Herding in Equity Crowdfunding

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Equity crowdfunding

Definition

Equity crowdfunding is an on-line based mechanism that enables broad groups of investors to fund startup companies and small businesses in return for equity.

- Growing phenomenon: In the UK, in 2015, around 35.5% of all seed-stage investment deals went through equity crowdfunding sites.
- Allows to cut intermediaries cost by directly relating investors and entrepreneur through an Internet platform.
- In order to understand the profitability of their new idea, entrepreneurs replace the expertise of financial intermediaries with the 'wisdom of the crowd'.

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  - If by the end of the campaign, the goal is reached, the campaign succeeds, funds are invested and backers get shares of the new firm.

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- If the campaign succeeds, entrepreneur can extend the campaign and sell a larger fraction of the firm.

Equity crowdfunding on Seedrs

WE ARE COLONY .COM

A global film streaming platform connecting filmmakers to passionate fans through exclusive content.

London, United Kingdom

www.wearecolony.com

INVESTMENT SOUGHT: £500,008

EQUITY OFFERED: 7.69%

72%

INVESTMENT ALREADY FUNDED: £358,355

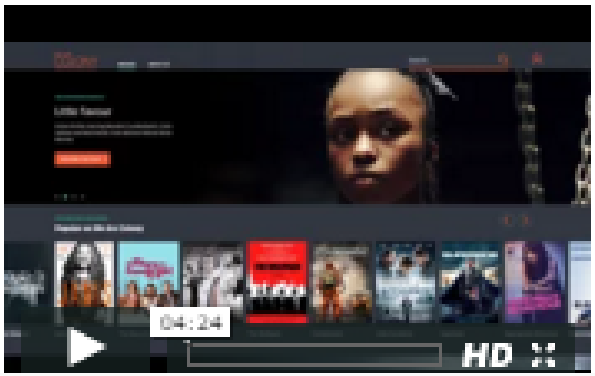
VALUATION (PRE-MONEY): £6,002,041

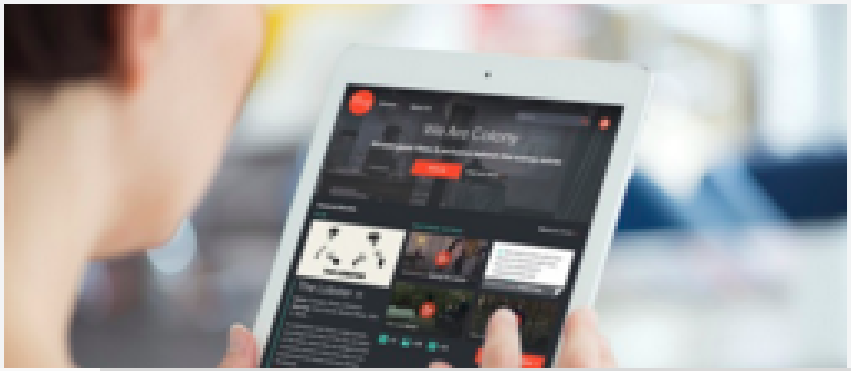
SHARE ON:

THIS CAMPAIGN EXPIRES: In 35 days

INVEST

Idea | Market | Team | Updates 8 | Q & A 4 | Investors 82





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Facts:

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Pros: Exploit the wisdom of the crowd for detecting profitable projects without recurring to experts

Cons: The sequential nature of a crowdfunding may induce

- Pledge herding: investors pledge, or pledge more, because previous investors pledged
- Abstention herding: investors not pledging because previous investors did not pledge
- Information cascades: Investors' actions provide no information about the project's profitability (the whole crowd is not wiser than the first few investors)

Research questions

Are crowdfunding campaigns gathering the wisdom of the crowd about new business ideas, or are they inducing investors, and particularly unsophisticated investors, to herd?

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Are crowdfunding campaigns gathering the wisdom of the crowd about new business ideas, or are they inducing investors, and particularly unsophisticated investors, to herd?

- Theory
  - Is (rational) herding theoretically possible in equity crowdfunding?
  - If yes, what type of herding?
  - Which type of herding generates information cascades?

- Empirics
  - Do real life investors engage in rational herding?
  - What type of investor is more likely to herd?
  - Do information cascades occur?

Paper main findings

- Both pledge and abstention rational herding are theoretically possible, but only abstention herding can generate an information cascade.
- Actual backers do engage in rational herding and in general their behavior is in line with our theory predictions.
- Using IV we can exclude alternative models: naïve herding, independent investments, investments dynamics induced by a factor unobservable to the econometrician.

Realted Literature

- Rational herding theories: Banerjee (1992); Welch, 1992; Bikhchandani et al., (1992); Smith and Sorensen, (2000); Horner and Herrera, (2013), Avery and Zemsky, (1998); Park and Sabourian, (2011), ...
- Empirical analysis of herding in crowdfunding: Zhang and Liu (2012) and Bursztyn et al. (2014), ...
- Crowdfunding theories: Belleflamme et al. (2014); Ellman and Hurkens (2016); Chemla and Tinn (2016); Strausz (2017); Cong and Xiao (2017), ...

Formal Model of pledging in equity crowdfunding

- Project of unknown quality, good or bad: each \$ invested into the project generate \$ $\alpha > 1$ if the project is good and 0 if the project is bad.

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  - Arrive following a Poisson process with intensity 1
  - Upon arrival a backer decides whether and how much to pledge.

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  - Arrive following a Poisson process with intensity 1
  - Upon arrival a backer decides whether and how much to pledge.
- Backer's private information:
  - private signals conditionally i.i.d. $\theta \in \{g, b, u\}$
  - Informed backers:
    $\mathbb{P}(\theta = g|\text{ good project}) = \mathbb{P}(\theta = b|\text{ bad project}) = \lambda q \in (0, 1)$
  - Uninformed backers
    $\mathbb{P}(\theta = u|\text{ good project}) = \mathbb{P}(\theta = u|\text{ bad project}) = 1 - \lambda$
- Public information:
  - h_t: history of past strictly positive pledges until time t.
  - Public belief: $\pi_t := \mathbb{P}(\text{good project}|h_t)$
  - Informed backer's belief $\pi_t^\theta := \mathbb{P}(\text{good project}|h_t, \theta)$

Equlibrium pledging behavior

A backer arriving at time t with signal θ and wealth W pledges

$$\max\left\{0, \frac{\alpha\pi_t^\theta - 1}{\alpha - 1} W\right\}$$

- Invests only if $E[NPV|h_t, \theta] > 0$
- The amount she invests is increasing in her belief π_t^θ
- Thea amount she invests is increasing in her wealth W.

Equlibrium evolution of public belief

- The public belief reaction to a pledge is increasing in the pledge size.
- The public belief weakly decreases in the time between two pledges.

Formally, If between t and $t' > t$ no pledge is observed, then at time t' the public belief is

$$\pi_{t'} = \begin{cases} \pi_t, & \text{if } \pi_t \leq \underline{\pi}^g \\ \max\left\{ \frac{\pi_t}{\pi_t + (1-\pi_t)e^{\lambda(2q-1)(t'-t)}}, \underline{\pi}^g \right\} < \pi_t, & \text{if } \underline{\pi}^g < \pi_t \leq \underline{\pi}^b \\ \pi_t, & \text{if } \pi_t > \underline{\pi}^b \end{cases} \tag{1}$$

Equlibrium implication about information cascade

Definition

The campaign is in an information cascade at time t if the pledging history after t provides no information about the project quality:

$$\forall t' \geq t, \mathbb{P}(\pi_{t'} = \pi_t) = 1$$

- A pledge size always has some information content: no pledging information cascade.
- There is $\underline{\pi} > 0$ such that as soon as $\pi_t < \underline{\pi}$, no backer pledges an abstention information cascade occurs.

Empirical Implications

I A backer pledge size is:
  a Strictly increasing in the size of the most recent pledges. ▸ I.a-b
  b Weakly decreasing in the elapsed time since the most recent pledge.

II The probability of observing a pledge in time t is
  a Strictly increasing in the size of the most recent pledge. ▸ II.a
  b Weakly decreasing in the elapsed time since the most recent pledge. ▸ II.b

III Predictions (I) and (II) should be
  a Stronger for uninformed backer. ▸ III.a
  b Weaker when total cumulative volume of past pledges is large. ▸ III.b

IV A long enough period without pledges can induce all future backers to abstain and lead to an information cascade. ▸ IV

Data

- Universe of campaigns and investments from SEEDRS, one of the 2 leading UK equity crowdfunding platforms
- Detailed data on backers and their individual pledges made to each campaign by the second
  - Period: October 2012 - March 2016
  - Pledges: 69,699
  - Campaigns: 710
  - Investors: 22,615

Descriptive statistics

Campaigns	
Pre-money valuation (median)	5,031,415
Equity offered (median)	7.66
Campaign goal (median)	387,334
% Raised	76.15
# investors	83.44
# Pledges	96.49
Type of Investor (Share)	
Authorized	0.79
High net worth	0.14
Sophisticated	0.07
% Recurrent investors	0.73

Estimation Workhorse: Distributed Investment Lags

$$\log I_{n,c} = \beta_0 + \sum_{k=1}^{K} \beta_k \log I_{n-k,c} + \alpha W_{n,c} + \gamma Z_{n,c} + \eta_c + \epsilon_{n_c}$$

- $I_{n,c}$: amount pledged by the n^{th} investor after the start of a campaign c and k is the lag to the pledge by the $n-k^{\text{th}}$ investor
  - positive values of $\beta_k$will indicate positively correlated pledges over time
- $W_{n,c}$: dummy variables indicating the type of investor (e.g. "sophisticated" or "unsophisticated")
- $Z_{n,c}$: campaign and time-varying variables capturing the information available to investor n at time of decision. (e.g. cumulative amount of funding, number of days since the campaign started, number of investors)
- η_c: Campaign fixed effects allows us not to care about the number of entrepreneurs, the pre-money valuation, whether there was a video or not, etc.

Alternative models

AM1 Backers only use private information and ignore pledging history.
Prediction: ($\beta_k = 0$, after controlling for campaign fix effect)

AM2 Pledges are solely due to the arrival exogenous public information observed by the backers but not by the econometrician.

AM3 Naive herding: all backers mimic the very first few backers.
Prediction: ($\beta_k = 0$, after controlling for the first pledges)

Common shocks problem and Instrumental variable

Correlation across pledges could result from the arrival exogenous information observed by the backers but not by the econometrician.

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Correlation across pledges could result from the arrival exogenous information observed by the backers but not by the econometrician.

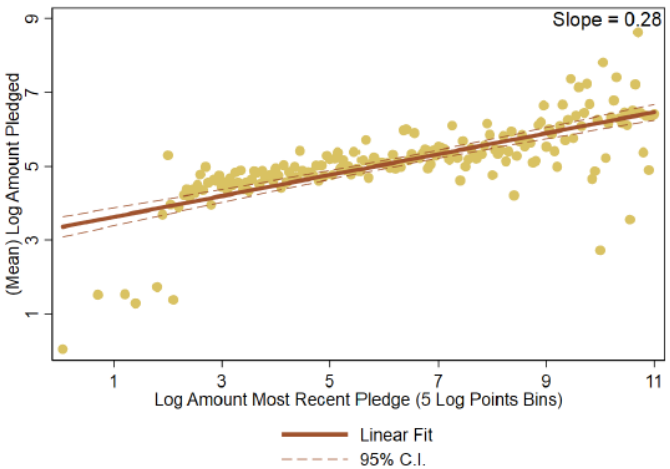
Instrumental variables approach: information on the characteristics of investors that is not revealed to potential follow-on investors but known to the researcher used to instrument lagged pledges
Three instruments of the endog. lagged investment $I_{n-k,c}$:

- (IV A) Amount of money returned to the backer if the last campaign he/she supported failed.
- (IV B) Number of pledges made by the investor across all previous campaigns before he/she made that $n-k^{th}$ investment
- (IV B) Maximum amount pledged across all previous campaigns on SEEDRS by the investor making the lagged pledge **before** he/she made that $n-k^{th}$ investment, zero if no prior investment

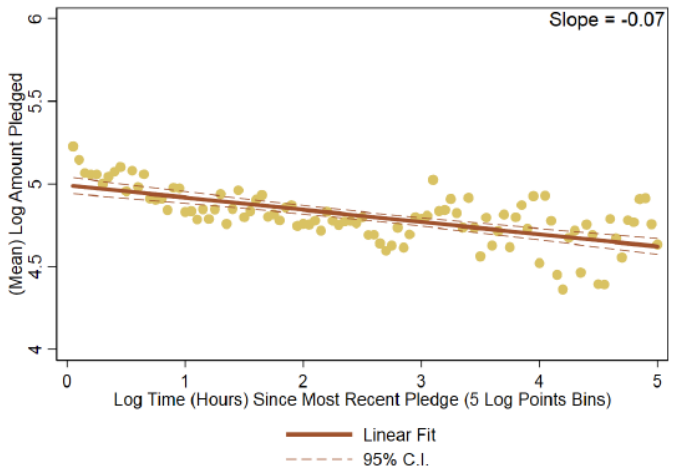
Pledge size to the most recent pledge's size and time

Figure 1: **Prediction 1-2.** Correlations Between the Amount Pledged by an Investor and the Timing and Size of the Most Recent Pledge

(a) Size of Most Recent Pledge



(b) Time Since Most Recent Pledge



Notes: All pledges are organized in bins of size 5 log points according to the size of the most recent pledge (Panel (a)), and the time elapsed (in hours) since the most recent pledge (Panel (b)). Each panel shows the relation between the median value of the respective bin and the average amount invested by the adjacent backers.

I.a-b Pledge size to the most recents pledges' size and time

Table 3: **Prediction 1-2.** The Effect of Prior Pledges and the Time Since the Most Recent Pledge

	Dependent Var: log amount pledged (£)			
	Model	Model + Controls	IV A	IV B
Prior pledges				
Log amount pledged (n-1)	0.083***	0.073***	0.126**	0.119***
	(0.007)	(0.006)	(0.064)	(0.020)
Log amount pledged (n-2)	0.034***	0.030***	0.077	0.038**
	(0.005)	(0.005)	(0.067)	(0.018)
Log amount pledged (n-3)	0.021***	0.020***	0.053	0.003
	(0.004)	(0.004)	(0.059)	(0.018)
Log amount pledged (n-4)	0.015***	0.012**	-0.016	0.009
	(0.004)	(0.004)	(0.058)	(0.018)
Log amount pledged (n-5)	0.013**	0.013**	0.021	0.006
	(0.004)	(0.004)	(0.062)	(0.017)
Log time (hours) since most recent pledge	-0.038**	0.006	-0.062	-0.081**
	(0.018)	(0.017)	(0.042)	(0.037)

▸ Empirical predictions ▸ Controls

II.a Probability of a pledge to the most recents pledges' size

Table 6: **Prediction 3.** Probability of Observing a Pledge at Any Given Hour and Size of Last Pledge

	Dependent Var: Dummy Investment in the Hourly Bin	
	Model	Model + Controls
Prior pledges		
IHS total amount pledged hour bin (t-1)	0.018***	0.017***
	(0.001)	(0.001)
IHS total amount pledged hour bin (t-2)	0.014***	0.013***
	(0.000)	(0.000)
IHS total amount pledged hour bin (t-3)	0.011***	0.010***
	(0.000)	(0.000)
IHS total amount pledged hour bin (t-4)	0.010***	0.008***
	(0.000)	(0.000)
IHS total amount pledged hour bin (t-5)	0.008***	0.006***
	(0.000)	(0.000)

▸ Empirical predictions ▸ Controls

II.b Probability of a pledge to time since most recent pledge

Table 7: **Prediction 4.** Probability of Observing a Pledge at Any Given Hour and Time Since Last Pledge

	Dependent Var: Dummy Investment in the Hourly Bin	
	Model	Model + Controls
Log Hours since most recent activity in bin	-0.023***	-0.018***
	(0.001)	(0.001)
Controls		
Log total amount funded up to bin (t-1)		-0.012***
		(0.002)
Campaign hotness at start of the day		0.003***
		(0.000)
Dummy campaign hotness intraday rise		0.011***
		(0.001)
Total pledges (/100) (t-1)		-0.035***
		(0.007)

Empirical predictions

III.a Uninformed backers react more to prior pledges

Table 8: **Prediction 5.** The Effect of Prior Pledges: Heterogeneous Effects by Investor Type (IV-B)

	Dependent Var: log amount pledged (£)					
	All	High-Net-Worth	Sophisticated	Authorized	Recurrent	Single Campaign
Prior pledges						
Log amount pledged (n-1)	0.120***	0.115**	-0.053	0.137***	0.084***	0.222**
	(0.020)	(0.047)	(0.066)	(0.026)	(0.017)	(0.072)
Log amount pledged (n-2)	0.038**	0.066	0.163	0.022	0.039**	0.045
	(0.018)	(0.053)	(0.161)	(0.021)	(0.017)	(0.051)
Log amount pledged (n-3)	0.003	0.022	0.029	0.003	0.001	0.016
	(0.018)	(0.080)	(0.061)	(0.019)	(0.020)	(0.068)
Log amount pledged (n-4)	0.009	0.053	0.004	-0.003	0.009	0.016
	(0.018)	(0.052)	(0.076)	(0.019)	(0.018)	(0.044)
Log amount pledged (n-5)	0.006	-0.068	-0.006	0.027	0.012	-0.043
	(0.017)	(0.069)	(0.065)	(0.018)	(0.017)	(0.074)
Log time (hours) since most recent pledge	-0.081**	-0.011	-0.277**	-0.074*	-0.064*	-0.021
	(0.037)	(0.089)	(0.121)	(0.043)	(0.036)	(0.100)
Observations	55,052	7,216	4,489	43,213	42,793	12,205
Average pledge (£)	1,228	3,102	1,694	863	791	2,752
SD pledge (£)	12,169	13,171	11,045	12,075	10,963	15,573
Average time (hours) since most recent pledge	11.4	10.9	9.7	11.6	12.2	8.7
S.D. time (hours) since most recent pledge	38.5	39.8	30.8	39.0	40.6	30.1
Kleibergen and Paap rk statistic	204.86	108.78	72.56	192.45	213.34	67.65
Hansen J statistic P-Val	0.61	0.25	0.56	0.46	0.40	0.22
Campaign FE	Yes	Yes	Yes	Yes	Yes	Yes

▸ Empirical predictions

III.b Pledge sensitivity to history decrease for good histories

Table 10: **Prediction 7.** The Effect of Prior Pledges and the Time Since the Most Recent Pledge. Conditional on Share of Desired Investment Raised in Private Phase.

	Dependent Var: log amount pledged (£)		
	Model	Private Phase Share $\in (0, 15]$	Private Phase Share > 15
Prior pledges			
Log amount pledged (n-1)	0.119***	0.230***	0.086***
	(0.020)	(0.048)	(0.023)
Log amount pledged (n-2)	0.038**	-0.021	0.044**
	(0.018)	(0.053)	(0.021)
Log amount pledged (n-3)	0.003	0.063**	-0.003
	(0.018)	(0.030)	(0.024)
Log amount pledged (n-4)	0.009	-0.011	0.002
	(0.018)	(0.030)	(0.027)
Log amount pledged (n-5)	0.006	0.048	0.007
	(0.017)	(0.040)	(0.022)
Log time (hours) since most recent pledge	-0.081**	-0.186**	-0.066
	(0.037)	(0.084)	(0.046)

Empirical predictions

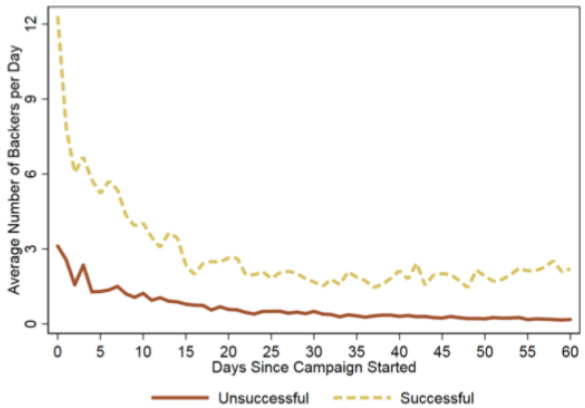
IV What happens early is very important

The probability of success of a campaign is highly dependent on early campaign dynamics: increasing with the number of backers and the amounts invested during the first days of a campaign.

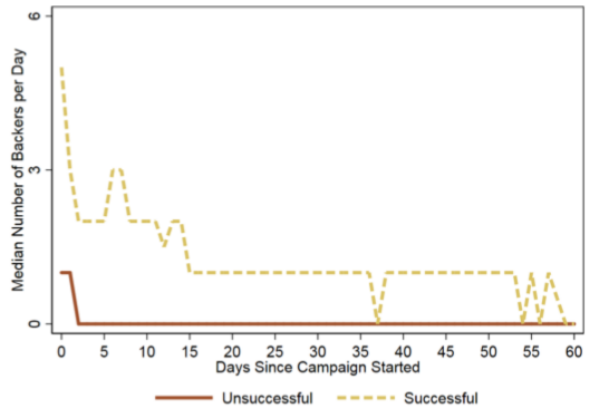
Figure 3: Number of Backers and Cumulative Investments to the Campaigns Across Time: Successful and Unsuccessful Campaigns

Average and Median Number of Backers per Day

(a) Mean



(b) Median



Number of Days to Reach a Given Percentage of the Investment Target

Empirical predictions

Conclusion

- Equity crowdfunding popularity is rapidly increasing both from the entrepreneurs' and investors' perspectives.
- Rational herding in equity crowdfunding is both theoretically possible and empirically observed in our equity crowdfunding data.
- The herding exists but concerns about "lemmings" type pledging information cascades appear unwarranted.
- Abstention cascade can occur theoretical and do occur in reality.
- Wisdom of the crowd is not necessarily gathered after a bad start.

Thank You!

I.a-b Pledge size to the most recents pledges' size and time

Controls				
Log total amount funded (n-1)		-0.033	-0.039	-0.019
		(0.023)	(0.036)	(0.025)
Dummy high-net-worth		1.199***	1.187***	1.188***
		(0.037)	(0.038)	(0.037)
Dummy sophisticated		0.449***	0.431***	0.437***
		(0.037)	(0.039)	(0.038)
Dummy recurrent investor		-0.642***	-0.631***	-0.631***
		(0.047)	(0.048)	(0.048)
Campaign hotness at start of the day		0.002***	-0.000	-0.000
		(0.001)	(0.001)	(0.001)
Dummy campaign hotness intraday rise		0.176***	0.122***	0.125***
		(0.020)	(0.026)	(0.026)
Total pledges (/100)		-0.016**	-0.007	-0.011
		(0.007)	(0.009)	(0.007)
Days from start of campaign		0.004***	0.005***	0.005***
		(0.001)	(0.001)	(0.001)
Google trend index		-0.001	-0.001*	-0.001**
		(0.000)	(0.001)	(0.001)
FTSE 100 index		-0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)
Observations	59,559	59,559	55,052	55,052
Average pledge (£)	1,232	1,232	1,228	1,228
SD pledge (£)	12,491	12,491	12,169	12,169
Average time (hours) since most recent pledge	11.2	11.2	11.4	11.4
S.D. time (hours) since most recent pledge	38.9	38.9	38.5	38.5
Kleibergen and Paap rk statistic			20.64	204.61
Hansen J statistic P-Val			.	0.62
Campaign FE	Yes	Yes	Yes	Yes

I a-b

II.a Probability of a pledge to the most recents pledges' size

Controls		
Log total amount funded up to bin (t-1)		-0.008***
		(0.001)
Campaign hotness at start of the day		0.002***
		(0.000)
Dummy campaign hotness intraday rise		0.008***
		(0.001)
Total pledges (/100) up to bin (t-1)		-0.020***
		(0.005)
Days from start of campaign		0.000
		(0.000)
FTSE 100 index		0.000
		(0.000)
Google trend index		0.000***
		(0.000)
Observations	706,429	706,429
R2	0.066	0.075
Frequency of Investments per Hour	0.060	0.060
SD of Frequency of Investments per Hour	0.238	0.238
Campaign FE	Yes	Yes
Hour of Day FE	Yes	Yes

II a