Macroeconomic attention and expected returns

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*The views expressed in this presentation are our own and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

Motivation

- Inattention to macroeconomic shocks proposed as a key mechanism for money non-neutrality and business cycle asymmetries. (Maćkowiak and Wiederholt, 2009, 2015; Song and Stern, 2024; Flynn and Sastry, 2024).
- Empirically, assessing the relevance of the mechanism is challenging as attention allocation is not directly observed.
- This paper: Can the cross-section of stock returns help us understand the relevance of firms' attention allocation?

This paper

- Measures attention to macroeconomy using firm disclosures.
  - Large variation in macro-attention across firms.
  - Macroeconomic attention highly counter-cylical (Song and Stern, 2024; Flynn and Sastry, 2024).
- Higher macroeconomic attention correlates with significantly lower returns.
  - Average returns of highest attention decile stocks are 13.1% p.a. lower than lowest decile stocks.
  - Not explained by known asset pricing factors and characteristics.
- Explain findings with simple model of macroeconomic attention and stock returns.
  - Higher macro-attention stocks have cash flows more exposed to aggregate risk relative to firm-specific risk.
  - Both aggregate and firm-specific risks are priced, but larger variation in firm-specific risk exposure drives the observed negative risk premium.

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Data

- Transcripts of 142,751 earnings calls from 2002-Q1 to 2020-Q1.
  - Restrict to US public-listed firms, excluding financial stocks.
- Collection of 44,835 Reuters news articles about the macroeconomy or company news.
  - Google Search to rank articles by relevance each week: "site: reuters.com" + "economy" or "[company name]" + "after: [start date]" + "before: [end date]".
  - Quality control: Select articles with "Economy" or "Company News" topic codes, keeping sentences with macro and firm-specific keywords.
- Firm level returns and balance sheet data from CRSP/Compustat.

Measuring attention to the macroeconomy

- Sentence classification:
  - Use word embeddings classification model to predict relevance score m_s for each sentence s.
  - $m_s = h(w_{s,1}, \ldots, w_{s,V})$ where $w_{s,v}$ are the embeddings of word v in sentence s.
  - $m_s \in [0, 1]$ is the probability that sentence s is macroeconomy-relevant.

- Macro Attention measure:
  - Macro attention of firm i in quarter t is the share of sentences classified as macroeconomy-relevant:

$$MacroAttn_{it} = \frac{1}{|\mathcal{S}_{it}|} \sum_{s \in \mathcal{S}_{it}} 1\{m_s \geq c\}$$

  where c is the relevance threshold.

Embeddings

Model performance comparison

- Single layer embeddings model achieves highest overall accuracy and f1-scores.

Representation	Hidden Layers	Accuracy	Recall	Precision	F1 Score
Learned Embeddings	0	0.958	0.834	0.903	0.867
Learned Embeddings	1	0.958	0.846	0.890	0.868
Binary Count	1	0.951	0.807	0.884	0.843
Binary Count	0	0.951	0.798	0.890	0.842
Term Frequency	1	0.946	0.855	0.820	0.837
Term Frequency	0	0.946	0.855	0.820	0.837
Pre-trained Embeddings	1	0.896	0.503	0.784	0.613
Pre-trained Embeddings	0	0.896	0.497	0.788	0.609
TF-IDF	0	0.891	0.340	0.982	0.505
TF-IDF	1	0.889	0.327	0.983	0.490

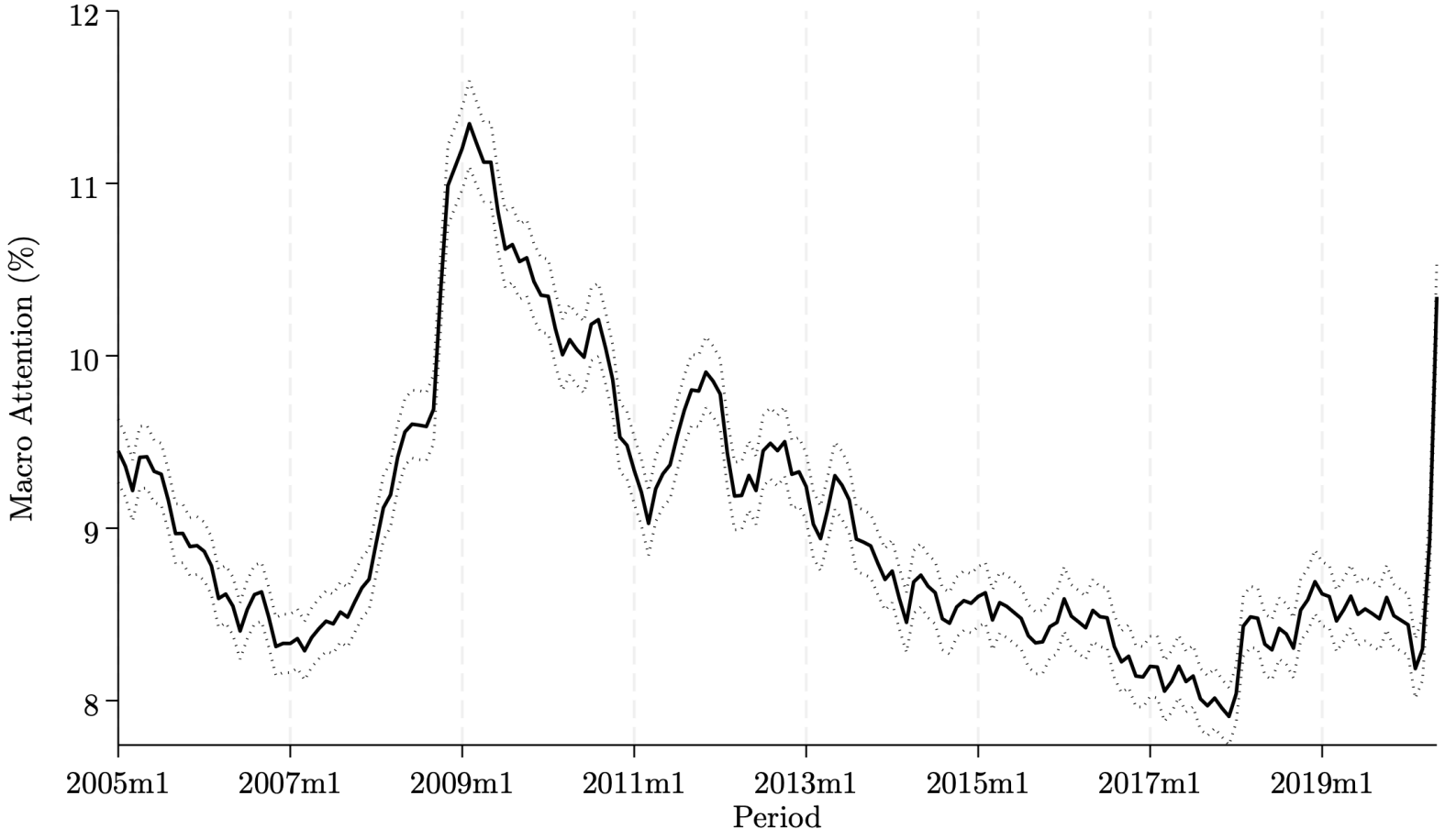
Validation: keywords of classified earnings call sentences

Macro		Non-macro	
inflat	optimist	morn	launch
economi	foreign	acquisit	excit
reform	curv	patient	client
budget	repeat	ebitda	store
recoveri	wait	technolog	deal
read	unchang	brand	sharehold
pace	gdp	platform	strateg
labor	moder	execut	integr
export	germani	digit	capabl
hous	headwind	everyon	offic

Table 1: Top 20 most common words for each class label. Words found in both class labels removed.

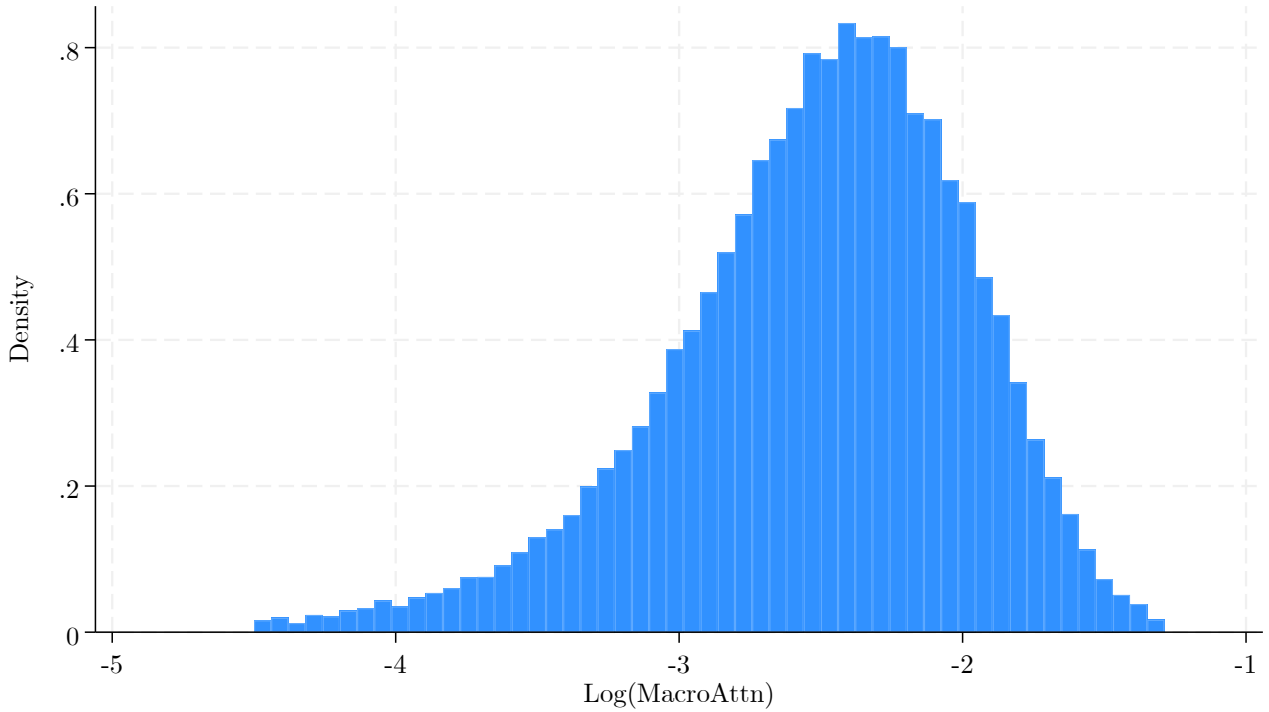
Macroeconomic attention over time

- Average earnings call spends 9 percent of the time discussing macro-relevant topics. Attention to the macroeconomy is countercyclical and persistent.



Variation in macroeconomic attention across firms

- Large cross-sectional variation in $MacroAttn_{it}$, even after controlling for time-and-sector FE and firm FE.



	Time FE	Sector FE	Sector x time FE	Firm FE
R-squared (%)	3.4	27.2	38.4	48.3

Macro-attention and firm characteristics

- Macro-attention higher when firms are riskier, larger, have lower book-to-market, and negative earnings surprise.

	(1) log(MacroAttn)	(2) log(MacroAttn)	(3) log(MacroAttn)	(4) log(MacroAttn)	(5) log(MacroAttn)
Firm risk	0.0164***				
	(9.32)				
log(Asset)		0.0318***			
		(9.60)			
Leverage			-0.0143		
			(-1.10)		
Book-to-market				-0.0108***	
				(-4.66)	
Earnings Surprise < 0					0.00774***
					(2.65)
Firm & Time FE	✓	✓	✓	✓	✓
R^2	0.51	0.51	0.51	0.51	0.51
N	106514	106514	106514	106514	106514

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Macro-attention and expected returns

- High macro-attention firms earn **lower** returns relative to low macro-attention firms, with a sizable difference in returns.

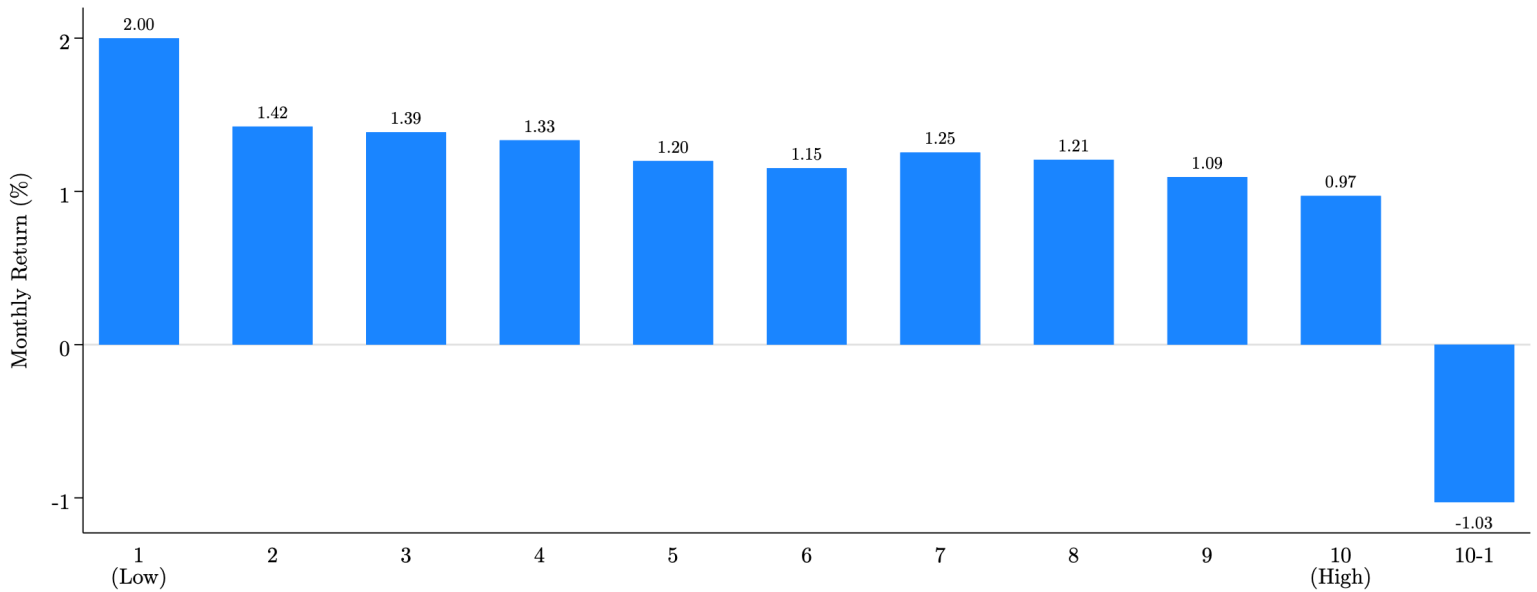
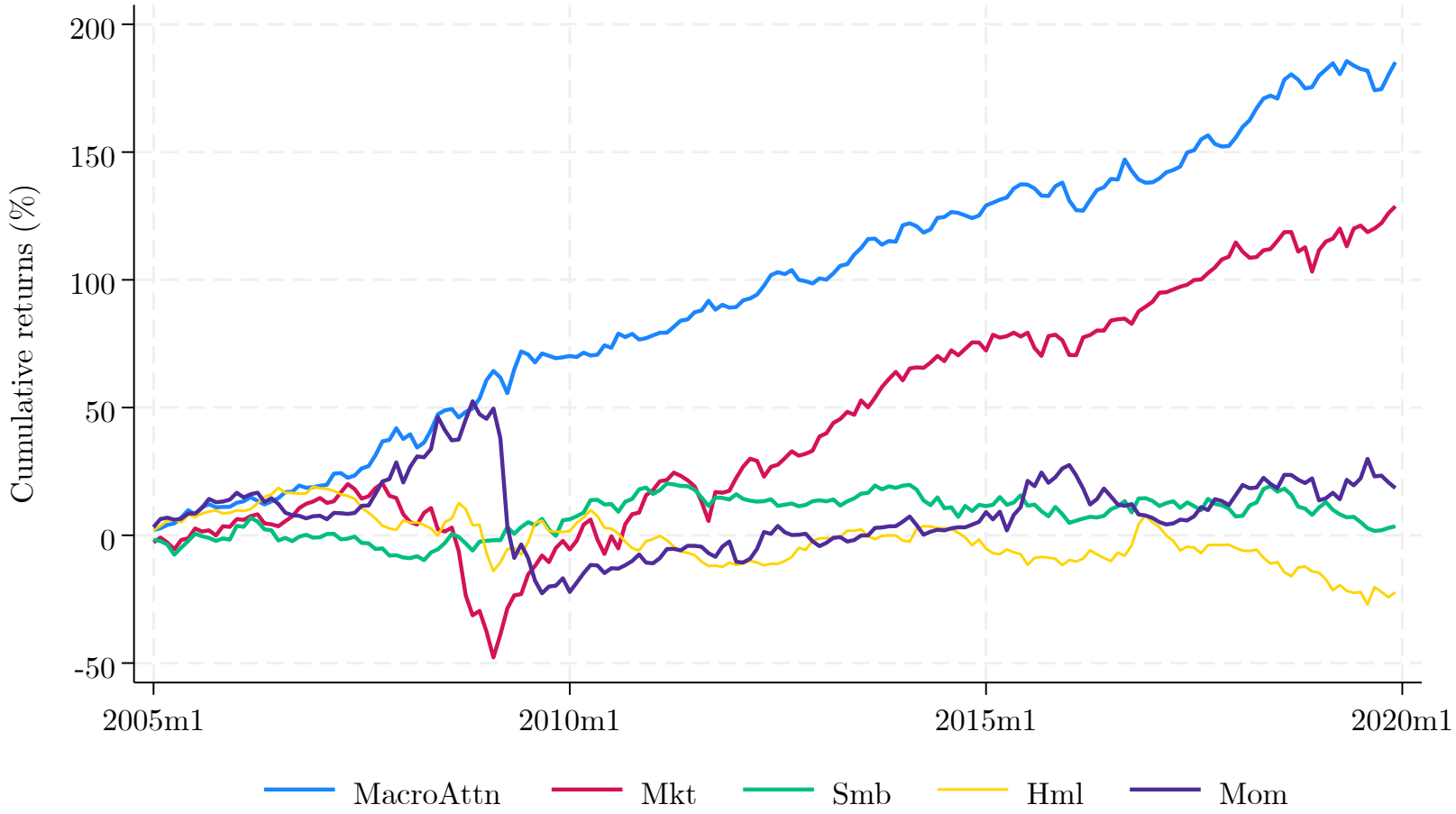


Figure 1: Average monthly returns of macroeconomic attention sorted portfolios over the sample period. The sample period is from January 2005 to December 2019.

Cumulative portfolio returns over time

- Returns to long-short portfolio are large relative to known asset pricing factors, accrue even in non-recession periods.



Controls for asset pricing factors and characteristics

- Macro-attention portfolio returns not fully explained by asset pricing factors.

	CAPM	FF-3	Carhart-4	FF-5	FF-3 + FVIX
α_{10-1}	-1.084***	-0.995***	-1.085***	-1.241***	-0.984***
	(-5.59)	(-6.06)	(-4.08)	(-7.68)	(-5.80)
R-squared	0.013	0.269	0.270	0.384	0.300

- Portfolio alphas persist in portfolios double-sorted on asset pricing factors and characteristics.

	Mkt-Beta	Size	Book-to-Mkt	Agg Vol	Idio Vol	Industry
α_{10-1}	-0.673***	-0.753***	-0.846***	-0.659***	-0.724***	-0.422**
	(-4.52)	(-4.53)	(-5.49)	(-4.49)	(-4.67)	(-2.48)
R-squared	0.283	0.307	0.254	0.300	0.322	0.117

Conceptual framework

- Firm i's dividend growth follows process

$$\Delta d_{i,t+1} = \eta_{t+1} + \nu_{it+1}$$

where $\eta_{t+1} \sim N(0, \sigma_\eta^2)$ are aggregate shocks, and $\nu_{it+1} \sim N(0, \varphi_i \sigma_\nu^2)$ are firm-specific shocks.

- Analyst covering firm i receives signals of macro and firm-specific shocks from earnings call.

$$s_{it}^\eta = \eta_{t+1} + \epsilon_{it}^\eta$$
$$s_{it}^\nu = \nu_{it+1} + \epsilon_{it}^\nu$$

where $\epsilon_{it}^\eta \sim N(0, \sigma_{\epsilon,\eta}^2)$ and $\epsilon_{it}^\eta \sim N(0, \sigma_{\epsilon,\nu}^2)$ are signal noises.

Analyst's forecasting problem

- Analyst minimize forecast errors by choosing how much attention to pay to each signal

$$\max_{\sigma^2_{\epsilon,\eta},\sigma^2_{\epsilon,\nu}} -E_t\left[(\Delta d_{it+1} - \Delta \hat{d}_{it+1})^2\right]$$

  subject to limitation in information processing capacity

$$\frac{1}{2}\log_2\left(1+\frac{\sigma^2_\eta}{\sigma^2_{\epsilon,\eta}}\right)+\frac{1}{2}\log_2\left(1+\frac{\varphi_i\sigma^2_\nu}{\sigma^2_{\epsilon,\nu}}\right)\leq\kappa$$

- The optimal attention to the signal of macro shocks given by:

$$MacroAttention_{it} = \frac{1}{2}+\frac{1}{4\kappa}\log_2\left(\frac{\sigma^2_\eta}{\varphi_i\sigma^2_\nu}\right)$$

- **Prediction 1:** $MacroAttention_{it}$ increasing in variance of macro-shocks, decreasing in variance of firm-specific shocks.

Return decomposition

- Following Campbell (1991), the unexpected log return of asset i can be decomposed as

$$r_{i,t+1} - E_t r_{i,t+1} = N^{CF}_{i,t+1} - N^{DR}_{i,t+1}$$

- Given dividend growth process, cash flow news is given by

$$N^{i}_{CF,t+1} = \eta_{t+1} + \nu_{i,t+1}$$

where $\eta_{t+1} \sim N(0, \sigma^2_\eta)$ and $\nu_{i,t+1} \sim N(0, \varphi_i \sigma^2_\nu)$.

- Assume discount rate news uncorrelated with cash flow news, with similar variance σ^2_ω and correlation ρ across all firms.

Risk premium

- For a representative investor with Epstein-Zin preferences and who holds the market portfolio, the risk premium of stock i is given by

$$rp_i = \gamma\sigma_m^2\beta_{i,m}^{CF,macro} + \gamma\sigma_m^2\beta_{i,m}^{CF,firm} + \sigma_m^2\beta_{i,m}^{DR}$$

  where cash-flow and discount-rate risk loadings given by:

$$\beta_{i,m}^{CF,macro} = \frac{\sigma_\eta^2}{\sigma_m^2},$$

$$\beta_{i,m}^{CF,firm} = \frac{1}{M}\frac{\varphi_i\sigma_\nu^2}{\sigma_m^2}$$

$$\beta_{i,m}^{DR} = \frac{\sigma_\omega^2}{\sigma_m^2}\left(1 + \frac{\rho(M-1)}{M}\right)$$

- **Prediction 2:** Higher $MacroAttention_{it}$ associated with lower firm-specific cash flow betas $\beta_{i,m}^{CF,firm}$

Bringing model to data

- Estimate cash flow and discount rate news using IBES earnings forecasts (De Lao and Myers, 2021).
- Decompose cash flow news into aggregate/firm-specific factors via factor model:

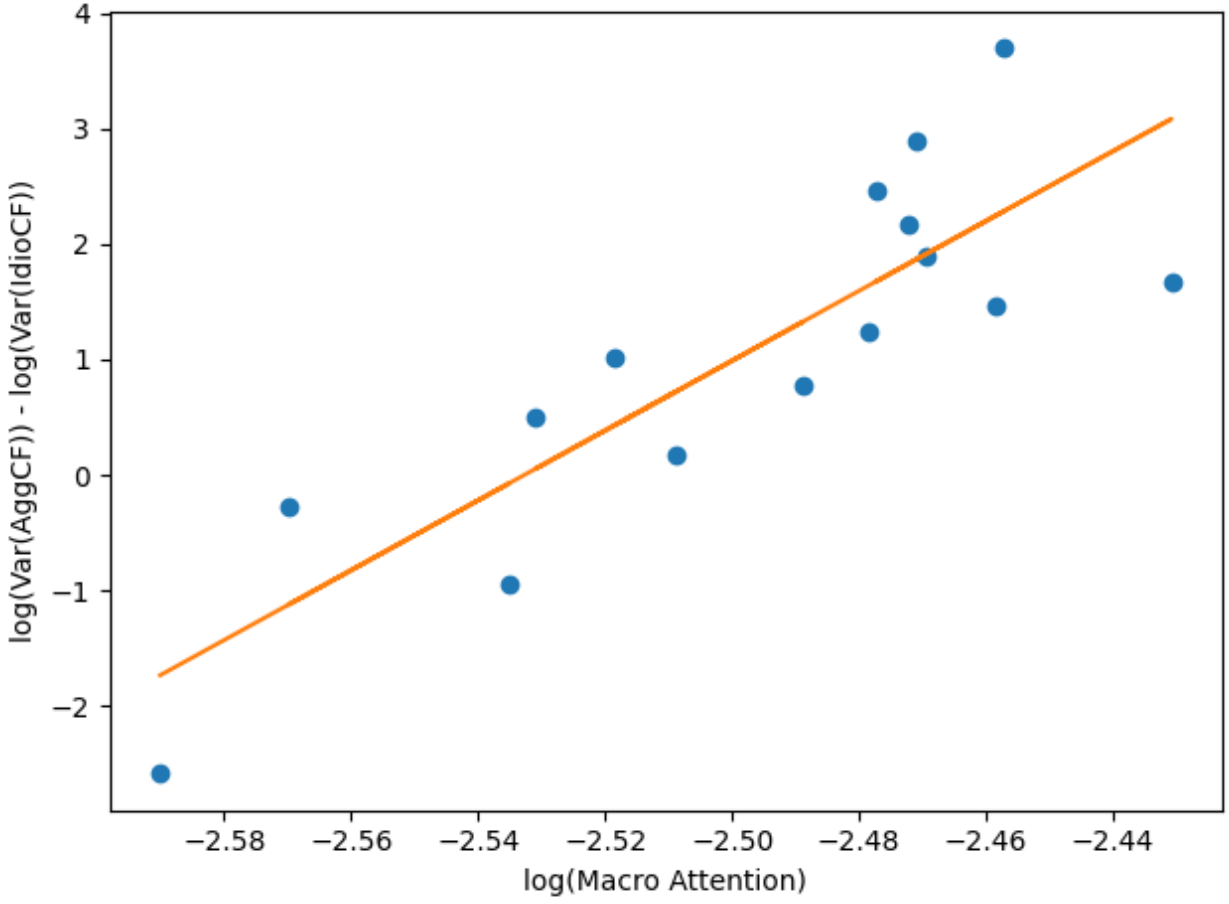
$$\min_{\Psi,U} \sum_{i,t} \left(x_{it} - \psi_i u_t'\right)^2 + \gamma \left(\|\Psi\|_F^2 + \|U\|_F^2 \right)$$

  - Variance from aggregate factors: $Var(\psi_i u_t)$
  - Variance from firm-specific factors: $Var(e_i) = Var(x_{it} - \psi_i u_t')$

Macro Attention and Variance of Cash Flow Risk

- Prediction 1: Analyst attention to the macroeconomy increasing in share of cash flow risk explained by macro shocks.

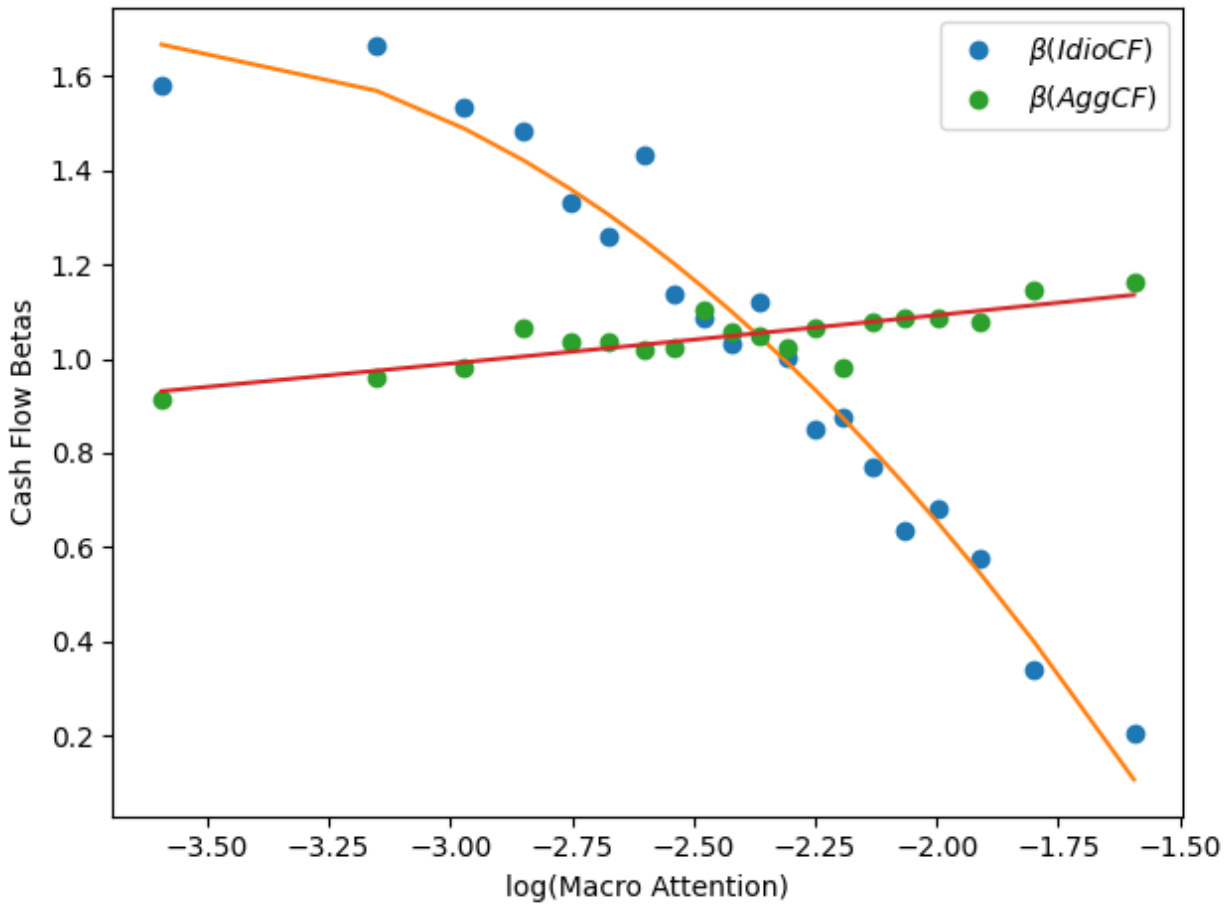
$$MacroAttention_{it} \propto \log(\sigma_\eta^2) - \log(\varphi_i \sigma_\nu^2)$$



Macro vs Firm-specific Cash Flow Betas

- Prediction 2: Higher macro-attention associated with lower firm-specific cash flow betas.

$$MacroAttention_{it} \propto \frac{1}{\beta_{i,m}^{CF,firm}}$$



Conclusion

- Macro-attention allocation has implications for the cross-section of stock returns:
  - Macroeconomic attention varies significantly across firms
  - Firms with higher macro-attention tend to earn lower returns.
  - Difference in returns not explained by known asset pricing factors such as size, value, or momentum.
- Simple model of attention allocation consistent with empirical findings:
  - Firms with higher macro-attention load more on aggregate cash flow risk, and less on firm-specific risk.
  - Empirically, larger variation in firm–specific risk exposure across macro-attention stocks, explaining negative risk premium.

Processing sentence with embeddings

- Step 1: Sentence Tokenization
  - The sentence is split into words: [“The”, “economic”, “outlook”, “is”, “uncertain”]
- Step 2: Word Embeddings
  - Each word is converted into a 300-dimensional vector using an embedding layer.
- Step 3: Neural Network
  - Global Max Pooling: Summarizes the sequence into a single vector.
  - Dense Layer: Further reduce vector into 64-dimensional vector, summarizing high level features.
  - Sigmoid Layer: Outputs a probability indicating the sentence’s macroeconomic relevance.
- Step 4: Output
  - Model outputs probability score (e.g., 0.87), indicating how macroeconomy-relevant the sentence is.

Measurement

Fama-MacBeth (1973) regressions Main

Table 2: Sample period is from January 2005 to December 2019. t-statistics incorporate Newey-West correction with four lags.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MacroAttn	-0.649***	-0.585***	-0.635***	-0.630***	-0.613***	-0.805***	-0.784***	-0.596***	-0.295**
	(-5.01)	(-4.45)	(-4.92)	(-4.84)	(-4.44)	(-6.28)	(-5.70)	(-4.51)	(-2.32)
$\beta(MKT)$	-0.346*								-0.340*
	(-1.74)								(-1.87)
$\beta(SMB)$		0.0536							-0.106
		(0.86)							(-1.26)
$\beta(HML)$			0.159*						0.221**
			(1.96)						(2.31)
$\beta(VIX)$				10.74					50.34*
				(0.33)					(1.71)
Size					-0.373***				-0.133***
					(-6.21)				(-3.46)
Book-to-market						0.127			-0.111
						(1.19)			(-1.58)
Lagged returns (12 mths)							-0.125		0.416*
							(-0.43)		(1.95)
Idio vol								43.93***	7.451
								(4.29)	(1.55)
Observations	323424	323398	323523	323661	323900	311784	321047	323401	284630
R^2	0.0206	0.0180	0.0186	0.0142	0.0150	0.0126	0.0154	0.0166	0.0794

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Fama-MacBeth (1973) regressions Main

Table 3: Sample period is from January 2005 to December 2019. t-statistics incorporate Newey-West correction with four lags.

	(1)		(2)	
MacroAttn	-0.17***	(-3.96)	-0.13***	(-3.77)
$\beta(MKT)$	-0.11	(-1.19)	-0.12	(-1.39)
$\beta(SMB)$	-0.19**	(-2.65)	-0.20**	(-2.89)
$\beta(HML)$	0.13	(1.54)	0.10	(1.28)
$\beta(VIX)$	-0.04	(-0.72)	-0.04	(-0.73)
Size	-0.44***	(-7.80)	-0.46***	(-7.87)
Book-to-market	-0.08	(-1.71)	-0.20***	(-3.76)
Lagged returns (12 mths)	0.04	(0.65)	0.03	(0.60)
Idio vol	0.25***	(4.16)	0.18***	(3.94)
Issuances (36 mths)			-0.03	(-0.95)
Accruals			0.14***	(4.82)
Return on asset			-0.28***	(-5.23)
Asset growth			-0.03	(-1.19)
Lagged returns (12 mths)			0.08*	(2.21)
Issuances (12 mths)			-0.02	(-0.52)
Turnover			0.07	(1.29)
Sale-to-price			0.10*	(2.05)
Net debt-to-price			0.06	(1.55)
Dividend yield			-0.02	(-0.43)
Observations	328852		328852	
R^2	0.0610		0.0805	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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