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CBOE OPTIONS EXCHANGE

When the Options Market Disagrees

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Heterogeneous Beliefs & Asset Prices: two opposite views

- *Positive Predictive effect for stock returns:* In rational expectations models with asymmetric information, agents use prices to infer the valuations of others and the heterogeneity of beliefs increases expected stock returns (Kraus and Smith, 1989; Wang, 1993; Naik, 1997).

- *Negative :* due to short-sale constraints → pessimists do not trade, optimists overvalue current prices (Miller 1977), → negative future returns. In dynamic models, when investors agree to disagree, disagreement and expected stock returns are negatively related (Harrison and Kreps, 1978; Scheinkman and Xiong, 2003; Hong, Scheinkman, and Xiong, 2006)

Empirical Results: The Literature Disagrees!

- Diether, Malloy, and Scherbina (2002), Chen, Hong, and Stein (2002), and Goetzmann and Massa (2005) → *negative relationship between disagreement and future stock returns* (explain it with the optimistic pricing model of Miller (1977))

- Banerjee (2011), and Carlin, Longstaff and Matoba (2014) → *positive relations between disagreement and expected asset returns* dominates, and favor rational expectation theories.

Why don't we agree?

- *How do we measure disagreement?*

- *Negative Disagreement-Return relations*:
  - Short-term analyst forecast dispersion (Diether et al. (2002))
  - breadth of institutional ownership (Chen, Hong and Stein, 2002)

- *Positive Disagreement-Return relations:*
  - disagreement among mortgage dealers about prepayment speed forecasts on mortgage-backed securities (Carlin et al. (2014))
  - (long-term) analyst forecast dispersion, Banerjee (2011)

What Do We Ideally Want?

- A reliable measure of investors' disagreement!
- Goetzman and Massa (2005): "… analysts' forecasts represent *the opinions of professional analysts* and do not necessarily reflect *the expectations of the average investor.* The alternative is to focus directly on investors' actions, measuring the dispersion of opinion *on the basis of the trades of the investors.* This would allow us to exploit the restrictions that most of the theoretical models have defined in terms of investors' trades."

- A market without short sale constraints → to clearly distinguish between optimist driven overpricing (with short-sale constraints) vs rational explanation

When the Options market Disagrees

- *New measure of investors' Disagreement*
- Using *customer* (end-user) signed equity options volume (open/close buy/sell CBOE/ISE call and put volumes, 60% of the overall trading options volume)
- ***Advantages compared to the stock market:***
- *Pessimists can short-sell* in the options market (buy put or sell call)
- Trading in stocks can be motivated by liquidity needs; *trading in the options market by customer accounts is largely driven by betting on directional price changes of underlying stocks* (Lakonishok et al., 2007).
- Unlike other measures, our measure *can be constructed daily* (compared to monthly, e.g. analyst forecast dispersion, or quarterly, e.g., institutional ownership)

What do we find?

- Customer disagreement **negatively** predicts stock returns (*5 weeks ahead*)
- The effect robust and significant to various controls.
- High minus Low zero investment strategy in stock portfolios sorted on customer disagreement produces between **-6%** to **-5%** in risk adjusted Alphas per year
- … and we can identify the *sources* of disagreement→
  - *Public News Releases* → higher disagreement→ higher economic impact on the future stock returns
  - *Positive or Negative news*!?! → always higher disagreement
- Investors *Agree to Disagree & no explicit short sale restrictions*

The results are consistent with:

- Duffie, Garleanu and Pedersen (2002) → the price of a security with limited shorting can exceed the price with shorting disallowed→ an investor can pay more than his valuation of he expects to benefit from the premiums after lending the security (to short-sellers) in the future
  - the negative impact of disagreement on stock returns is **about five times bigger** for stocks with higher short-sale costs (higher loan fees or harder-to-borrow stocks) than for stocks with lower costs.
  - And options disagreement increases with loan fees and lower availability of stocks on loans (Duffie et al. 2002; D'Avalio, 2002)

Stock Volume and Volatility:

- Hong and Stein, 2007 → disagreement should lead to higher stock volume and volatility

- We find that options disagreement positively predicts stock trading volume and volatility across multiple horizons

Measuring Disagreement I

$$DIS^{Z}_{i,d} \equiv \frac{\sum_{j}^{N^{Z}_{i,d}} abs(\Delta^{Z}_{i,j,d}) \left[BO^{Z}_{i,j,d} + SO^{Z}_{i,j,d} - abs\left(BO^{Z}_{i,j,d} - SO^{Z}_{i,j,d}\right)\right]}{\sum_{j}^{N^{Z}_{i,d}} \left(BO^{Z}_{i,j,d} + SO^{Z}_{i,j,d}\right)}$$

- $Z \in \{C, P\}$
- Z=C for calls, and Z=P for puts
- **OB** – open buy **CB** – close buy
- **OS** – open sell **CS** – close sell
- **BO=OB+CB** and **SO=OS+CS**
- Compute separately for call and puts, and then volume-weighted average is obtained

Measuring Disagreement II

$$DIS\text{-}CP_{i,d} \equiv \frac{\sum_j^{N_{i,d}} \left[Pos_{i,j,d} + Neg_{i,j,d} - abs\left(Pos_{i,j,d} - Neg_{i,j,d} \right) \right]}{\sum_j^{N_{i,d}} \left(BO^C_{i,j,d} + SO^P_{i,j,d} + SO^C_{i,j,d} + BO^P_{i,j,d} \right)}$$

$$Pos_{i,j,d} \equiv \Delta^C_{i,j,d} \cdot BO^C_{i,j,d} + abs(\Delta^P_{i,j,d}) \cdot SO^P_{i,j,d}$$

$$Neg_{i,j,d} \equiv \Delta^C_{i,j,d} \cdot SO^C_{i,j,d} + abs(\Delta^P_{i,j,d}) \cdot BO^P_{i,j,d}$$

Other Variables

- Using CBOE/ISE signed customer volumes we compute option imbalances (Bollen and Whaley 2004) and put-call volume ratio (Pan and Poteshman 2006)

$$IMB\text{-}Option_{i,d} \equiv \frac{\sum_j^{N_{i,d}^C} \Delta_{i,j,d}^C \left(BO_{i,j,d}^C - SO_{i,j,d}^C\right) + \sum_j^{N_{i,d}^P} abs(\Delta_{i,j,d}^P) \left(BO_{i,j,d}^P - SO_{i,j,d}^P\right)}{\sum_j^{N_{i,d}^C} \left(BO_{i,j,d}^C + SO_{i,j,d}^C\right) + \sum_j^{N_{i,d}^P} \left(BO_{i,j,d}^P + SO_{i,j,d}^P\right)}$$

$$PP_{i,d} = \frac{\sum_j^{N_{i,d}^P} OBO_{i,j,d}^P}{\sum_j^{N_{i,d}^P} OBO_{i,j,d}^P + \sum_j^{N_{i,d}^C} OBO_{i,j,d}^C}$$

Summary Statistics

	Mean	Std.	1st	50th	99th
DIS	0.1412	0.1151	0.0000	0.1362	0.4182
DIS-CP	0.1684	0.1229	0.0000	0.1728	0.4415

	Mean	Std.	1st	50th	99th
IMB-Custom	-0.0721	0.2329	-0.6757	-0.0625	0.6307
PP	0.3135	0.3024	0.0000	0.2568	1.0000
Log(OptVolume)	9.4213	2.5314	3.6889	9.4788	14.8684
ILS (%)	0.1711	0.3711	0.0257	0.1073	0.9371
Size	14.5414	1.5833	11.3790	14.4200	18.6629
StockIMB	0.0077	0.0943	-0.2379	0.0036	0.2784
σ(Ret) (%)	2.7530	1.8336	0.7192	2.3226	9.4266

Correlations

	DIS	DIS-CP	Turnover	Analyst-Disp
DIS	1			
DIS-CP	0.9404	1		
Turnover	0.2552	0.2443	1	
Analyst-Disp	-0.0147	-0.0204	0.0961	1

	DIS	DIS-CP
IMB-Custom	0.1480	0.1155
PP	-0.0458	-0.0116
Log(OptVolume)	0.5772	0.5923
ILS	-0.1539	-0.1811
Size	0.3629	0.3786
StockIMB	0.0307	0.0320
σ(Ret)	0.0434	0.0272

Hypothesis I: Disagreement & Expected Stock Returns

- → the literature is mixed.
- If the options market is dominated by informed trading (Pan and Poteshman 2006; Easley et al., 1998; Cremers and Weinbaum, 2010) then imbalance will be high and disagreement will be low, and have no effect on stock returns.
- If options market is dominated by directional bets on price changes of underlying stocks (Lakonishok et al., 2007), and investors diverge in their opinions ((Vijh, 1990; Cho and Engle, 1999; and Choy and Wei, 2012) – we should observe negative predictability.
- If information asymmetry/uncertainty in the stock market is high, and uninformed investors choose to hedge in the options market, then we should observe positive predictability.
- *Let the data speak*

FM predictive regressions

	Dependent Variable: $CAR_{i,t+h}$ (%)				
	h=1	*h=2*	*h=3*	*h=4*	*h=5*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
$DIS_{i,t}$	-0.3951	-0.2340	-0.2423	-0.3339	-0.2226
	-3.83	*-2.13*	*-2.26*	*-2.98*	*-1.86*
Option-$IMB_{i,t}$	0.2540	-0.0035	0.0774	0.0371	-0.0198
	5.79	*-0.08*	*1.55*	*0.85*	*-0.42*
$PP_{i,t}$	-0.2863	-0.2025	-0.0966	-0.1214	-0.0927
	-6.17	*-4.36*	*-2.19*	*-2.91*	*-2.10*
$Log(OptVolume)_{i,t}$	-0.0059	-0.0167	-0.0099	-0.0147	-0.0097
	-0.70	*-2.16*	*-1.22*	*-1.72*	*-1.22*
$ILS_{i,t}$ (%)	-0.4280	-0.3540	-0.1024	-0.1837	-0.2499
	-3.03	*-2.71*	*-0.77*	*-1.52*	*-1.79*
$Size_{i,t}$	-0.0118	0.0095	0.0115	0.0221	0.0129
	-0.58	*0.48*	*0.60*	*1.05*	*0.65*
Stock-$IMB_{i,t}$	0.1398	0.2780	0.1712	0.0358	0.1040
	0.89	*1.88*	*1.15*	*0.24*	*0.66*
$Ret_{i,t}$ (%)	-0.0085	-0.0034	-0.0025	0.0046	-0.0024
	-1.98	*-0.87*	*-0.69*	*1.19*	*-0.67*
$Ret_{i,t-1}$ (%)	-0.0008	-0.0016	0.0036	-0.0025	-0.0043
	-0.22	*-0.44*	*0.97*	*-0.68*	*-1.19*
$Ret_{i,t-2}$ (%)	-0.0001	0.0013	-0.0008	-0.0033	-0.0033
	-0.02	*0.37*	*-0.22*	*-0.94*	*-0.95*
$Ret_{i,t-3}$ (%)	0.0025	-0.0015	-0.0025	-0.0019	0.0043
	0.72	*-0.42*	*-0.72*	*-0.55*	*1.33*
$\sigma(Ret_{i,t})$ (%)	-0.0439	-0.0319	-0.0241	-0.0078	-0.0128
	-1.92	*-1.37*	*-1.01*	*-0.33*	*-0.54*
Adj. R^2	5.55	5.43	5.38	5.29	5.20
N	1,386	1,385	1,384	1,382	1,381

Fama-French-Carhart Alphas, DIS sorted portfolios, weekly, 2005-2013

Panel A: Alphas of Equally-Weighted Portfolios Sorted on DIS

Rank	$Alpha_{t+1}$	*t-Stat.*	$Alpha_{t+2}$	*t-Stat.*	$Alpha_{t+3}$	*t-Stat.*	$Alpha_{t+4}$	*t-Stat.*	$Alpha_{t+5}$	*t-Stat.*
1. Low	1.80	*1.45*	2.24	*1.85*	1.64	*1.43*	1.72	*1.53*	2.42	*2.13*
2	1.42	*1.16*	0.92	*0.76*	1.93	*1.60*	1.85	*1.45*	0.95	*0.79*
3	1.19	*0.99*	0.29	*0.23*	-0.56	*-0.43*	0.26	*0.20*	0.50	*0.38*
4	-1.37	*-1.02*	-0.55	*-0.39*	-0.95	*-0.72*	-1.63	*-1.13*	-1.15	*-0.81*
5. High	-3.12	*-1.66*	-3.30	*-1.68*	-3.02	*-1.49*	-3.43	*-1.74*	-3.61	*-1.79*
H-L	-4.92	*-2.58*	-5.54	*-2.72*	-4.66	*-2.22*	-5.15	*-2.55*	-6.03	*-2.97*

Panel B: Alphas of Value-Weighted Portfolios Sorted on DIS

Rank	$Alpha_{t+1}$	*t-Stat.*	$Alpha_{t+2}$	*t-Stat.*	$Alpha_{t+3}$	*t-Stat.*	$Alpha_{t+4}$	*t-Stat.*	$Alpha_{t+5}$	*t-Stat.*
1. Low	1.45	*1.30*	2.39	*2.15*	1.58	*1.40*	2.43	*2.16*	3.70	*3.11*
2	2.99	*2.58*	1.72	*1.54*	2.75	*2.48*	2.30	*2.11*	1.14	*1.04*
3	2.11	*2.02*	2.37	*2.24*	1.05	*0.95*	2.42	*2.32*	1.52	*1.22*
4	0.42	*0.48*	0.28	*0.30*	1.50	*1.57*	1.49	*1.54*	1.05	*0.99*
5. High	-1.44	*-2.12*	-1.55	*-2.01*	-1.57	*-2.02*	-1.93	*-2.50*	-1.44	*-1.80*
H-L	-2.89	*-1.98*	-3.94	*-2.56*	-3.15	*-2.01*	-4.37	*-2.80*	-5.14	*-3.14*

Hypothesis II

- In agree to disagree models, investors disagree even if they have the same information (Harrison and Kreps, 1978; Harris and Raviv, 1993; Kandel and Pearson, 1995; Scheinkman and Xiong, 2003; and Cao and Ou-Yang, 2009).
- Traders equally disagree about either positive or negative news (Kandel and Pearson, 1995)
- ***H2.1***. *As option investors agree to disagree, the predictive ability of disagreement in the cross-section of stocks covered by news releases should be stronger compared to no-news cross-section*.
- ***H2.2.***: *The impact of disagreement on future stock returns should remain negative regardless of whether stocks are experiencing positive or negative news.*
- ***H2.3***. *Disagreement should increase with public news releases.*

Positive and Negative News (RavenPack Analytics→ only new News)

	Dependent Variable: $CAR_{i,t+1}$ (%)			
	(1)	*(2)*	*(3)*	*(4)*
$IndicNews_{i,t}$	*0.0866*			
	2.37			
$DIS\text{-}News_{i,t}$	*-0.4876*			
	-3.34			
$DIS\text{-}NoNews_{i,t}$	*-0.3556*			
	-2.71			
$ESS_{i,t}$		*0.0017*	*0.0013*	*0.0016*
		1.28	*0.80*	*1.18*
$DIS_{i,t}$		*-0.3767*		
		-2.47		
$DIS\text{-}P_{i,t}$			*-0.3469*	
			-1.93	
$DIS\text{-}N_{i,t}$			*-0.4183*	
			-2.39	
$DIS\text{-}E_{i,t}$				*-0.9285*
				-2.36
$DIS\text{-}NoE_{i,t}$				*-0.4061*
				-2.61
Controls	*Y*	*Y*	*Y*	*Y*
Adj. R^2	5.60	7.13	7.17	7.23
N	1,386	646	646	647

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Hypothesis III

- Duffie, Garleanu and Pedersen (2002): lending fees and demand for loanable securities are endogenously increasing in differences of opinions.
- By anticipating higher future lending fees caused by higher future shorting demand, optimists are willing to pay higher prices for stocks today expecting to lend them in the future. This inflates current prices and lowers future returns.
- ***H3.1***: *The predictive power of disagreement for stock returns is more pronounced among stocks with higher loan fees or that are harder-to-borrow*.
- *H3.2*: *Disagreement should increase with the costs of short-selling*.

Short Sale Contraints & Disagreement

	Dependent Variable: $CAR_{i,t+1}$ (%)			
	SSConstraint = Utilization Rate		SSConstraint = Loan Fee	
	(1)	*(2)*	*(3)*	*(4)*
$SSConstraint_{i,t}$	-0.3667	-0.2501	-2.4184	-1.8534
	-4.01	*-2.64*	*-5.17*	*-3.63*
$DIS_{i,t}$	-0.2991		-0.2940	
	-2.81		*-2.77*	
$DIS\text{-}SSCH_{i,t}$		-0.8954		-1.0137
		-3.29		*-3.57*
$DIS\text{-}SSCL_{i,t}$		-0.2265		-0.1913
		-2.09		*-1.78*
Controls	*Y*	*Y*		*Y*
Adj. R^2	5.77	5.89	5.88	6.03
N	1,301	1,301	1,300	1,300

Hypothesis IV

- when investors use different economic models and interpret the same news differently, i.e., agree to disagree (Harris and Raviv, 1993; Kandel and Pearson, 1995; Hong and Stein (2007) and Banerjee, 2011), Disagreement and volume are positively related.
- Moreover, higher trading volume should also be accompanied by an increase in volatility (Banerjee and Kremer, 2010)
- ***H4.1***. *Disagreement positively predicts stock trading activity*
- ***H4.2***. *Disagreement positively predicts stock volatility*

Disagreement & Stock trading activity

	Dependent Variable: $Turnover_{i,t+h}$				
	h=1	*h=2*	*h=3*	*h=4*	*h=5*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
$DIS_{i,t}$	5.4251	6.9382	7.5572	7.8653	7.8175
	21.84	*26.27*	*26.95*	*26.24*	*26.96*
Option-$IMB_{i,t}$	1.2850	0.9124	0.6735	0.6175	0.6429
	14.97	*10.62*	*7.49*	*6.42*	*6.31*
$PP_{i,t}$	0.4716	0.6111	0.6536	0.6381	0.6285
	8.48	*8.50*	*7.68*	*6.92*	*6.83*
$Log(OptVolume)_{i,t}$	0.9517	1.1125	1.1817	1.1978	1.2089
	37.14	*38.68*	*38.78*	*39.06*	*38.18*
$ILS_{i,t}$ (%)	-8.8421	-10.5963	-11.1425	-11.3079	-11.5203
	-22.66	*-23.00*	*-21.90*	*-20.89*	*-20.62*
$Size_{i,t}$	-1.7249	-2.0341	-2.1605	-2.1929	-2.1782
	-33.65	*-35.62*	*-34.72*	*-33.73*	*-32.19*
Stock-$IMB_{i,t}$	1.8100	1.9094	1.9029	1.6037	1.7583
	5.90	*5.59*	*5.30*	*4.28*	*4.70*
Lagged Stock Ret	*Y*	*Y*	*Y*	*Y*	*Y*
$\sigma(Ret_{i,t})$ (%)	0.5086	0.6437	0.6584	0.6465	0.7508
	12.33	*13.74*	*12.40*	*11.25*	*13.09*
$Turnover_{i,t}$	0.5669	0.4650	0.4214	0.4030	0.3831
	61.54	*49.81*	*44.74*	*40.66*	*38.66*
Adj. R^2	47.38	38.12	34.59	32.91	31.42
N	1,387	1,387	1,387	1,388	1,388

Disagreement & Stock volatility

	Dependent Variable: $Ret^2_{i,t+h}$ in %				
	h=1	*h=2*	*h=3*	*h=4*	*h=5*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
$DIS_{i,t}$	0.1905	0.3590	0.3570	0.2609	0.3908
	3.95	*5.06*	*4.92*	*4.19*	*5.03*
Option-$IMB_{i,t}$	0.1416	0.0464	0.0726	0.0698	0.0359
	5.09	*3.36*	*2.66*	*2.82*	*1.51*
$PP_{i,t}$	0.0126	0.0098	0.0362	0.0178	0.0297
	1.28	*0.84*	*2.29*	*1.14*	*2.35*
$Log(OptVolume)_{i,t}$	0.0485	0.0381	0.0391	0.0363	0.0324
	13.29	*13.67*	*11.20*	*8.43*	*10.96*
$ILS_{i,t}$ (%)	0.7995	0.5941	0.7356	0.6957	0.6804
	6.75	*12.30*	*8.08*	*8.74*	*9.10*
$Size_{i,t}$	-0.0835	-0.0824	-0.0781	-0.0716	-0.0707
	-10.57	*-10.84*	*-8.17*	*-7.26*	*-7.88*
Stock-$IMB_{i,t}$	0.2103	0.2171	-0.0142	0.0340	0.0848
	2.16	*3.28*	*-0.09*	*0.36*	*0.77*
Lagged Stock Ret	*Y*	*Y*	*Y*	*Y*	*Y*
$\sigma(Ret_{i,t})$ (%)	0.1249	0.1328	0.1373	0.1434	0.1484
	11.25	*10.54*	*9.33*	*8.55*	*8.61*
Adj. R^2	7.56	7.12	6.99	6.95	6.85
N	1,387	1,387	1,387	1,387	1,387

	Dependent Variable: $DIS_{i,t}$			
	(1)	*(2)*	*(3)*	*(4)*
$News\text{-}Dummy_{i,t}$		0.0007	0.0009	0.0009
		2.82	*3.67*	*3.49*
$Earnings\text{-}Dummy_{i,t}$		0.0035	0.0038	0.0033
		3.42	*3.77*	*3.24*
$UtilizationRate_{i,t}$			0.0223	
			22.37	
$LoanFee_{i,t}$				0.0788
				15.32
$Option\text{-}IMB_{i,t}$	0.0017	0.0016	0.0036	0.0034
	0.96	*0.93*	*2.03*	*1.89*
$PP_{i,t}$	-0.0352	-0.0352	-0.0361	-0.0353
	-25.78	*-25.80*	*-26.23*	*-25.77*
$Log(OptVolume)_{i,t}$	0.0215	0.0215	0.0207	0.0212
	79.47	*79.30*	*78.14*	*77.99*
$ILS_{i,t}$ (%)	0.0151	0.0149	0.0077	0.0025
	8.58	*8.47*	*4.06*	*1.25*
$Size_{i,t}$	0.0106	0.0106	0.0125	0.0108
	37.11	*37.48*	*43.17*	*37.82*
$Stock\text{-}IMB_{i,t}$	-0.0055	-0.0056	-0.0065	-0.0044
	-2.52	*-2.57*	*-2.81*	*-1.90*
$Ret_{i,t}$ (%)	0.0009	0.0009	0.0009	0.0009
	18.04	*17.85*	*16.97*	*16.90*
$Ret_{i,t-1}$ (%)	0.0009	0.0009	0.0009	0.0009
	20.77	*20.75*	*20.90*	*20.93*
$Ret_{i,t-2}$ (%)	0.0006	0.0006	0.0007	0.0007
	17.20	*17.11*	*16.56*	*16.49*
$Ret_{i,t-3}$ (%)	0.0005	0.0005	0.0005	0.0005
	13.31	*13.28*	*13.39*	*13.27*
$\sigma(Ret_{i,t})$ (%)	0.0080	0.0081	0.0080	0.0081
	25.93	*25.96*	*23.31*	*23.67*
Adj. R^2	31.03	31.05	31.54	31.45
N	1,387	1,387	1,302	1,301

Conclusion

- A new measure of investors Disagreement
- The first empirical support to Agree-to-Disagree models *without* explicit short-sale constraints
- The first empirical support to Duffie, Garleanu and Pedersen (2002): *prices can be more over-valued without short-sale restrictions*, compared to short-sale constraints, *and heterogeneity of believes*
- One of the first to demonstrate the sources of disagreement and its relations to the trading activity and volatility