} = \alpha + \beta D_q^{\mathrm{PLS}} + \sum_{i=1}^{4} \lambda_i y_{q-i+1} + \epsilon_{q+1}$$

	β	t-stat	R^2
CFNAI	-0.97^{**}	-2.38	27.77
Industrial production	-1.21^{***}	-3.15	22.86
Consumption	-0.06^{**}	-2.26	61.54
Unemployment	0.32^{***}	3.47	17.94
Investment (quarterly)	-3.28^{***}	-2.91	12.06
Equity issuance	-0.47^{***}	-2.02	34.11
Business inventory	-0.59^{**}	-2.44	59.94
Capacity utilization	-0.71^{**}	-2.30	20.43

Forecasting Asymmetry of Disagreement

- Cross-sectionally, the predictive power should be stronger among stocks with
  1. low institutional ownership (Nagel, 2005)
  2. high beta (Hong and Sraer, 2016)
  3. high IVOL (Stambaugh, Yu, and Yuan, 2015)
- In time-series, the predictive power should be stronger in high sentiment periods (Atmaz and Basak, 2018).

Cross-Sectional Predictability Asymmetry



- Low ownership indicates more stringent short sale constraints and therefore more overpricing (Miller, 1977).
- The results with beta and IVOL portfolios are consistent with the literature.

Time-Series Predictability Asymmetry

Panel A: Performance of $R_{t+1} = \alpha + \beta D_t + \varepsilon_{t+1}$ in high and low sentiment periods

	In-sample R^2		Out-of-sample R^2_{OS}	
	High sentiment	Low sentiment	High sentiment	Low sentiment
D^{EW}	2.89	−0.02	−0.23	0.49
D^{PCA}	1.47	−0.49	−0.52	0.07
D^{PLS}	4.74	0.08	3.53**	−0.22

Panel B: $R_{t+1} = \alpha + \beta_1 I_t^{\mathrm{high}} D_t + \beta_2 I_t^{\mathrm{low}} D_t + \epsilon_{t+1}$

	β_1	t-stat	β_2	t-stat	R^2
D^{EW}	−1.00***	−3.57	−0.30	−1.09	2.01
D^{PCA}	−0.72**	−2.66	−0.04	−0.19	1.07
D^{PLS}	−1.02***	−3.63	−0.36	−0.94	2.92

More Results

The aggregate disagreement indexes positively predict

1. stock market volatility (Atmaz and Basak, 2018)
2. market illiquidity (Sadka and Scherbina, 2007)
3. trading volume (Banerjee, 2011; Atmaz and Basak, 2018)

Controlling for Economic Variables

$$R_{t+1} = \alpha + \beta D_t^{\mathrm{PLS}} + \psi Z_t + \varepsilon_{t+1}$$

Economic predictor	β	ψ	R^2
Dividend-price ratio	-0.86^{***}	-0.08	2.61
Dividend yield	-0.85^{***}	-0.07	2.61
Earning-price ratio	-0.84^{***}	-0.06	2.60
Dividend payout ratio	-0.83^{***}	-0.01	2.59
Stock sample variance	-0.82^{***}	-0.01	2.59
Book-to-market ratio	-0.84^{***}	-0.10	2.64
Net equity expansion	-0.84^{***}	-0.12	2.66
Treasury bill rate	-0.85^{***}	-0.31	3.08
Long-term bond yield	-0.86^{***}	-0.23	2.86
Long-term bond return	-0.81^{***}	0.40^{**}	3.41
Term spread	-0.86^{***}	-0.45^{**}	3.63
Default yield spread	-0.84^{***}	-0.22	2.82
Default return spread	-0.81^{***}	0.32	3.11
Inflation rate	-0.83^{***}	0.03	2.59

Controlling for Uncertainty

$$R_{t+1} = \alpha + \beta D_t^{\mathrm{PLS}} + \psi U_t + \epsilon_{t+1},$$

	β	ψ	R^2
Economic uncertainty Index	-1.06^{***}	0.06	5.24
Treasury implied volatility	-0.89^{***}	-0.08	4.02
Economic policy uncertainty	-0.89^{***}	0.27	3.40
Financial uncertainty	-0.69^{***}	-0.44	3.53
Macro uncertainty	-0.74^{***}	-0.30	3.01
Real economy uncertainty	-0.82^{***}	-0.24	2.87
Sample stock variance	-0.82^{***}	-0.01	2.58
VIX	-1.05^{***}	0.29	4.86

Conclusion

We construct three aggregate disagreement indexes that can predict the market returns out-of-sample and are consistent with the implications of existing theories.