

# Return Extrapolation and Day/Night Effects

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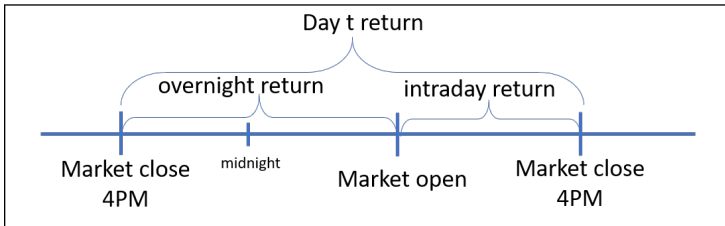
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# Tug of war – Lou, Polk, and Skouras (2019)



Panel A: Portfolios sorted by overnight returns

Decile	Overnight	Intraday
	Excess	Excess
1	<b>-1.51%</b> (-7.76)	<b>1.62%</b> (4.76)
10	<b>1.96%</b> (8.17)	<b>-1.63%</b> (-4.74)
10-1	<b>3.47%</b> (16.57)	<b>-3.24%</b> (-9.34)

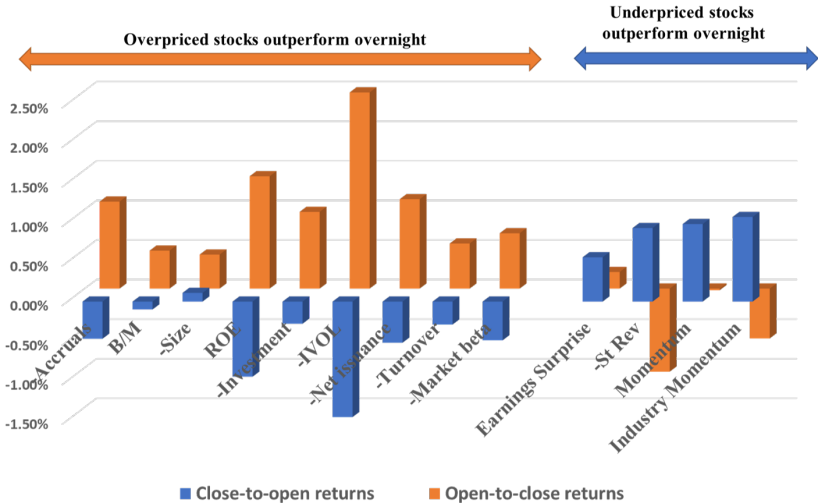
Panel B: Portfolios sorted by intraday returns

Decile	Overnight	Intraday
	Excess	Excess
1	<b>1.59%</b> (5.51)	<b>-1.51%</b> (-3.45)
10	<b>-0.22%</b> (-1.20)	<b>0.69%</b> (2.51)
10-1	<b>-1.81%</b> (-8.44)	<b>2.19%</b> (6.72)

- ▷ Stocks with relatively *high* past overnight (daytime) returns outperform *overnight* (during the day).

# Tug of war – Lou, Polk, and Skouras (2019)

- Investors that have different clienteles trade on different times of the day.



# Research questions

- ▷ What types of stocks do overnight traders prefer?
- ▷ What are the drivers of day/night return patterns?
- ▷ Relationship to other documented day/night return patterns
  - Stock prices appreciate only overnight (Kelly and Clark 2011)
  - CAPM only holds overnight (Hendershott, Livdan, Roesch 2020)

# Three ingredients from behavioral finance and institutional trading

## 1) Return extrapolation

- ▷ Expectations are positively correlated with past returns
- ▷ Market returns (Greenwood and Shleifer 2014) and individual stock returns (Da, Huang, and Jin 2014)

## 2) Unsophisticated investors trade relatively more in the morning.

- ▷ Different investor clientele (Lou, Polk, and Skouras 2019)
- ▷ Higher attention at open (Berkman et. al. 2012)
- ▷ Larger price dislocation and illiquid at open (e.g., Brock and Kleidon 1992)

## 3) Short-selling constraint is binding → overpricing (Miller 1977)

# Our main findings - Return extrapolation

- ▷ At the **stock** level, we find:
  - **Morning** order imbalance is **positively** (**negatively for afternoon**) related to past daytime returns
  - **Overnight** returns **positively** related (**unrelated for daytime**) to past daytime returns
- ▷ At the **portfolio** level, we find extrapolative trading leads to the observed day/night return patterns of characteristic-sorted portfolios
- ▷ At the **aggregate** level, we find evidence of extrapolative trading

# Relationship to existing work

- ▷ The **direction** (daytime returns *positively* predict next night returns) is in contrast to
  - daily return reversals (e.g., Avramov Chordia, and Goyal 2006)
  - periodicity in order flows (Heston, Korajczyk, and Sadka 2010)
  - existence of investor clienteles (Lou, Polk, and Skouras 2019)
- ▷ We **focus** on the morning trades
  - Overnight risk premium (e.g., Barrot, Kaniel, and Sraer 2016, Hendershott et. al. 2020)
  - Margin requirement and lending fee overnight (e.g., Bogousslavsky 2021)

# Data

- ▷ Trade and Quote (1993-2014) combined with Polygon (2015-2020)
  - Polygon is the data provider for Robinhood
  - NYSE, NASDAQ, and AMEX. Remove stock price less than \$5 and stocks with market capitalization that falls in the first NYSE quintile
- ▷ Returns are based on mid-quotes
- ▷ Intraday Order imbalance (OIB) measured using signed volume (Lee and Ready 1991)

$$\text{OIB} = \frac{\text{Buy} - \text{Sell}}{\text{Shares Outstanding}}.$$

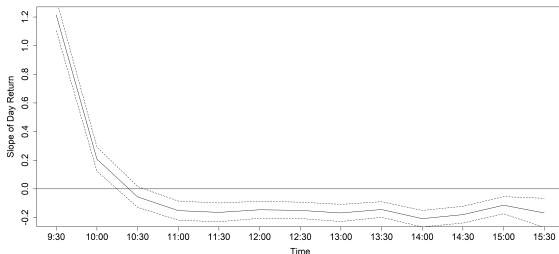
- ▷ 13 anomaly characteristics from Lou, Polk, and Skouras (2019)
- ▷ Retail order imbalance (Boehmer, Jones and Zhang 2021), intermarket sweep order to proxy institutional trade



# Extrapolation at the stock level - Fama-Macbeth regression

$$OIB_{int,t,i} = \alpha + \beta R_{9:45-3:59,t-1,i} + \delta' OIB_{t-1,i} + \epsilon_{int,t,i}$$

	9:30-9:45	9:45-10:30	10:30-4:00
$R_{9:45-3:59,t-1,i}$	1.8620 (26.88)	0.3332 (9.51)	-0.1537 (-9.68)
$R^2$ (%)	0.68	1.41	3.27



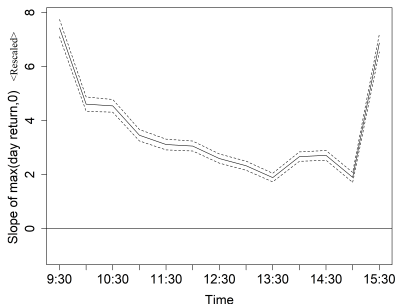
# What happens with binding short sale constraint?

- ▷ Unconditional effect
  - Since returns are on average close to zero, return extrapolation does not imply any unconditional effect on morning OIB.
- ▷ However, short-sale constraints will only be binding when past returns are negative.
  - We test by adding “**Max(day return , 0)**” to the regression
  - If there is extrapolation, we expect  $\beta_a > 0$ .

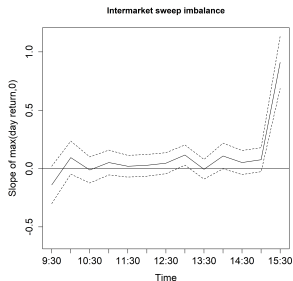
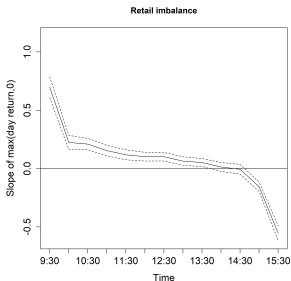
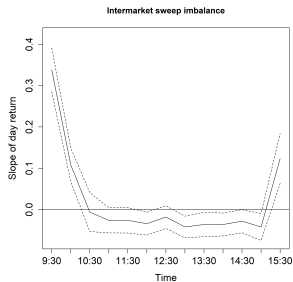
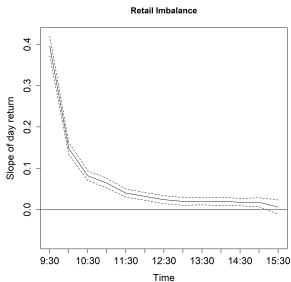
$$\begin{aligned} \text{OIB}_{int,t,i} = & \alpha + \beta R_{9:45-3:59,t-1,i} \\ & + \beta_a \max(R_{9:45-3:59,t-1,i}, 0) + \text{Control}_{t-1,i} + \epsilon_{int,t,i} \end{aligned}$$

# OIB predictability with short sale constraint

	9:30-9:45	9:45-10:30	10:30-4:00
$R_{9:45-3:59, t-1}$	0.8032 (5.39)	-0.3041 (-3.98)	-0.4571 (-14.43)
$\max(R_{9:45-3:59, t-1}, 0)$	2.0664 (9.56)	1.3060 (11.66)	0.7893 (18.14)
Control	Lagged night and week returns		
$R^2$ (%)	0.70	1.43	3.33



# Retail (left) vs Institutional (right) Trade



# Return predictability - FM approach

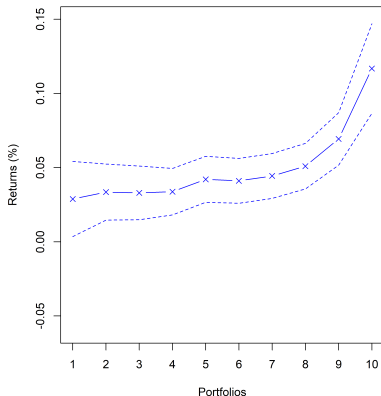
- To avoid mechanical reversal due to illiquidity and program trading, we use lagged day returns ending 3PM.

Dependent variable	Night returns: $R_{3:59-9:45,t}$			$R_{9:45-3:59,t}$	
$R_{9:45-3:59,t-1}$	-0.1000 (-0.87)				
$R_{9:45-3:00,t-1}$	0.9533 (8.12)	0.8807 (7.92)	-0.3839 (-2.76)	1.1716 (6.89)	
$\max(R_{9:45-3:00,t-1}, 0)$			1.0215 (4.72)	-0.2479 (-1.05)	
$R_{3:59-9:45,t-1}$		3.1559 (10.29)	3.7447 (30.05)	-3.2472 (-23.00)	
Characteristic controls	N	N	N	Y	Y
$R^2$ (%)	0.00	0.03	0.05	0.14	0.06

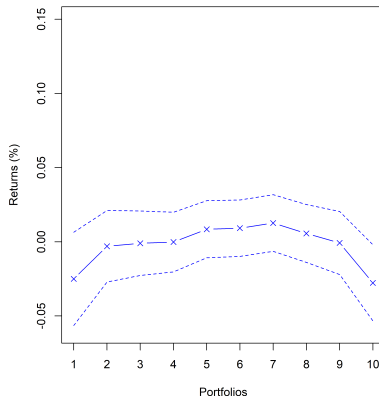
# Portfolio sorted by 3PM daytime returns (t)

## Value-weighted portfolio returns

Night returns(t+1)



Day returns(t+1)



# Morning extrapolation stronger for retail-focused stocks?

## Regression of Order Imbalance

	Z=Mispricing		Z=Google Search Vol		Z=% Retail volume	
	9:30-9:45	10:30-4:00	9:30-9:45	10:30-4:00	9:30-9:45	10:30-4:00
$R_{9:45-3:59, t-1}$	0.9892 (4.07)	0.0969 (1.96)	2.4352 (28.55)	2.4352 (-2.19)	0.4656 (2.96)	0.4903 (18.44)
$Z \times R_{9:45-3:00, t-1}$	0.0132 (2.69)	-0.0056 (-5.75)	11.0916 (5.39)	-2.8402 (-9.03)	46.2576 (13.21)	-8.7669 (-17.63)
Z	0.0004 (5.05)	0.0003 (15.71)	0.1028 (4.3)	0.1028 (5.47)	-0.1656 (-2.46)	0.0068 (0.57)

## Regression of Returns

	Z=Mispricing		Z=Google Search Vol		Z=% Retail volume	
	Night	Day	Night	Day	Night	Day
$R_{9:45-3:59, t-1}$	-2.7646 (-2.15)	-0.5491 (-1.17)	-1.0307 (-2.72)	-2.1700 (-0.83)	-2.7459 (-3.62)	0.6721 (2.58)
$Z \times R_{9:45-3:00, t-1}$	0.0642 (2.93)	0.0323 (3.09)	13.6811 (6.74)	1.3157 (0.13)	33.1346 (6.12)	-8.6307 (-2.71)
Z	-0.0004 (-0.89)	-0.0009 (-4.26)	0.0322 (0.87)	-3.8893 (-1.03)	0.3486 (3.82)	-0.4663 (-4.25)

# Characteristic-sorted portfolios ( $13 \times 10$ portfolios)

- ▷ The short-sale constraint is captured by **return dispersion** of the portfolio
- If the fraction of stocks with positive returns are higher, cross-sectional dispersion will increase

	OIB ( $\times 1000$ )				Returns			
$R_{t-1,9:45-3:00}$	0.979 (6.67)	-0.713 (-23.27)	0.929 (6.58)	-0.660 (-23.37)	0.030 (8.39)	0.008 (1.62)	0.021 (6.4)	0.004 (1.09)
Lag disp.			0.946 (6.16)	0.405 (12.96)			0.026 (7.67)	-0.039 (-7.68)
$R_{t-1,3:59-9:45}$	0.030 (0.17)	-0.078 (-1.94)	-0.014 (-0.09)	-0.098 (-2.62)	0.040 (8.87)	0.016 (2.59)	0.038 (9.25)	0.013 (2.45)
$R^2$ (%)	12.59	35.62	12.59	36.05	0.49	0.06	0.55	0.26



# Extrapolation and overpriced stocks

- ▷ We further investigate whether market-wide extrapolation is more prevalent for **overpriced** stocks
- ▷ Characteristics are defined so that high (portfolio 10) is underpriced (positive alpha)
- ▷ Replace portfolio returns and dispersion with market-wide measure

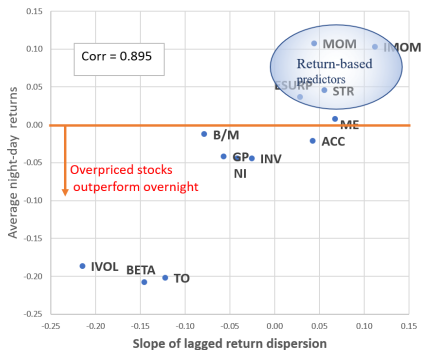
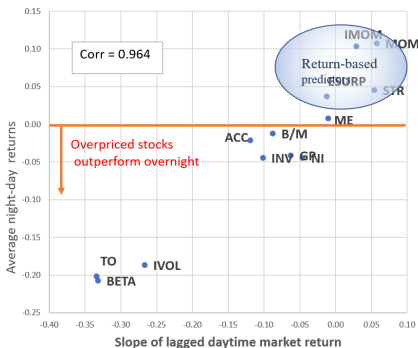
$$HML_{c,t+1} = \alpha_c + \beta_c R_{m,t} + \gamma_c \text{Disp}_{m,t} + \epsilon_{c,t+1},$$

HML = night – day returns of the HML portfolio

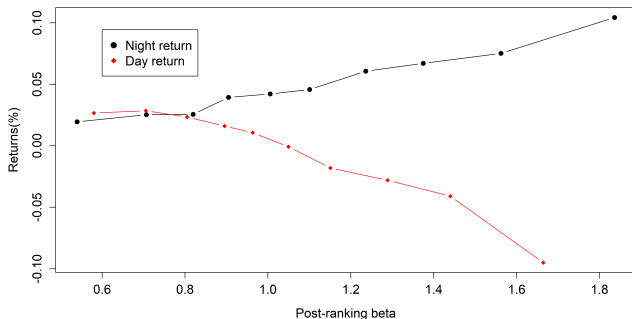
- ▷ Compare the slope of this regression ( $\beta_c$  and  $\gamma_c$ ) with the night-day return difference (as in LPS).

# Day/night returns (y) vs. slopes of regression(x)

$$HML_{c,t+1} = \alpha_c + \beta_c R_{m,t} + \gamma_c \text{Disp}_{m,t} + \epsilon_{c,t+1}$$

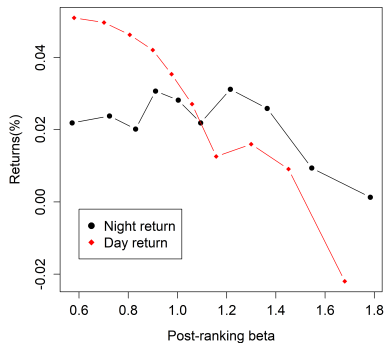
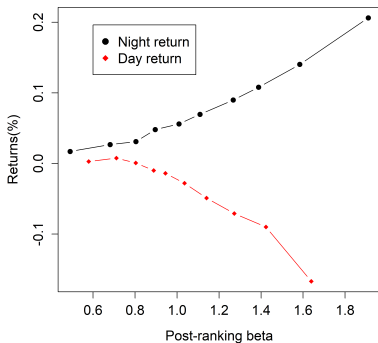


# Security Market Line (SML) around the day



- ▷ Hendershott, Livdan, and Roesch (2020) argue that high beta stocks require *overnight risk premium*
- ▷ Also consistent with *extrapolating market returns* since market returns are on average positive
- ▷ If these patterns are driven by return extrapolation, we expect the **overnight SML to be steeper following positive day returns**

# SML conditional on previous daytime returns



Following positive returns (left) and negative returns (right)

# Market return extrapolation at the aggregate level

	Order Imbalance					
	9:30-9:45		10:30-4:00		Difference	
$R_{m,9:45-3:00,t-1}$	2.102 (6.44)	1.969 (5.66)	-0.151 (-1.26)	-0.242 (-1.91)	2.253 (7.55)	2.211 (7.24)
Dispersion( $t-1$ )		5.002 (11.89)		3.419 (20.31)		1.584 (4.86)
$R^2$ (%)	1.06	6.56	0.03	21.62	1.49	2.15

	Returns					
	Night		Day		Night minus day	
$R_{m,9:45-3:00,t-1}$	0.039 (2.04)	0.039 (2.07)	-0.055 (-2.00)	-0.055 (-2.00)	0.094 (2.90)	0.094 (2.91)
Dispersion( $t-1$ )		-0.019 (-0.91)		0.010 (0.35)		-0.028 (-0.88)
$R^2$ (%)	0.17	0.19	0.19	0.18	0.39	0.41

# Conclusion

- ▷ We find strong evidence of extrapolative trading near the open.
- ▷ Our results explains:
  - Higher returns at the open for stocks that performed well the past day
  - Higher returns at the open for overpriced stocks
  - Steep SML for overnight returns