Are disagreements agreeable? Evidence from information aggregation

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Motivation

- Researchers in economics and finance have long been interested in studying the effects of expectations across investors.
- There is a lack of research that examines disagreement measures collectively. If extant measures capture disagreement, they should display commonality and have a common factor. ---> **PLS**
- Disagreement measures are known to predict cross sectional stock returns but fail to predict **market returns**, what about the aggregation disagreement information?

Research framework

Disagreement measures

1. professional forecasts (13)
2. analyst forecasts (2)
3. household forecasts (6)
4. unexplained stock trading volume(1)
5. idiosyncratic volatility (1)
6. option open interest(1)

PLS

Disagreement index

Characteristics

Predictable

Market return

Implications

Atmaz and Basak (2018)

1. Asymmetric forecasting power
2. Conditional on higher sentiment
3. Predictivity via cash flow channel
4. Related to trading volume and market volatility

Contribution

- This paper contributes to the disagreement literature by aggregating predictive information from extant individual disagreement measures.
- This paper is related to the broad literature on return predictability that disagreement predicts market returns in- and out-of-sample.
- While many papers have explored the relation between disagreement and stock returns at the firm level, studies at the market level are relatively rare and this paper contributes to these studies.

Disagreement measures

- 13 disagreement measures based on professional forecasts
  - The disagreements between professional forecasts on macro variables are based on Survey of Professional Forecasters (SPF)
  - In each quarter, the forecasters predict macro variables for horizons ranging from the current up to four quarters ahead
  - Gross domestic production (GDP), industrial production (IP), consumption (CON), investment (INV), housing starts (HSG), unemployment (UEP), the Consumer Price Index (CPI), and the 3-month T-bill rate (TBL).
- We define disagreement on each macro variable as the difference between the 75th and 25th forecasts for each horizon, averaging across all horizons as the disagreement measure of macro variable.

Disagreement measures

- 2 disagreement measures based on analyst forecasts
- Following Yu and Yuan (2011) and Hong and Sraer (2016) , we adopt the “bottom-up” approach by defining disagreement in month t as:

$$D_t^{Yu} = \frac{\sum_i MKTCAP_{i,t} \times D_{i,t}}{\sum_i MKTCAP_{i,t}}$$

$$D_t^{HS} = \frac{\sum_i \beta_{i,t} \times D_{i,t}}{\sum_i \beta_{i,t}}$$

- where $D_{i,t}$ is the analyst forecast dispersion on the earnings per share (EPS) long-term growth rate (LTG) of firm i, and $MKTCAP_{i,t}$ and $\beta_{i,t}$ are firm i ’s market cap and market beta.

Disagreement measures

- 6 disagreement measures based on household forecasts
- We construct household disagreement based on the University of Michigan Surveys of Consumers Attitudes (SCA).
- In each survey, the SCA collects responses to 50 core questions that are generally related to households' opinions about current economic conditions and their expectations about future economic conditions.
- $D = -\sum w_i P_i^2 \,,\ i = positive, neutral, negative$
- where w_i is the weight of each category as $w_{positive}$= 1, $w_{neutral}$ = 2, and $w_{negative}$ = 1, p is proportion of each category.

Disagreement measures

- Disagreement based on unexplained stock trading volume
- We define volume as the residual of applying an AR(4) to the log turnover with the past 120-month observations
- We run the following time series regression with data from the past 120-month period at the end of each month on a rolling basis as

$$Volume_t = \alpha + \beta_1 R_t^+ + \beta_2 R_t^- + \varepsilon_t$$

- Disagreement can be defined by standardized unexplained volume

$$D_t^{SUV} = \varepsilon_t / \sigma_{\varepsilon,t}$$

Disagreement measures

- Disagreement based on idiosyncratic volatility
- We regress daily stock returns on the FF3 factors with a 12-month rolling window and estimate the firm level idiosyncratic volatility. Disagreement defined as the value-weighted idiosyncratic volatility.
- Disagreement based on option open interest

$$D_t^{OID} = 1 - |COI_t - POI_t|/|COI_t + POI_t|$$

- where $COI_t(POI_t)$ is the call (put) option open interest.

Disagreement measures

- Forecasting market returns with extant disagreement measures

where $Rt+1$ is the log excess return of the S&P 500 index in month $t + 1$

	$h = 1$				$h = 3$				$h = 12$			
Disagreement	β	t-value	R^2	R^2_{OS}	β	t-value	R^2	R^2_{OS}	β	t-value	R^2	R^2_{OS}
D^{GDP}	0.11	−0.50	0.06	−1.88	−0.22	−1.35	0.72	−5.40	−0.36***	−3.54	7.43	−13.61
D^{GDPg}	−0.27	−1.53	0.38	−3.44	−0.24	−1.62	0.89	−7.18	−0.24**	−2.56	3.21	−16.47
D^{IP}	−0.06	−0.24	0.02	−2.38	−0.07	−0.42	0.08	−5.04	−0.04	−0.31	0.09	−12.18
D^{IPg}	0.04	0.20	0.01	−2.23	−0.21	−1.46	0.65	−9.50	−0.14	−1.09	1.13	−20.03
D^{CON}	−0.11	−0.49	0.07	−1.79	−0.24	−1.21	0.88	−4.34	−0.17	−1.27	1.72	−15.22
D^{CONg}	−0.10	−0.41	0.05	−2.38	−0.19	−0.92	0.59	−5.73	−0.17	−1.29	1.73	−19.59
D^{INV}	−0.24	−1.36	0.31	−2.73	−0.27*	−1.75	1.12	−8.11	−0.14	−0.88	1.15	−12.17
D^{INVg}	0.19	1.31	0.21	−1.60	0.02	0.17	0.01	−4.60	0.02	0.14	0.04	−8.25
D^{HSG}	−0.40**	−2.11	0.85	−5.39	−0.26*	−1.70	1.04	−12.29	−0.21	−1.57	2.48	−23.20
D^{HSGg}	−0.21	−0.99	0.23	−6.49	−0.34**	−2.08	1.70	−24.59	−0.33*	−1.90	5.73	−28.78
D^{UEP}	0.16	0.76	0.13	−0.73	0.13	0.82	0.27	−2.64	0.16	1.47	1.48	−3.38
D^{CPI}	−0.36*	−1.90	0.73	−6.39	−0.27**	−2.26	1.18	−27.39	−0.11	−1.32	0.74	−19.33
D^{TBL}	−0.60**	−2.23	1.94	−4.21	−0.48**	−2.12	3.60	−9.36	−0.25	−1.53	3.84	−13.52
D^{Yu}	−0.30	−1.23	0.35	−2.72	−0.30	−1.32	1.05	−4.07	−0.27	−1.25	3.06	−25.93
D^{HS}	−0.12	−0.42	0.06	−3.67	−0.16	−0.55	0.30	−7.92	−0.23	−0.85	2.52	−11.16
D^{RPF}	−0.22	−1.26	0.26	−3.35	−0.09	−0.55	0.11	−6.13	−0.16	−1.57	1.52	−17.10
D^{EPF}	−0.22	−1.03	0.26	−4.49	−0.16	−1.11	0.40	−9.37	−0.05	−0.49	0.17	−17.36
D^{BC}	−0.44**	−2.48	1.05	−5.77	−0.23	−1.56	0.86	−10.44	−0.08	−0.66	0.37	−19.99
D^{UC}	−0.06	−0.27	0.02	−3.40	−0.03	−0.19	0.02	−6.35	−0.05	−0.37	0.17	−19.27
D^{IRC}	−0.17	−0.72	0.16	−2.64	−0.41**	−2.12	2.66	−12.05	−0.44**	−2.52	11.72	−25.38
D^{HOM}	0.11	0.65	0.07	−0.86	0.01	0.04	0.00	−3.71	−0.19	−1.12	1.94	−20.53
D^{SUV}	−0.30	−1.24	0.23	−2.80	−0.34	−1.48	0.86	−6.86	−0.43*	−1.86	4.81	−18.40
D^{IVOL}	−0.03	−0.15	0.00	−5.46	−0.02	−0.07	0.00	−14.61	0.00	−0.02	0.00	−14.82
D^{OID}	−0.20	−0.73	0.10	−2.73	−0.15	−0.57	0.15	−6.09	−0.24	−0.93	1.47	−15.53

PLS disagreement index

- In the first step, we run a time series regression of each individual disagreement measure on the realized subsequent market returns:

$$D_{t-1}^{k} = \pi_{k,0} + \pi_k R_t + u_{k,t-1}, \qquad k = GDP, \dots, OID.$$

- In the second step, we run a cross-sectional regression of $D_t^k \; on \; \pi_k$ at the end of each month:

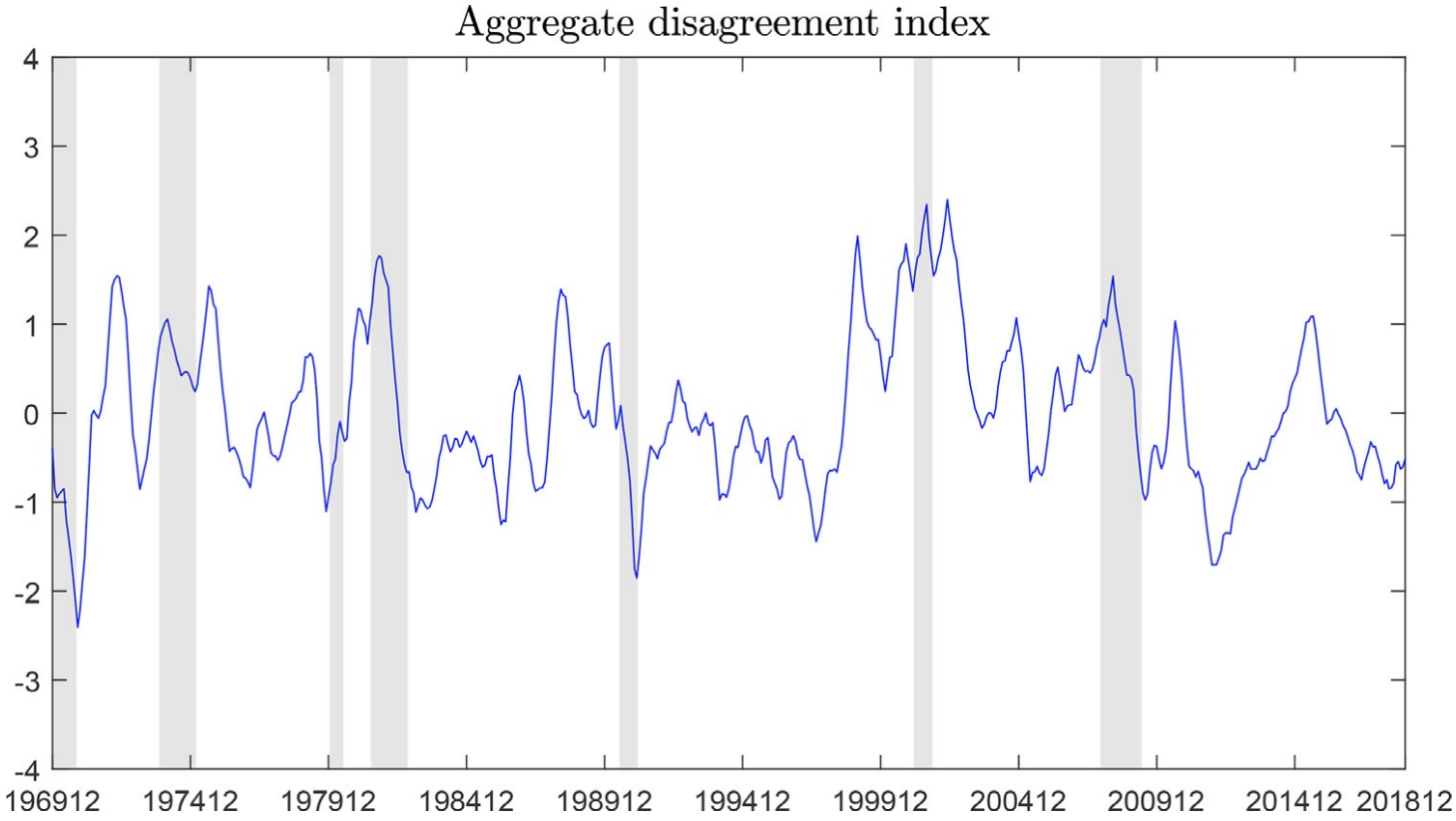
$$D_t^k = a_t + D_t \pi_k + v_{k,t}$$

- In the third step, to predict R_{t+1}, we run the predictive regression:

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

PLS disagreement index

- The disagreement index is time-varying and does not diminish over time and the disagreement index value can be large in bad times.



Forecasting performance

$$R_{t,t+h} = \alpha + \beta D_t + \varepsilon_{t,t+h}$$

- where $R_{t,t+h}$ is the cumulative market return between months t and t + h (h = 1, 3, and 12), and D_t is the PCA, equal weight, or PLS index.

Method	β	t-value	R^2	R^2_{OS}
Panel A: $h = 1$				
PCA	−0.38**	−1.96	0.61	0.20
Equal-weight	−0.60***	−2.87	1.46	0.90**
PLS	−0.83***	−3.96	2.52	1.56**
Panel B: $h = 3$				
PCA	−1.13**	−2.14	1.74	1.71***
Equal-weight	−1.73***	−2.99	3.88	3.74***
PLS	−2.24***	−3.82	5.98	7.68***
Panel C: $h = 12$				
PCA	−2.92**	−1.99	2.78	3.04***
Equal-weight	−4.93***	−3.06	7.49	9.41***
PLS	−7.04***	−4.16	13.88	13.26***

Controlling for economic predictors

- We consider the 14 economic predictors in Welch and Goyal (2008) , output gap in Cooper and Priestley (2009) , and aggregate short interest in Rapach et al. (2016) , and run the following regression:

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

	Univariate		Bivariate		
Economic predictor	ψ	R^2	β	ψ	R^2
Dividend-price ratio (DP)	0.15	0.11	−0.82***	0.02	2.52
Dividend yield (DY)	0.17	0.15	−0.82***	0.03	2.52
Earning-price ratio (EP)	0.08	0.03	−0.83***	−0.01	2.52
Dividend payout ratio (DE)	0.08	0.03	−0.82***	0.03	2.53
Sample variance (SVAR)	−0.22	0.26	−0.81***	−0.07	2.54
Book-to-market ratio (BM)	0.00	0.00	−0.83***	−0.03	2.53
Net equity expansion (NTIS)	−0.06	0.02	−0.83***	−0.07	2.55
T-bill rate (TBL)	−0.26	0.36	−0.81***	−0.21	2.76
Long-term bond yield (LTY)	−0.15	0.11	−0.82***	−0.12	2.60
Long-term bond return (LTR)	0.42**	0.93	−0.82***	0.41**	3.41
Term spread (TMS)	−0.41**	0.89	−0.81***	−0.39**	3.31
Default yield spread (DFY)	−0.16	0.13	−0.84***	−0.21	2.74
Default return spread (DFR)	0.36	0.68	−0.80***	0.32	3.06
Inflation rate (INFL)	0.01	0.00	−0.83***	0.05	2.54
Output gap (OG)	−0.46***	1.08	−0.75***	−0.33**	3.07
Short interest (SI)	−0.55**	1.48	−0.84***	−0.46*	3.85
Kitchen sink (via elastic net)	–	–	-0.72***	–	5.50

Controlling for uncertainty measures

- In the literature, disagreement has two alternative interpretations: investor heterogeneity and uncertainty

$$R_{t+1} = \alpha + \beta D_t + \psi U_t + \varepsilon_{t+1}$$

	Correlation	Univariate		Bivariate		
Uncertainty	Corr(Uncertainty$_t$, D_t)	ψ	R^2	β	ψ	R^2
Economic uncertainty	0.09	−0.13	0.09	−1.02***	−0.04	4.88
Treasury implied volatility	0.33***	−0.37	0.70	−1.01***	−0.06	4.72
Financial uncertainty	0.23***	−0.62**	2.01	−0.69***	−0.49*	3.68
Macro uncertainty	0.24***	−0.45	1.06	−0.74***	−0.30	2.96
Economic policy uncertainty	−0.20***	0.25	0.32	−0.86***	0.10	3.02
News implied volatility	0.07	0.09	0.04	−0.85***	0.14	2.74
Sample variance	0.23***	−0.22	0.26	−0.81***	−0.07	2.54
VIX	0.26***	0.00	0.00	−1.06***	0.24	4.66
Kitchen sink (via elastic net)	–	–	–	-0.89**	–	5.09

Economic value

- Suppose a mean-variance investor invests her wealth in the stock market and the one-month T-bill. At the start of each month, she allocates a proportion of w t to the stock market to maximize her next one-month expected utility

$\hat{\mu}_p$ and $\hat{\sigma}_p^2$ are the mean and variance of the investor's portfolio over the out-of-sample evaluation period.

- $U(R_p) = E(R_p) - \frac{\gamma}{2} Var(R_p)$, $\quad R_{p,t+1} = w_t R_{t+1} + R_{f,t+1}$
- $w_t = \frac{1}{\gamma} \frac{\hat{R}_{t+1}}{\hat{\sigma}_{t+1}^2}$
- $CER = \hat{\mu}_p - \frac{2}{\gamma} \hat{\sigma}_p^2$

	No transaction cost		50 bps transaction costs	
	CER gain (%)	Sharpe ratio	CER gain (%)	Sharpe ratio
Panel A: Risk aversion $\gamma = 3$				
PCA	0.71	0.14**	0.52	0.13
Equal-weight	1.70**	0.16**	1.33*	0.15**
PLS	2.50***	0.18***	1.92**	0.16**
Panel B: Risk aversion $\gamma = 5$				
PCA	0.96**	0.12**	0.81**	0.11**
Equal-weight	2.10***	0.16***	1.69**	0.14**
PLS	2.68***	0.17***	1.88**	0.14**

Alternative econometric methods

- We consider six LASSO-related machine learning methods: equal-weight LASSO, combination LASSO (Han et al., 2020), encompassing LASSO (Han et al., 2020), adaptive LASSO (Freyberger et al., 2020), egalitarian LASSO (Diebold and Shin, 2019), and elastic net (Kozak et al., 2020).

Method	$h = 1$	$h = 3$	$h = 12$
Equal-weight LASSO	1.26**	6.09***	12.08***
Combination LASSO	1.08**	2.87***	9.67***
Encompassing LASSO	1.09**	2.92***	9.41***
Adaptive LASSO	0.71*	2.34***	7.47***
Egalitarian LASSO	1.30*	2.69***	8.42***
Elastic net	1.36**	2.69***	8.43***

Economic implications

- Atmaz and Basak (2018) The first channel: disagreement represents uncertainty and investors require a higher expected return to hold a stock when disagreement on the stock increases
- The second channel: investor disagreement affects stock returns via an amplification effect on the average bias.
    1. predicts market returns asymmetrically, with stronger power in high-sentiment periods
    2. negatively predicts investors' ex post return forecast errors
    3. predicts market returns via a cash flow channel
    4. explain the positive relation between trading volume and volatility

Economic implications

- 1) predicts market returns asymmetrically, with stronger power in high-sentiment periods

$$R_{t+1} = \alpha + \beta_{high} S_t^{high} D_t + \beta_{low} S_t^{low} D_t + \varepsilon_{t+1}$$

- S_t^{high} is a dummy variable that equals one if month t is in high sentiment periods and zero if month t is in low sentiment periods

Panel A: Forecasting performance in different periods					
In-sample R^2			Out-of-sample R^2_{OS}		
High sentiment	Low sentiment		High sentiment		Low sentiment
5.28	0.80		3.69**		-0.55
Panel B: State-dependent regression					
	β_{high}	t-value	β_{low}	t-value	R^2
Sentiment-based state	−1.12***	−4.71	−0.42	−1.21	2.96

Economic implications

- 2) negatively predicts investors' ex post return forecast errors
- 4 measures of investor expectation of 12-month-ahead market returns

$$R_{t:t+12} = \alpha + \beta D_t + \varepsilon_t$$

$$Realized\ return_{t:t+12} - Expectation_{t:t+12} = \alpha + \beta D_t + \varepsilon_t$$

Panel A: Expectations of market returns				
	Corr(Expectation$_{t:t+12}$, D_t)	β	t-value	R^2
Analysts' return forecast	0.35***	3.26***	2.61	12.45
University of Michigan survey	0.24***	2.71*	1.69	5.55
Graham–Harvey's survey	0.26**	0.57**	2.40	6.58
Shiller's survey	0.25***	2.16**	2.31	6.50
Panel B: Market return forecast errors				
		β	t-value	R^2
Analysts' return forecast		−7.34***	−2.73	23.26
University of Michigan survey		−8.42***	−3.36	21.17
Graham–Harvey's survey		−9.65***	−4.41	31.61
Shiller's survey		−9.18***	−4.45	30.34

Economic implications

- 3) predicts market returns via a cash flow channel

$$\tilde{R}_t \approx E_{t-1}(R_t) + CF_t - DR_t$$

- where CF_t and DR_t are cash flow news and discount rate news

$$R_{t+1} = \alpha + \beta_{CF} D_t^{CF} D_t + \beta_{DR} D_t^{DR} + \varepsilon_{t+1}$$

VAR variables	β_{CF}	t-value	β_{DR}	t-value	R^2
$\tilde{R}$, DP	−0.65***	−2.92	−0.01	−0.08	2.15
$\tilde{R}$, DP, DY	−0.65***	−3.08	−0.01	−0.03	2.16
$\tilde{R}$, DP, EP	−0.67***	−2.73	−0.11	−0.51	2.06
$\tilde{R}$, DP, DE	−0.67***	−2.73	−0.11	−0.51	2.06
$\tilde{R}$, DP, RVOL	−0.70**	−2.52	−0.06	−0.23	2.23
$\tilde{R}$, DP, BM	−0.65***	−3.29	0.11	0.61	2.16
$\tilde{R}$, DP, NTIS	−0.66***	−3.02	−0.02	−0.11	2.21
$\tilde{R}$, DP, TBL	−0.55***	−2.86	0.10	0.59	1.62
$\tilde{R}$, DP, LTY	−0.64***	−3.23	0.09	0.53	2.13
$\tilde{R}$, DP, LTR	−0.65***	−3.13	0.02	0.09	2.24
$\tilde{R}$, DP, TMS	−0.57***	−2.87	0.07	0.39	1.81
$\tilde{R}$, DP, DFY	−0.65***	−2.82	−0.02	−0.11	2.16
$\tilde{R}$, DP, DFR	−0.65***	−2.70	−0.03	−0.13	2.10
$\tilde{R}$, DP, INFL	−0.65***	−3.29	0.03	0.16	2.20
$\tilde{R}$, DP, OG	−0.57***	−2.83	−0.06	−0.32	1.57
$\tilde{R}$, DP, SI	−0.47**	−2.08	0.27	1.28	1.93
$\tilde{R}$, DP, PC	−0.66***	−2.78	0.04	0.16	2.26

Economic implications

- 4) explain the positive relation between trading volume and volatility

$$Elasticity_{t+1} = \alpha + \beta D_t + \varepsilon_{t+1}$$

$$Volume_{t+1} = \alpha + \beta_1 DVolatility_t + \beta_2 Volatility_t^{\circ} + \varepsilon_{t+1}$$

- where the elasticity is the slope of regressing the daily change in turnover on the daily change in volatility within month t + 1.

Panel A: Predicting volatility-volume elasticity					
Volatility measure	β	t-value	R^2		
Realized volatility	4.01***	4.41	4.94		
Realized semi volatility	1.85**	2.08	1.83		
Median realized volatility	1.99**	1.98	1.25		
Futures realized volatility	2.24**	2.17	1.49		
Panel B: Predicting trading volume					
Volatility measure	β_1	t-value	β_2	t-value	R^2
Realized volatility	2.38***	3.32	-1.30	-1.36	5.31
Realized semi volatility	2.53***	3.44	-1.16	-1.32	5.58
Median realized volatility	2.60***	3.31	-1.44*	-1.77	6.36
Futures realized volatility	1.13**	2.15	-0.46	-0.75	1.18

Conclusion

- This paper examines whether extant individual disagreement measures are agreeable and proposes a disagreement index by PLS
- We show that this PLS disagreement index significantly predicts market returns both in- and out-of-sample
- The disagreement index asymmetrically predicts market returns with greater power in high- sentiment periods, is negatively related to investors' ex post return forecast errors, predicts market returns through a cash flow channel, and is able to explain the positive volume-volatility relation.

Consideration

- Apply the disagreement index to other markets, such as bonds, commodities, and currencies
- Construct aggregate disagreement indexes at different frequencies, such as daily or weekly
- Two main sources of disagreement, differences in information sets and differences in models that investors use to interpret information