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Incentive-Driven Inattention

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Introduction

What drives the updating of beliefs?

- To investigate this question, we build a model that endogenizes attention.
- Model estimation: Survey dataset with daily data.
- Model fits relatively well the data patterns.
- Perform counterfactuals on changing the survey-design.

Introduction

Why study surveys of professional forecasters?

- Key inputs in economic agents' decisions.
- Professional forecasters often represent an upper bound for rationality.
- Survey forecasts can outperform model-based forecasts.

  (Ang, Bekaert and Wei, 2007; Faust and Wright, 2012)
- Large and influential literature uses survey data to investigate information frictions, violations of rationality or persistent disagreement.

  (Patton and Timmermann, 2010; Coibion and Gorodnichenko, 2015)

Introduction

The Focus survey of professional forecasters (*Central Bank of Brazil - BCB*)

- Daily data from more than 100 institutions;
- Participants can provide forecasts for different horizons and a large number of variables;
- The anonymity of forecasters is preserved;
- *Top5 ranking* to improve forecasting expertise.

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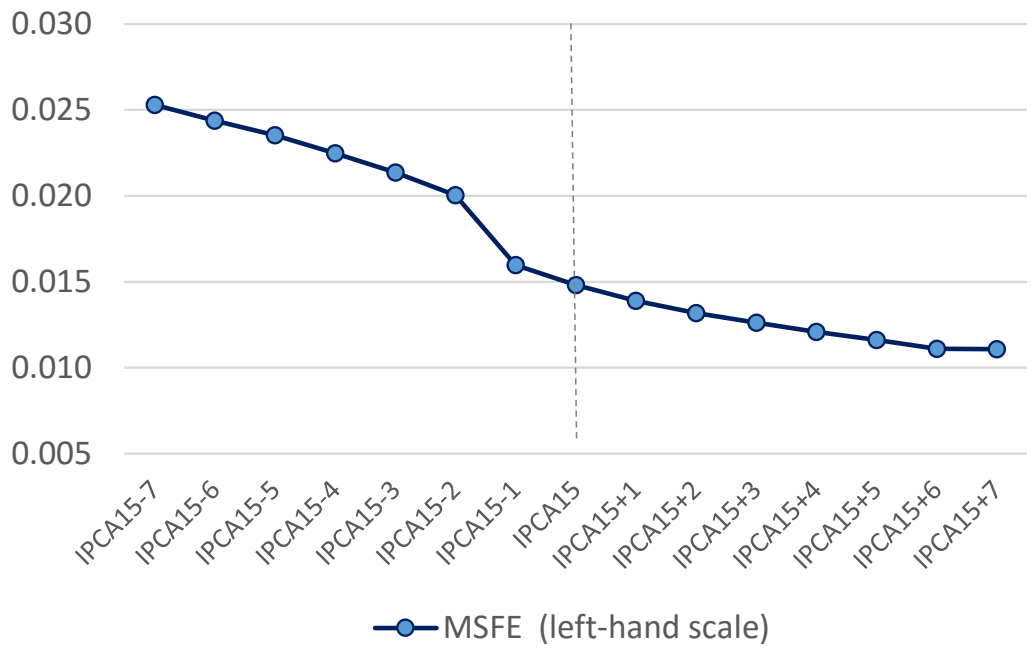
In this paper, we study daily nowcasts of monthly inflation (as measured by IPCA).

- IPCA: CPI released around the 8th of the month subsequent to the reference month.
- IPCA15: same index but 14-days-distanced (released about the 22nd of the reference month).

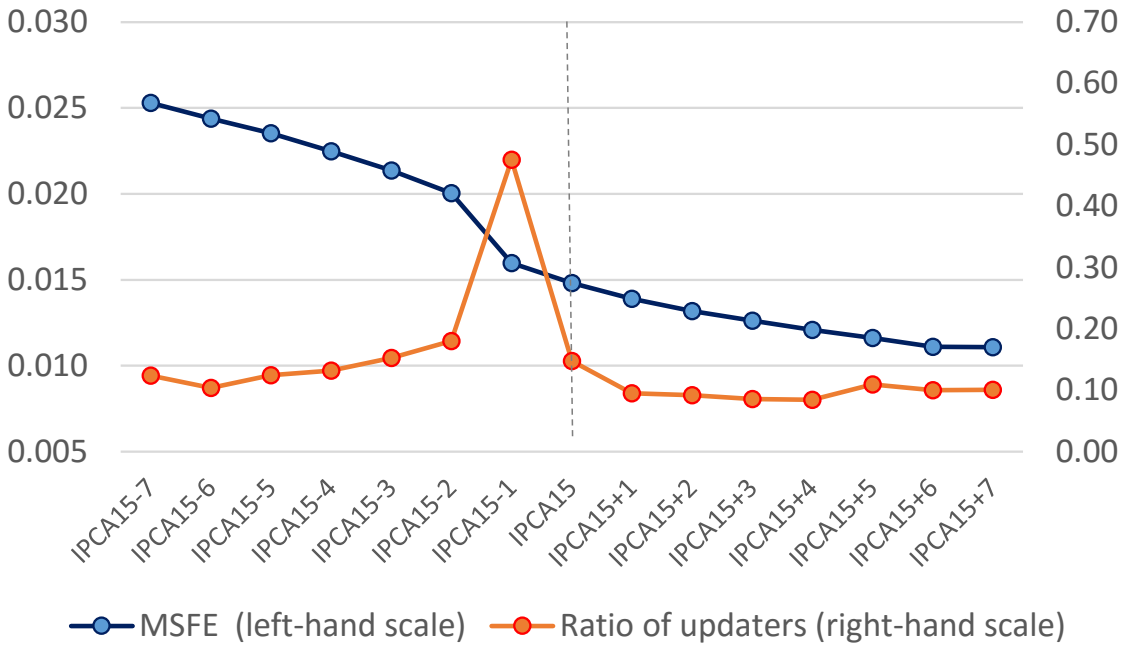
Introduction

Figure 1 - Mean Squared Forecast Error (*MSFE*)



Introduction

Figure 1 - Mean Squared Forecast Error (*MSFE*) and Ratio of Updaters



Why does attention spike the day before the IPCA15 release day?

Theory part 1: Modeling decisions to revise (*attention*)

Framework

- Finite set of forecasters i who can submit to the survey, on day t, the forecast $F_{i,t}$ of a monthly inflation rate x_m.
- How much attention forecaster i devotes to the variable of interest is constrained by his or her total attention budget Λ_i.
- Each forecaster decides how to allocate Λ_i among the total days in the month when he or she can submit a forecast.

Theory part 1: Attention

Forecaster's Objective

$$\min_{0 \leq \lambda_{i,t} \leq 1, t \in T} \Sigma_{t \in T} \left\{ \frac{\omega_{i,t}}{2} \mathbb{E}\left[(F_{i,t} - x_m)^2 \right] + c_{i,t} \lambda_{i,t} \right\} \quad \text{s.t.}$$

- the total "attention budget" constraint:

$$\Sigma_{t \in T} \left(\lambda_{i,t} \right) \leq \Lambda_i \tag{1}$$

- forecast is the conditional expectation:

$$F_{i,t} = E\left[x_m | \Omega_{i,t} \right] \tag{2}$$

- the uncertainty-reduction constraint:

$$\sigma^2_{x_m | \Omega_{i,t}} = \Pi_{s=1}^{t} \left[\left(2^{2\lambda_{i,s}} \right)^{-1} \right] \sigma^2_{x_m} \tag{3}$$

Theory part 1: Attention

Optimal Attention

- Let $\widetilde{\Lambda}_{i,t} \equiv \lambda_{i,1} + ... + \lambda_{i,t}$ be the cumulative attention.
- Define $\beta_{i,t} \equiv \frac{\omega_{i,t}}{c_i}$ as the benefit/cost ratio of updating.
- Assuming an interior solution, F.O.C. imply that:

$$\widetilde{\Lambda}_{i,t} = \frac{1}{2} \log_2 \left(\beta_{i,t} \ln (2) \sigma^2_{x_m} \right) \tag{4}$$

Theory part 2: Accuracy

From the literature on sticky-information:

(e.g., Mankiw and Reis, 2002; Reis, 2006; Coibion and Gorodnichenko, 2012)

$$F_t = \lambda_t \mathbb{E}\left(x_m | \Omega_t\right) + \left(1 - \lambda_t\right) F_{t-1} \tag{5}$$

Let $v_t = x_m - \mathbb{E}\left(x_m | \Omega_t\right)$. Daily MSFE of consensus forecast:

$$\begin{aligned} MSFE_t &= \mathbb{E}\left[\left(x_m - F_t\right)^2\right] \\ &= \left(\frac{1-\lambda_t}{\lambda_t}\right)^2 \mathbb{E}\left[\left(\Delta F_t\right)^2\right] + \mathbb{E}\left(v_t^2\right) \end{aligned} \tag{6}$$

Theory part 2: Accuracy

- Monthly inflation is equal to the sum of daily inflation rates.
- Assume that daily inflation follows an AR(1) process.
- Reconcile daily inflation with monthly IPCA and IPCA15 data.
- Kalman filter with mixed frequencies (*Mönch and Uhlig, 2005*).

Structural Model

GMM moment conditions

$$0 = \mathbb{E}\left[\left(\widetilde{\Lambda}_t - \frac{1}{2}\log_2\left(\beta_t \ln(2)\,\sigma_x^2\right)\right) \otimes z_{1,t-s_1}\right] \quad (7)$$

$$0 = \mathbb{E}\left[\left(\left(x_{m,t} - c - \phi x_{m,t-1}\right)^2 - \sigma_\varepsilon^2\right) \otimes z_{2,t-s_2}\right] \quad (8)$$

$$0 = \mathbb{E}\left[\begin{pmatrix} MSFE_t - \left(\frac{1-\lambda_t}{\lambda_t}\right)^2 \mathbb{E}\left[(\Delta F_t)^2\right] \\ -w_t\sigma_\varepsilon^2 - \sigma_\eta^2 \end{pmatrix} \otimes z_{3,t-s_3}\right] \quad (9)$$

Parameters: $\left(\beta_t, \sigma_x^2, c, \phi, \sigma_\varepsilon^2, \sigma_\eta^2\right)$

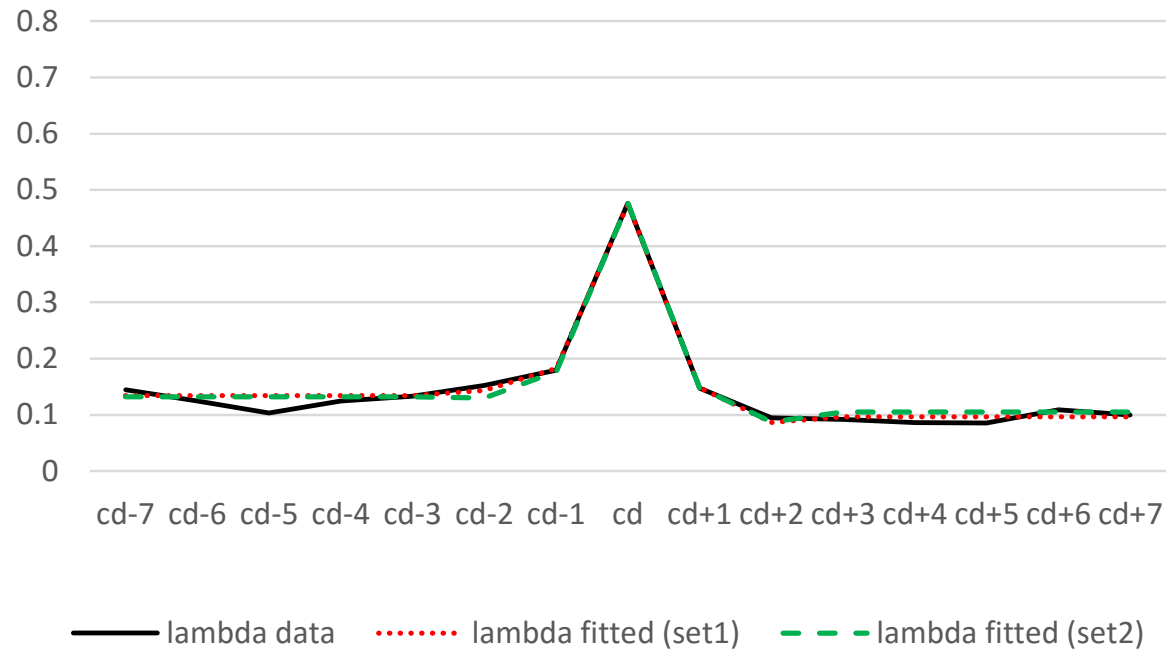
Model Estimation

Data

- Daily forecasts from January 2nd, 2004 to January 8th, 2015;
- Data covers monthly inflation rates (IPCA) from Jan/04 to Dec/14;
- Unbalanced panel (*N x T*) containing 234,605 observations;
- Breakdown: *T* = 2,751 daily observations and average of *N* = 85.3 forecasters.

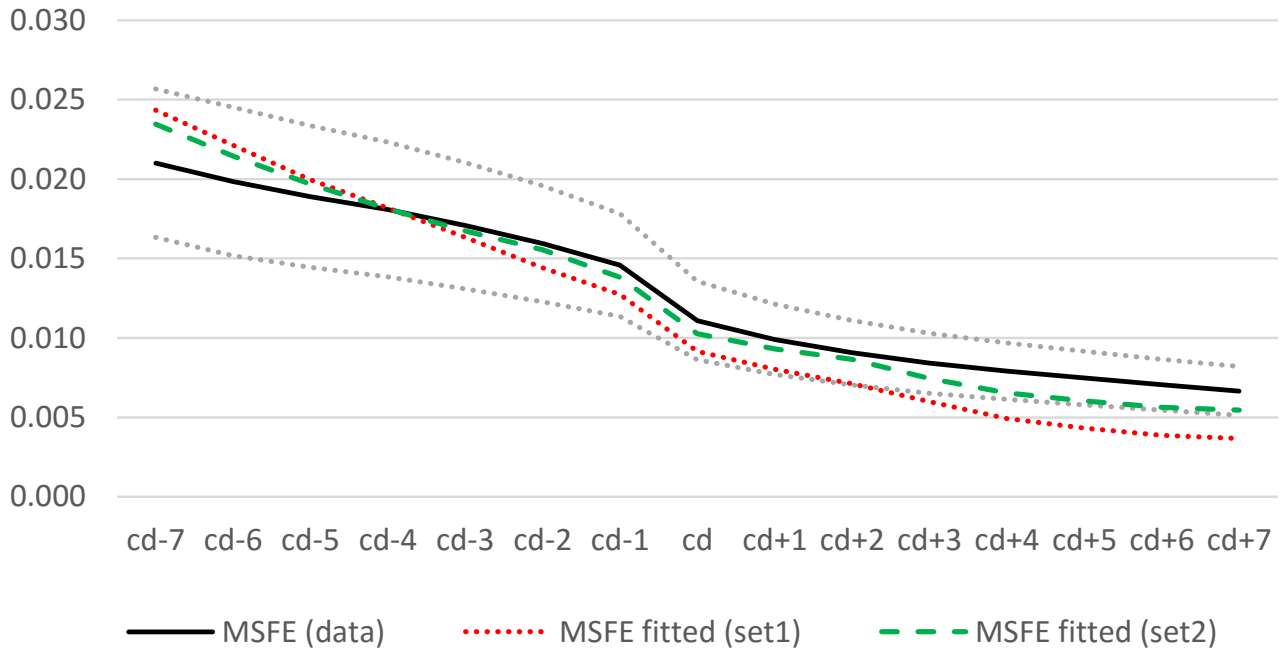
Model Fit

Figure 2 – Attention (*data x model*)



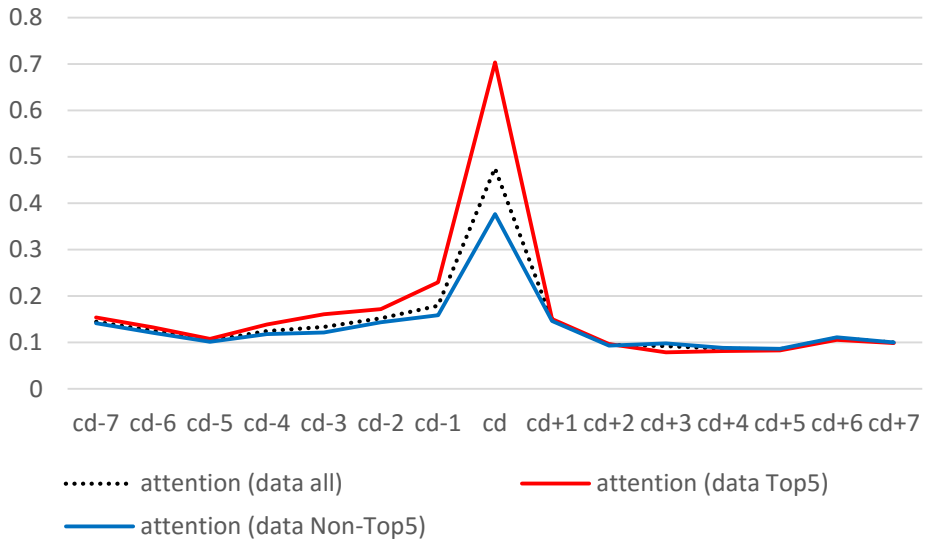
Model Fit

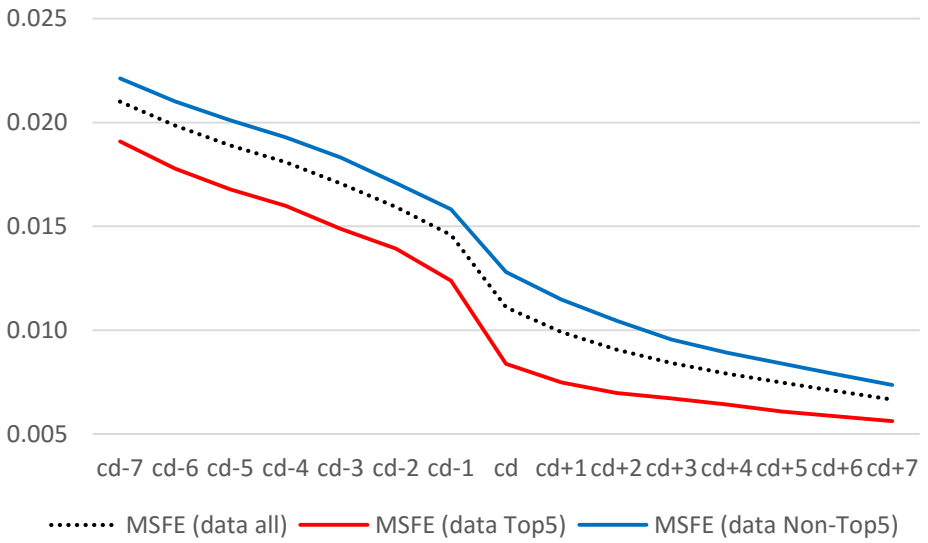
Figure 3 – Accuracy (*data x model*)



Are Forecasters Heterogeneous?

Figure 4 - Attention (left) and Accuracy (right)





Are Forecasters Heterogeneous?

Parameter	Heterogeneous case							
	Attention implied by the model in MSE eq.				Attention from data in MSE eq.			
	Set of instrum. #1		Set of instrum. #2		Set of instrum. #1		Set of instrum. #2	
$\beta_{IPCA,\ top5}$	36.24	***	36.29	***	36.66	***	36.68	***
	(0.45)		(0.45)		(0.44)		(0.44)	
$\beta_{IPCA+1,\ top5}$	45.77	***	45.89	***	46.34	***	46.35	***
	(0.78)		(0.78)		(0.80)		(0.80)	
$\beta_{IPCA+2,\ top5}$	55.67	***	55.81	***	56.76	***	56.75	***
	(1.24)		(1.25)		(1.28)		(1.28)	
$\beta_{CD-4,\ top5}$	85.22	***	86.02	***	87.75	***	90.49	***
	(3.24)		(3.53)		(3.83)		(4.34)	
$\beta_{CD-3,\ top5}$	111.88	***	112.65	***	112.47	***	114.37	***
	(4.62)		(4.90)		(5.38)		(5.96)	
$\beta_{CD-2,\ top5}$	134.68	***	140.05	***	141.22	***	140.26	***
	(6.76)		(7.11)		(7.35)		(7.27)	
$\beta_{CD-1,\ top5}$	187.32	***	189.08	***	188.36	***	191.20	***
	(10.29)		(10.41)		(10.50)		(10.66)	
$\beta_{CD,\ top5}$	495.99	***	489.94	***	497.60	***	499.36	***
	(26.07)		(25.92)		(26.44)		(26.56)	
$\beta_{CD+1,\ top5}$	616.04	***	611.81	***	634.44	***	631.56	***
	(32.53)		(31.82)		(35.58)		(35.38)	
$\beta_{CD+2,\ top5}$	710.76	***	724.54	***	727.54	***	722.60	***
	(30.47)		(29.80)		(45.56)		(45.20)	
$\beta_{CD+3,\ top5}$	763.16	***	780.26	***	833.98	***	847.78	***
	(32.64)		(33.04)		(60.13)		(60.92)	

Are Forecasters Heterogeneous?

Parameter	Heterogeneous case							
	Attention implied by the model in MSE eq.				Attention from data in MSE eq.			
	Set of instrum. #1		Set of instrum. #2		Set of instrum. #1		Set of instrum. #2	
$\beta_{IPCA,\ non\text{-}top5}$	35.02	***	35.04	***	35.18	***	35.15	***
	(0.30)		(0.30)		(0.29)		(0.29)	
$\beta_{IPCA+1,\ non\text{-}top5}$	43.46	***	43.45	***	43.92	***	43.87	***
	(0.52)		(0.51)		(0.52)		(0.52)	
$\beta_{IPCA+2,\ non\text{-}top5}$	51.28	***	51.34	***	51.65	***	51.59	***
	(0.68)		(0.67)		(0.71)		(0.70)	
$\beta_{CD\text{-}4,\ non\text{-}top5}$	74.79	***	75.88	***	76.51	***	79.29	***
	(2.16)		(2.88)		(2.38)		(3.34)	
$\beta_{CD\text{-}3,\ non\text{-}top5}$	91.83	***	95.08	***	91.66	***	93.94	***
	(2.80)		(3.67)		(3.09)		(4.16)	
$\beta_{CD\text{-}2,\ non\text{-}top5}$	109.59	***	110.59	***	112.07	***	111.08	***
	(3.92)		(3.91)		(4.15)		(4.10)	
$\beta_{CD\text{-}1,\ non\text{-}top5}$	136.03	***	136.69	***	136.14	***	137.31	***
	(5.01)		(5.05)		(5.09)		(5.14)	
$\beta_{CD,\ non\text{-}top5}$	230.36	***	227.88	***	228.54	***	229.54	***
	(8.14)		(8.17)		(8.16)		(8.24)	
$\beta_{CD+1,\ non\text{-}top5}$	281.55	***	288.55	***	282.47	***	279.53	***
	(10.17)		(8.33)		(10.53)		(10.43)	
$\beta_{CD+2,\ non\text{-}top5}$	318.65	***	320.55	***	320.91	***	316.95	***
	(10.85)		(8.29)		(13.19)		(12.99)	
$\beta_{CD+3,\ non\text{-}top5}$	360.73	***	356.40	***	381.06	***	385.60	***
	(12.52)		(10.04)		(17.60)		(17.80)	

Are Forecasters Heterogeneous? *Yes!*

Parameter	Heterogeneous case			
	Attention implied by the model in MSE eq.		*Attention from data in MSE eq.*	
	Set of instrum. #1	*Set of instrum. #2*	*Set of instrum. #1*	*Set of instrum. #2*
$\sigma^2_{\eta,\ top5}$	-2.3E-03	-6.8E-04	3.2E-04	3.0E-03 ***
	(2.5E-03)	(2.3E-03)	(1.0E-03)	(1.1E-03)
$\sigma^2_{\eta,\ non\text{-}top5}$	1.0E-03	2.2E-03	3.1E-03 ***	5.4E-03 ***
	(2.4E-03)	(2.1E-03)	(1.1E-03)	(1.1E-03)
σ^2_{ε}	5.5E-06 ***	4.9E-06 ***	4.8E-06 ***	3.5E-06 ***
	(1.2E-06)	(9.3E-07)	(4.9E-07)	(5.9E-07)
c	1.5E-03	9.5E-04	6.5E-04	1.7E-05
	(1.7E-03)	(1.6E-03)	(9.6E-04)	(1.9E-03)
ϕ	0.932 ***	0.935 ***	0.940 ***	0.979 ***
	(0.100)	(0.100)	(0.060)	(0.120)
GMM TJ test				
p-value	0.8595	0.9220	0.5131	0.6836
degress of freedom	15	28	15	28
Homogeneity test I				
Ho: $\beta_{Top5}=\beta_{Non\text{-}Top5}$ and $\sigma^2_{\eta,Top5}=\sigma^2_{\eta,Non\text{-}Top5}$				
p-value	0.0000	0.0000	0.0000	0.0000
Homogeneity test II				
Ho: $\sigma^2_{\eta,Top5}=\sigma^2_{\eta,Non\text{-}Top5}$				
p-value	0.0001	0.0000	0.0000	0.0000

Notes: Robust standard errors in parentheses. ***, ** and * indicate, respectively, 1%, 5% and 10% significance level. The homogeneity test I is a joint Wald test including all β and σ^2_{η} coefficients.

Counterfactuals

When to put the Top5 ranking contest day (CD)?

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Survey-design (CD) → λ_t → F_t → $MSFE_t$

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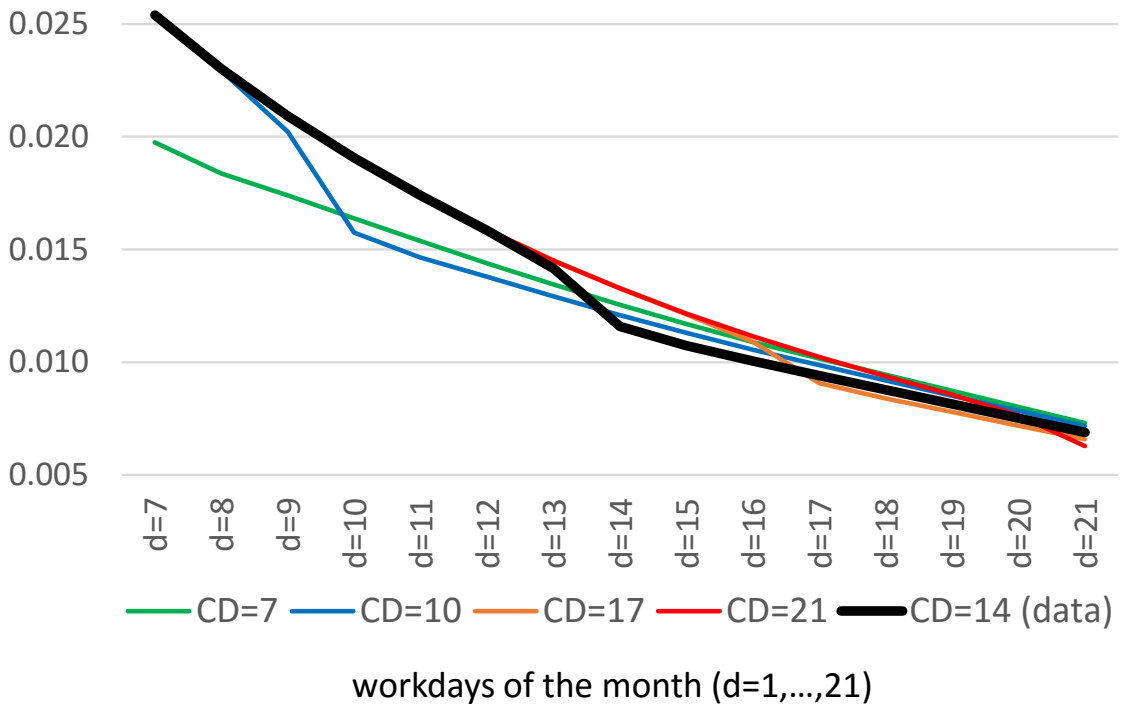
Figure 5 - MSFE for different contest days (CD)



Conclusions

- This paper explores the effect of incentives on survey participation.
- Compared to the literature on information rigidities:
  - We have endogenous updating from a benefit-cost optimal decision.
- Empirical results: good fit of the model using survey data.
- Counterfactuals and discussion about survey-design:
  - Single contest day
  - Multiple contest days