

Investor Horizon and the Life Cycle of Innovative Firms: Evidence from Venture Capital

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Research question

- ▶ Incentives and the funding of corporate innovation

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- ▶ Focus on Venture Capital (VC) funds: major providers of funding to innovative firms

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- ▶ Focus on Venture Capital (VC) funds: major providers of funding to innovative firms
- ▶ Specific feature: fixed investment horizon of ten years
- ▶ How does the fixed horizon of VC funds affect their investment decisions?

Motivation

- ▶ Facts and trends in VC financing
 - ▶ VC investments cluster in sectors with fast innovation clock speed (Lerner 2012)
 - ▶ 40% of VCs have shifted away from research in critical therapies, due to FDA process length (NVCA 2011)

Motivation

“VC funds [...] have focused on sectors such as software and social networking, which are characterized by fast innovation clock speeds.”

Josh Lerner - The Architecture of Innovation (2012)

Motivation



Vital Signs

**The Crisis in Investment in U.S. Medical
Innovation and the Imperative of FDA Reform**

Confidential: Do Not Distribute Prior to October 6, 2011

Survey Findings

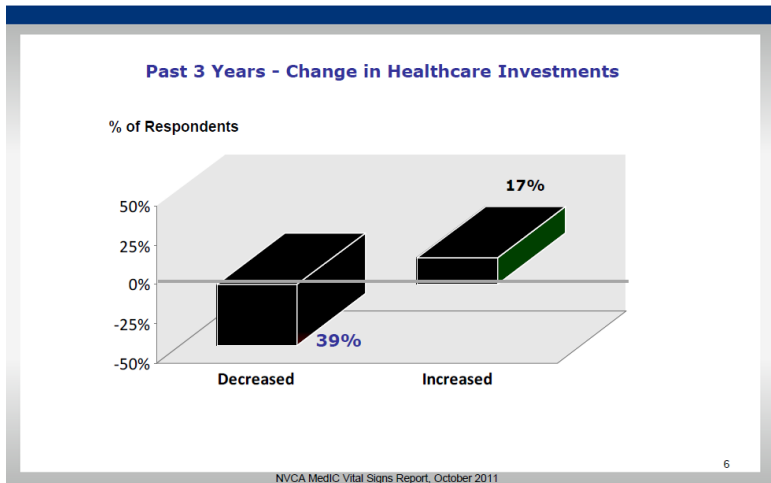
October 2011

NVCA MedIC Vital Signs Report, October 2011

National Venture Capital Association (2011)

Motivation

39% of VC firms reported decreases in their healthcare investment in the past 3 years.



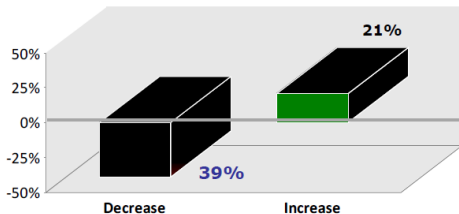
National Venture Capital Association (2011)

Motivation

Nearly twice as many VC firms expect to decrease their healthcare investment in the next 3 years.

Next 3 Years - Expected Change in Healthcare Investments

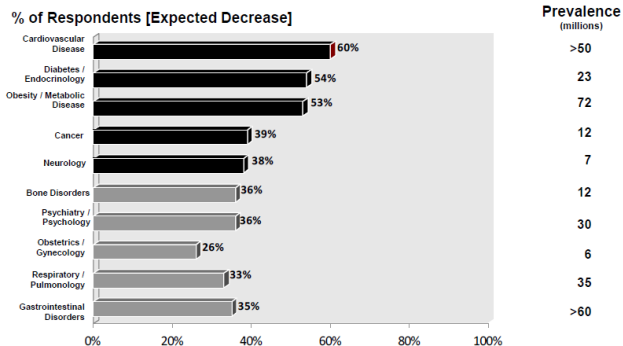
% of Respondents



Motivation

Significant decrease in VC investments expected in highly prevalent diseases.

Next 3 Years - Investments in Therapeutic Areas Expected to Change



Source: CDC; NIH; American Heart Association; American Diabetes Association; Surgeon General; American Academy of Neurology; American Lung Association; US Health & Human Services; National Cancer Institute
NVCA Medic Vital Signs Report, October 2011

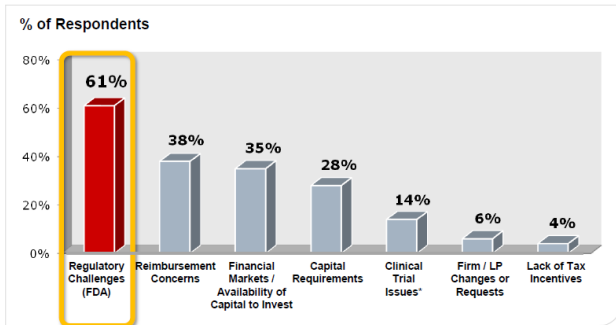
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National Venture Capital Association (2011)

Motivation

FDA regulatory challenges are having the greatest impact on VC investment decisions.

Factors Cited as Having the Highest Impact on VC Investment



*Unrelated to Regulatory Challenges

NVCA MEDIC Vital Signs Report, October 2011

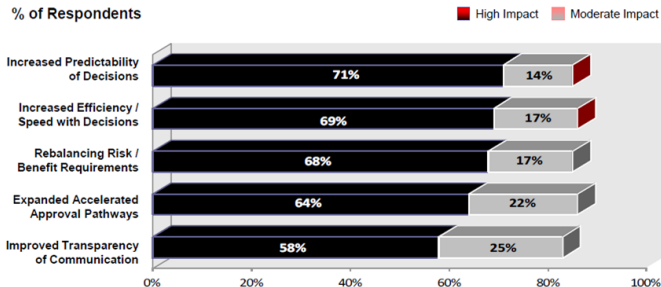
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National Venture Capital Association (2011)

Motivation

Meaningful FDA reform is critical to reversing these trends.

Expected Impact on Investments from Changes at FDA



Motivation

- ▶ Facts and trends in VC financing
 - ▶ VC investments cluster in sectors with fast innovation clock speed (Lerner 2012)
 - ▶ 40% of VCs have shifted away from research in critical therapies, due to FDA process length (NVCA 2011)
- ▶ Incentives that matter for the funding available to innovative companies
 - ▶ Entrepreneurial firms are important contributor to productivity growth

This paper

1. **Horizon and the profile of investments**

- ▶ Funds with short horizons invest in less innovative, more mature firms

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2. **Horizon and VC firm experience**

- ▶ Sensitivity of investment decisions to horizon increases with experience

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3. **Horizon and convex compensation structure**

- ▶ Fewer innovative investments when cumulative performance has been high

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3. **Horizon and convex compensation structure**

- ▶ Fewer innovative investments when cumulative performance has been high

4. **Aggregate implications?**

- ▶ VC funding shifts to mature firms in times when average horizon is shorter, and in sectors with longer life cycles

Literature

- ▶ Real effects of VC and PE fund contracts
 - ▶ Lerner and Schoar 2004, Ljungqvist et al 2008, Axelson et al. 2009, Kandel et al. 2011, Chung et al. 2012, Ewens et al. 2013, Hochberg et al. 2014, Arcot et al. 2013
- ▶ Investor horizon and corporate policies
 - ▶ Bushee 1998, Polk and Sapienza 2009, Cella et al. 2013, Derrien et al. 2014
- ▶ Corporate ownership and innovation
 - ▶ Belenzon et al 2009, Belenzon and Berkovitz 2010, Lerner et al. 2011, Chemmanur et al. 2011, Tian and Wang 2011, Ferreira et al 2012, Atanassov 2013, Aghion et al. 2013, Seru 2014, Bernstein 2014, Bernstein et al. 2014

Data and variables

- ▶ VC investments from 1980 to 2010 (VentureXpert)
 - ▶ 44,000 VC investments in 19,600 companies involving 3,432 funds and 1,397 VC firms

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 - ▶ Patenting behavior around the investment

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- ▶ Fund horizon
 - ▶ Between- and within-fund variations in fund age
- ▶ Fund cumulative performance
 - ▶ Cumulative number of successful exits through IPOs or M&As

Data and variables

► Proxies for company maturity

PANEL A: Log investment holding period			
Log company age	-0.10*** (0.01)		
Development stage dummy		-0.35*** (0.03)	
Log number of prior rounds			-0.25*** (0.02)
Constant	1.23*** (0.02)	1.31*** (0.02)	1.27*** (0.02)
Year FE	yes	yes	yes
Observations	8,180	8,581	8,581
R-squared	0.10	0.12	0.12

PANE LB: Successful exit dummy			
Log company age	0.02*** (0.00)		
Development stage dummy		0.05*** (0.01)	
Log number of prior rounds			0.09*** (0.01)
Constant	0.31*** (0.01)	0.29*** (0.01)	0.26*** (0.00)
Year FE	yes	yes	yes
Observations	24,754	27,189	27,189
R-squared	0.08	0.07	0.09

Outline

1. Horizon and the profile of investments
2. Horizon and VC firm experience
3. Horizon and convex compensation structure
4. Aggregate implications?

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Horizon and the profile of investments

Hypothesis

- ▶ Horizon might matter for the funding of innovative firms
 - ▶ Innovation takes time to produce observable outcomes (Manso 2011)
 - ▶ Information discount larger for young firms (Chemmanur and Fulghieri 1999)

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- ▶ Empirically
 - ▶ Expect a positive correlation between fund age and company maturity

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 - ▶ Innovation takes time to produce observable outcomes (Manso 2011)
 - ▶ Information discount larger for young firms (Chemmanur and Fulghieri 1999)
- ▶ Empirically
 - ▶ Expect a positive correlation between fund age and company maturity
 - ▶ Correlation may be mechanical or spurious
 - ▶ Clustering of innovation and fundraisings → Year FE
 - ▶ Heterogeneous investment skills → VC Firm FE
 - ▶ General shift in investment style → Vintage and fund FE
 - ▶ Time varying incentives → Time varying fund controls

Horizon and the profile of investments

Main results

► Investment-level OLS regressions

$$CompAge_{i,t} = \alpha + \lambda_1 FundAge_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	Log company age						
Log fund age	0.24*** (0.01)	0.19*** (0.01)	0.23*** (0.01)	0.22*** (0.01)	0.14*** (0.01)	0.14*** (0.02)	0.21*** (0.01)
Log nb. of exits	0.06*** (0.01)	0.07*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.05*** (0.01)	0.09*** (0.01)	0.03*** (0.01)
First-time fund × Log nb. of exits	-0.05*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.05*** (0.01)	-0.04*** (0.01)	-0.08*** (0.02)	-0.06*** (0.02)
First-time fund	-0.04*** (0.01)	-0.03** (0.01)	-0.11*** (0.02)	-0.04*** (0.02)	-0.03** (0.02)	-0.01 (0.03)	
Log nb. of past inv.	-0.06*** (0.01)	-0.06*** (0.01)	-0.06*** (0.01)	-0.05*** (0.01)	-0.04*** (0.01)	-0.06*** (0.01)	-0.03*** (0.01)
Follow-up fund	-0.07*** (0.01)	-0.06*** (0.01)	-0.02* (0.01)	-0.02* (0.01)	-0.00 (0.01)	0.02 (0.02)	-0.03* (0.02)
Log fund size	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.02*** (0.00)	-0.03*** (0.00)	-0.02*** (0.01)	
Vintage FE	Yes	No	No	Yes	No	No	No
Year FE	No	Yes	No	No	Yes	No	No
VC firm FE	No	No	Yes	Yes	Yes	No	No
VC firm × year FE	No	No	No	No	No	Yes	No
Fund FE	No	No	No	No	No	No	Yes
Observations	46641	46641	46641	46641	46641	46641	46641
R ²	0.037	0.041	0.149	0.152	0.160	0.346	0.209

Horizon and the profile of investments

Additional findings

1. Similar results with other proxies for company maturity
 - ▶ Development stage dummy Dev. Stage
 - ▶ Log nb. of prior rounds of financing Nb. rounds

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2. “Placebo test”: no sensitivity of investments to horizon for CVC or Evergreen funds Unconstrained

Horizon and the profile of investments

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 - ▶ Development stage dummy Dev. Stage
 - ▶ Log nb. of prior rounds of financing Nb. rounds
2. “Placebo test”: no sensitivity of investments to horizon for CVC or Evergreen funds Unconstrained
3. Time series variations: weaker sensitivity in hot markets, and when the market-wide time-to-exit is shorter Hot markets

Horizon and the profile of investments

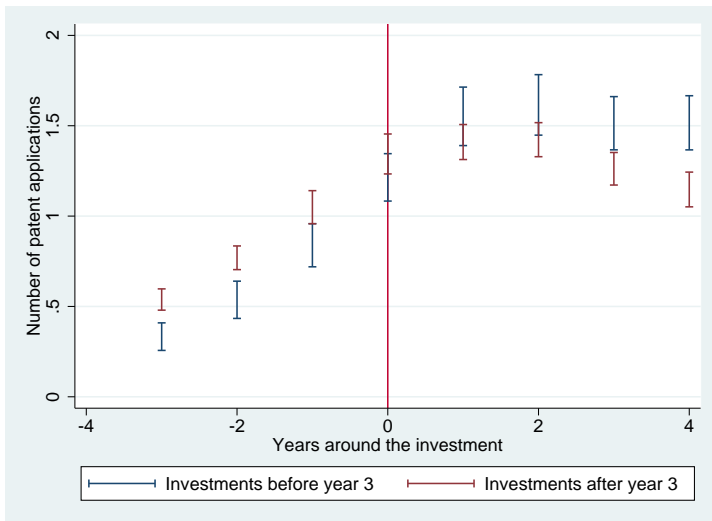
Additional findings

- ▶ Similar results with patenting behavior
 - ▶ Funds with shorter horizons less likely to invest in first-time patenters
 - ▶ Patents and citations increase more around investments made funds with longer horizons

Horizon and the profile of investments

Additional findings

- ▶ Similar results with patenting behavior



Outline

1. Horizon and the profile of investments
2. **Horizon and VC firm experience**
3. Horizon and convex compensation structure
4. Aggregate implications?

Horizon and VC firm experience

Hypothesis

- ▶ Does the sensitivity of investment decisions to horizon vary in the cross-section of VC firm experience?
 - ▶ Established VC firms might face a smaller information discount when selling innovative companies
 - ▶ Alternatively, they might be better able to match the maturity of their assets to their fund's horizon

Horizon and VC firm experience

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- ▶ Does the sensitivity of investment decisions to horizon vary in the cross-section of VC firm experience?
 - ▶ Established VC firms might face a smaller information discount when selling innovative companies
 - ▶ Alternatively, they might be better able to match the maturity of their assets to their fund's horizon
- ▶ Interact *Log fund age* with various proxies for VC firm experience
 - ▶ VC firm number of funds raised
 - ▶ VC firm age
 - ▶ VC firm total number of deals

Horizon and VC firm experience

Main results

- ▶ Investment-level OLS regressions
- ▶ Proxy for experience: log nb. of funds raised

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund age	0.15*** (0.01)	0.09*** (0.01)	0.07*** (0.01)	0.04*** (0.01)	0.09*** (0.01)	0.07*** (0.01)
Log fund age × Experience	0.04*** (0.01)	0.04*** (0.01)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.01)	0.03*** (0.01)
Experience	-0.03*** (0.01)	-0.07*** (0.02)	-0.00 (0.01)	-0.03** (0.01)	-0.02*** (0.01)	-0.07*** (0.02)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	46641	46641	46641	46641	46641	46641
R ²	0.042	0.160	0.034	0.139	0.043	0.158

Horizon and VC firm experience

Additional findings

1. Results robust to other proxies for VC firm experience
 - ▶ VC firm age Age
 - ▶ VC firm total nb. of deals Nb. of deals

Horizon and VC firm experience

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 - ▶ VC firm age Age
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2. Consistent exit patterns
 - ▶ Investments made by experienced funds with short horizon have higher likelihood of exit Exits

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 - ▶ VC firm age *Age*
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2. Consistent exit patterns
 - ▶ Investments made by experienced funds with short horizon have higher likelihood of exit *Exits*
3. Mechanism: VC firms with overlapping funds allocate investments to most appropriate vintage
 - ▶ Interact *Log fund age* with the concentration of VC firm's dry powder across vintages
 - ▶ Explains most of the effect of experience *Concentration*

Horizon and VC firm experience

► OLS investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of rounds	
Log fund age	0.26*** (0.03)	0.20*** (0.03)	0.11*** (0.02)	0.10*** (0.02)	0.16*** (0.02)	0.18*** (0.02)
Log fund age	0.01	0.01	0.00	0.00	0.01	0.01
× Log VC firm nb. of funds raised	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log fund age	-0.12***	-0.12***	-0.04***	-0.06***	-0.08***	-0.12***
× Dry powder concentration	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	46641	46641	46641	46641	46641	46641
R ²	0.043	0.160	0.034	0.139	0.044	0.158

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Horizon and convex compensation structure

Hypothesis

- ▶ Compensation of VC firm includes option-like performance component: the *carried interest*
 - ▶ 20% of the overall performance of the fund above a hurdle rate (Gompers Lerner 1999, Metrick Yasuda 2010)

Horizon and convex compensation structure

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 - ▶ 20% of the overall performance of the fund above a hurdle rate (Gompers Lerner 1999, Metrick Yasuda 2010)
- ▶ Might tilt VC funds to take less risk when past performance has been high Real world example
 - ▶ Convex payoffs affect risk taking when horizon is finite (Hodder Jackwerth 2007, Panageas Westerfield 2009)

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 - ▶ Convex payoffs affect risk taking when horizon is finite (Hodder Jackwerth 2007, Panageas Westerfield 2009)
- ▶ Following successful exits, VC funds
 - ▶ Make fewer new investments
 - ▶ Conditional on investing, select less innovative companies

Horizon and convex compensation structure

Main results

► Effect of past performance on investments

Panel A: fund \times year panel regressions

	Log nb. of investments		Log amount invested		Investment dummy	
Log fund nb. of exits	-0.34*** (0.02)	-0.35*** (0.03)	-0.01*** (0.00)	-0.01*** (0.00)	-0.16*** (0.01)	-0.16*** (0.02)
Observations	23902	23902	23902	23902	23902	23902
R ²	0.471	0.754	0.174	0.626	0.354	0.721

Panel B: investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund nb. of exits	0.04*** (0.01)	0.08*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.05*** (0.01)	0.06*** (0.01)
Observations	46641	46641	46641	46641	46641	46641
R ²	0.159	0.346	0.139	0.323	0.157	0.359
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
VC firm FE	Yes	No	Yes	No	Yes	No
VC firm \times Year FE	No	Yes	No	Yes	No	Yes

Horizon and convex compensation structure

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Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
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VC firm FE	Yes	No	Yes	No	Yes	No
VC firm \times Year FE	No	Yes	No	Yes	No	Yes

Horizon and convex compensation structure

Additional findings

1. Results robust to using alternative proxies for cumulative past performance: [Other proxies](#)
 - ▶ Ratio of the number of exits to the number of investments
 - ▶ Ratio of the amount invested in exited investments to the cumulative invested amount

Horizon and convex compensation structure

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 - ▶ Ratio of the number of exits to the number of investments
 - ▶ Ratio of the amount invested in exited investments to the cumulative invested amount
2. Effect is weaker for first time funds [First-time funds](#)
 - ▶ Carried interest is a smaller share of the total compensation of first-time funds (Chung et al. 2012)

Outline

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4. **Aggregate implications?**

Aggregate implications?

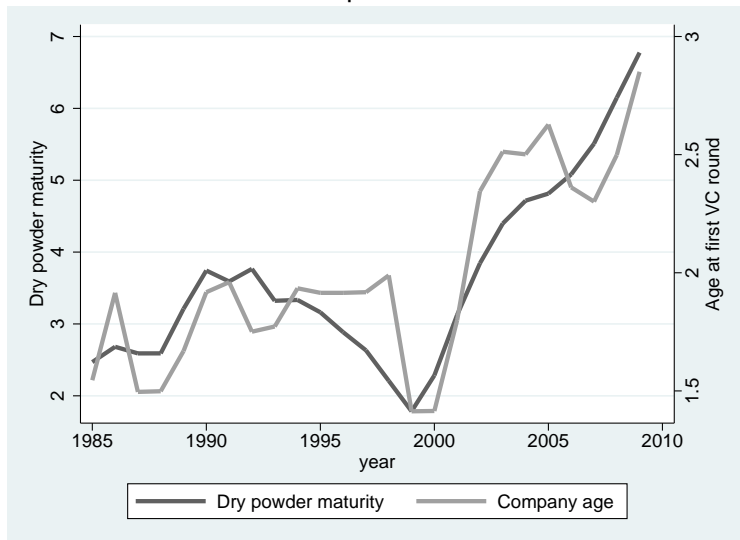
- ▶ When the average fund horizon increases, VC funding shifts to more mature companies
 - ▶ Positive time series correlation between the average fund horizon and the age of companies receiving their first round of VC funding Time-series

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- ▶ When the average fund horizon increases, VC funding shifts to more mature companies
 - ▶ Positive time series correlation between the average fund horizon and the age of companies receiving their first round of VC funding Time-series
- ▶ In sectors with longer average time-to-exit, VC funding goes to more mature companies
 - ▶ Positive cross-sectional correlation between sector-wide time-to-exit and the age of companies receiving their first round of VC funding Cross-section

Conclusion

- ▶ VC firms select less innovative companies when their fund horizon shrinks, especially the most experienced ones
- ▶ When cumulative performance has been high, funds make fewer new investments, in less innovative companies
- ▶ Potential implications for the aggregate funding available to innovative companies

Supplementary tables

When past performance has been high...



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When past performance has been high...



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When past performance has been high...



Horizon and the profile of investments

► OLS investment-level regressions

$$V_{i,t} = \alpha + \lambda_1 \text{Age}_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	Development stage dummy						
Log fund age	0.08*** (0.01)	0.08*** (0.01)	0.07*** (0.01)	0.08*** (0.01)	0.06*** (0.01)	0.08*** (0.01)	0.08*** (0.01)
Log fund nb. of exits	0.05*** (0.01)	0.06*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	0.03*** (0.01)	0.05*** (0.01)	0.01 (0.01)
First-time fund × Log nb. of exits	0.02** (0.01)	0.01 (0.01)	-0.02** (0.01)	-0.01 (0.01)	-0.01* (0.01)	-0.03** (0.01)	-0.02* (0.01)
First-time fund	-0.04*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.02* (0.01)	-0.01 (0.01)	-0.02 (0.02)	
Log nb. of past inv.	-0.04*** (0.00)	-0.04*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.02*** (0.00)	-0.03*** (0.01)	-0.01*** (0.00)
Follow-up fund dummy	0.00 (0.01)	0.00 (0.01)	0.04*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	0.02 (0.01)	0.01 (0.01)
Log fund size	0.02*** (0.00)	0.02*** (0.00)	0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	
Vintage FE	Yes	No	No	Yes	No	No	No
Year FE	No	Yes	No	No	Yes	No	No
VC firm FE	No	No	Yes	Yes	Yes	No	No
VC firm × year FE	No	No	No	No	No	Yes	No
Fund FE	No	No	No	No	No	No	Yes
Observations	46641	46641	46641	46641	46641	46641	46641
R ²	0.033	0.033	0.129	0.137	0.139	0.323	0.199

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$$V_{i,t} = \alpha + \lambda_1 \text{Age}_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	Log number of prior rounds						
Log fund age	0.14*** (0.01)	0.11*** (0.01)	0.15*** (0.01)	0.16*** (0.01)	0.12*** (0.01)	0.16*** (0.01)	0.14*** (0.01)
Log fund nb. of exits	0.06*** (0.01)	0.08*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.05*** (0.01)	0.07*** (0.01)	0.01 (0.01)
First-time fund × Log nb. of exits	0.06*** (0.01)	0.04*** (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.03*** (0.01)	-0.04** (0.02)	-0.01 (0.01)
First-time fund	-0.11*** (0.01)	-0.10*** (0.01)	-0.10*** (0.01)	-0.07*** (0.01)	-0.05*** (0.01)	-0.07*** (0.02)	
Log nb. of past inv.	-0.05*** (0.00)	-0.05*** (0.00)	-0.05*** (0.00)	-0.05*** (0.01)	-0.05*** (0.00)	-0.07*** (0.01)	-0.02*** (0.01)
Follow-up fund dummy	0.02** (0.01)	0.02*** (0.01)	0.05*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.03** (0.02)	0.03** (0.01)
Log fund size	-0.01*** (0.00)	-0.01*** (0.00)	-0.01*** (0.00)	-0.03*** (0.00)	-0.03*** (0.00)	-0.04*** (0.00)	
Vintage FE	Yes	No	No	Yes	No	No	No
Year FE	No	Yes	No	No	Yes	No	No
VC firm FE	No	No	Yes	Yes	Yes	No	No
VC firm × year FE	No	No	No	No	No	Yes	No
Fund FE	No	No	No	No	No	No	Yes
Observations	46641	46641	46641	46641	46641	46641	46641
R ²	0.037	0.044	0.144	0.151	0.157	0.359	0.224

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Horizon and the profile of investments

► OLS investment-level regressions

$$V_{i,t} = \alpha + \lambda_1 \text{Age}_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	Log age of syndicate partners						
Log fund age	0.22*** (0.01)	0.15*** (0.01)	0.24*** (0.01)	0.21*** (0.01)	0.12*** (0.01)	0.07*** (0.02)	0.21*** (0.01)
Log fund nb. of exits	0.05*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.05*** (0.01)	0.03*** (0.01)	0.04*** (0.01)	0.05*** (0.01)
First-time fund × Log nb. of exits	-0.04*** (0.01)	-0.02*** (0.01)	-0.00 (0.01)	-0.02 (0.01)	-0.03*** (0.01)	-0.03* (0.02)	-0.01 (0.01)
First-time fund	-0.06*** (0.01)	-0.05*** (0.01)	-0.13*** (0.01)	-0.06*** (0.01)	-0.05*** (0.01)	-0.07** (0.03)	
Log nb. of past inv.	-0.04*** (0.01)	-0.04*** (0.00)	-0.04*** (0.01)	-0.03*** (0.01)	-0.03*** (0.01)	-0.02*** (0.01)	-0.02** (0.01)
Follow-up fund dummy	-0.08*** (0.01)	-0.06*** (0.01)	-0.11*** (0.01)	-0.07*** (0.01)	-0.04*** (0.01)	-0.01 (0.02)	-0.09*** (0.01)
Log fund size	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.01** (0.00)	-0.01** (0.00)	-0.01** (0.00)	
Vintage FE	Yes	No	No	Yes	No	No	No
Year FE	No	Yes	No	No	Yes	No	No
VC firm FE	No	No	Yes	Yes	Yes	No	No
VC firm × year FE	No	No	No	No	No	Yes	No
Fund FE	No	No	No	No	No	No	Yes
Observations	32886	32886	32886	32886	32886	32886	32886
R ²	0.099	0.136	0.150	0.172	0.204	0.406	0.249

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Horizon and the profile of investments

► OLS investment-level regressions

$$V_{i,t} = \alpha + \lambda_1 \text{Age}_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	Prior patenting dummy					
Log fund age	0.12*** (0.01)	0.05*** (0.01)	0.12*** (0.01)	0.12*** (0.01)	0.05*** (0.01)	0.11*** (0.02)
Log fund nb. of exits	0.03*** (0.01)	0.03*** (0.01)	0.01 (0.01)	0.02** (0.01)	0.02* (0.01)	0.02 (0.01)
First-time fund × Log nb. of exits	-0.03** (0.01)	-0.01 (0.01)	-0.02 (0.01)	-0.04** (0.01)	-0.02 (0.01)	-0.05*** (0.02)
First-time fund	0.02 (0.01)	0.02 (0.01)	-0.10*** (0.02)	-0.03* (0.02)	-0.02 (0.02)	
Log fund nb. of past inv.	-0.02*** (0.01)	-0.02*** (0.01)	-0.02*** (0.01)	-0.01** (0.01)	-0.01** (0.01)	0.00 (0.01)
Follow-up fund dummy	-0.02* (0.01)	-0.01 (0.01)	0.02 (0.01)	0.01 (0.01)	0.01 (0.01)	0.00 (0.02)
Log fund size	-0.02*** (0.00)	-0.02*** (0.00)	0.02*** (0.00)	-0.01** (0.00)	-0.01*** (0.00)	
Vintage fixed effects	Yes	No	No	Yes	No	No
Inv. year fixed effects	No	Yes	No	No	Yes	No
VC firm fixed effects	No	No	Yes	Yes	Yes	No
Fund fixed effects	No	No	No	No	No	Yes
Observations	13365	13365	13365	13365	13365	13642
R ²	0.068	0.087	0.155	0.170	0.188	0.260

Horizon and the profile of investments

► OLS investment-level regressions

$$V_{i,t} = \alpha + \lambda_1 \text{Age}_{i,t} + \lambda_2 X_{i,t} + \gamma_i + \mu_t + \epsilon_{i,t}$$

	<u>Log company age</u>		<u>Dev. stage dummy</u>		<u>Log nb. of prior rounds</u>	
Log fund age	0.01 (0.03)	0.01 (0.04)	0.02 (0.02)	0.03 (0.02)	0.02 (0.02)	0.04 (0.03)
Log fund nb. of exits		-0.03 (0.03)		-0.03** (0.01)		-0.03 (0.02)
First-time fund		0.04 (0.05)		-0.03 (0.03)		-0.00 (0.05)
Log fund nb. of past investments		0.01 (0.02)		0.01 (0.01)		-0.01 (0.02)
Follow-up fund dummy		-0.01 (0.04)		0.02 (0.03)		0.00 (0.03)
Log fund size		0.00 (0.02)		0.01 (0.02)		-0.00 (0.02)
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Investor fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4928	4928	4928	4928	4928	4928
R ²	0.207	0.208	0.228	0.229	0.246	0.247

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Horizon and the profile of investments

	Log patents + 1			Log scaled patents + 1		
Log fund age	0.14*** (0.01)	0.03*** (0.01)	0.15*** (0.02)	0.08*** (0.01)	0.02*** (0.01)	0.09*** (0.01)
Inv. year -3 × Log fund age	0.05*** (0.01)	0.05*** (0.01)	0.06*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	0.03*** (0.01)
Inv. year -2 × Log fund age	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
Inv. year -1 × Log fund age	0.04*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.02*** (0.01)	0.02*** (0.01)	0.02*** (0.01)
Inv. year +1 × Log fund age	-0.07*** (0.01)	-0.07*** (0.01)	-0.07*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)	-0.04*** (0.01)
Inv. year +2 × Log fund age	-0.10*** (0.02)	-0.10*** (0.02)	-0.08*** (0.02)	-0.06*** (0.01)	-0.06*** (0.01)	-0.05*** (0.01)
Inv. year +3 × Log fund age	-0.11*** (0.02)	-0.11*** (0.02)	-0.07*** (0.02)	-0.06*** (0.01)	-0.06*** (0.01)	-0.05*** (0.01)
Inv. year +4 × Log fund age	-0.14*** (0.02)	-0.14*** (0.02)	-0.09*** (0.02)	-0.08*** (0.01)	-0.08*** (0.01)	-0.06*** (0.01)
Year FE × Fund controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE × Company controls	No	No	No	No	No	No
Company FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	No	Yes	No
Vintage FE	Yes	No	No	Yes	No	No
VC firm FE	Yes	Yes	No	Yes	Yes	No
Fund FE	No	No	Yes	No	No	Yes
Observations	106925	106925	106925	106925	106925	106925
R ²	0.394	0.398	0.396	0.414	0.418	0.417

Horizon and the profile of investments

► OLS investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund age	0.22*** (0.02)	0.17*** (0.02)	0.10*** (0.01)	0.08*** (0.01)	0.14*** (0.01)	0.16*** (0.02)
Log fund age × Hot mkt. cond.	-0.05** (0.02)	-0.04** (0.02)	-0.03*** (0.01)	-0.03*** (0.01)	-0.06*** (0.02)	-0.07*** (0.02)
Hot market conditions	0.02 (0.03)	0.01 (0.03)	0.02 (0.02)	0.03 (0.02)	-0.00 (0.02)	0.02 (0.03)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	33222	33222	33222	33222	33222	33222
R^2	0.045	0.173	0.035	0.148	0.046	0.169

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Horizon and VC firm experience

- ▶ OLS investment-level regressions
- ▶ Proxy for experience: log VC firm age

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund age	0.15*** (0.01)	0.10*** (0.01)	0.06*** (0.01)	0.04*** (0.01)	0.08*** (0.01)	0.08*** (0.01)
Log fund age × Log VC firm age	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Log VC firm age	-0.02*** (0.00)	-0.01 (0.01)	-0.01** (0.00)	-0.01** (0.00)	-0.00 (0.00)	-0.01* (0.01)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	46641	46641	46641	46641	46641	46641
R^2	0.042	0.160	0.034	0.139	0.044	0.158

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Horizon and VC firm experience

- ▶ OLS investment-level regressions
- ▶ Proxy for experience: log VC firm number of investments

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund age	0.14*** (0.01)	0.10*** (0.01)	0.06*** (0.01)	0.04*** (0.01)	0.09*** (0.01)	0.08*** (0.01)
Log fund age × Log VC firm nb. of past inv.	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01*** (0.00)
Log VC firm nb. of past inv.	-0.03*** (0.00)	-0.02*** (0.01)	-0.01*** (0.00)	-0.01*** (0.00)	-0.00 (0.00)	-0.01* (0.01)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	46641	46641	46641	46641	46641	46641
R ²	0.042	0.160	0.034	0.139	0.044	0.158

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Horizon and VC firm experience

► OLS investment-level regressions

	Successful exit dummy			
Log fund age	0.027*** (0.006)	0.011 (0.008)	0.012* (0.007)	0.012 (0.008)
Log fund age × Log investor age		0.005*** (0.002)		
Log fund age × Log investor nb. of past inv.			0.005*** (0.002)	
Log fund age × Log PE firm nb. of funds raised				0.015*** (0.004)
Log PE firm age		-0.010*** (0.004)		
Log PE firm nb. of past inv.			-0.009** (0.004)	
Log PE firm nb. of funds raised				-0.014 (0.012)
Fund controls	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes
VC firm fixed effects	Yes	Yes	Yes	Yes
Observations	46641	46641	46641	46641
R ²	0.137	0.138	0.138	0.138

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Horizon and VC firm experience

► OLS investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of rounds	
Log fund age	0.26*** (0.03)	0.20*** (0.03)	0.11*** (0.02)	0.10*** (0.02)	0.16*** (0.02)	0.18*** (0.02)
Log fund age	0.01	0.01	0.00	0.00	0.01	0.01
× Log VC firm nb. of funds raised	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Log fund age	-0.12***	-0.12***	-0.04***	-0.06***	-0.08***	-0.12***
× Dry powder concentration	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Inv. year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
VC firm fixed effects	No	Yes	No	Yes	No	Yes
Observations	46641	46641	46641	46641	46641	46641
R ²	0.043	0.160	0.034	0.139	0.044	0.158

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Horizon and convex compensation structure

Panel A: fund \times year panel regressions

	Log nb. of investments		Log amount invested		Investment dummy	
Log fund nb. of exits	-0.36*** (0.02)	-0.37*** (0.03)	-0.01*** (0.00)	-0.01*** (0.00)	-0.16*** (0.01)	-0.18*** (0.02)
First-time fund \times Log fund nb. of exits	0.12*** (0.02)	0.12** (0.04)	-0.00 (0.00)	0.00 (0.00)	0.02* (0.01)	0.06* (0.03)
First time fund	0.04 (0.02)	0.04 (0.04)	0.01* (0.00)	-0.01 (0.01)	0.03*** (0.01)	-0.01 (0.03)
Observations	23902	23902	23902	23902	23902	23902
R ²	0.473	0.755	0.174	0.626	0.354	0.722

Panel B: investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Log fund nb. of exits	0.05*** (0.01)	0.09*** (0.01)	0.03*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.07*** (0.01)
First-time fund \times Log fund nb. of exits	-0.04*** (0.01)	-0.08*** (0.02)	-0.01* (0.01)	-0.03** (0.01)	-0.03*** (0.01)	-0.04** (0.02)
First-time fund	-0.03** (0.02)	-0.01 (0.03)	-0.01 (0.01)	-0.02 (0.02)	-0.05*** (0.01)	-0.07*** (0.02)
Observations	46641	46641	46641	46641	46641	46641
R ²	0.160	0.346	0.139	0.323	0.157	0.359
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
VC firm FE	Yes	No	Yes	No	Yes	No
VC firm \times Year FE	No	Yes	No	Yes	No	Yes

Horizon and convex compensation structure

Panel A: fund \times year panel regressions

	Log nb. of investments		Log amount invested		Investment dummy	
Ratio of exits to investments	-0.36*** (0.04)	-0.19*** (0.03)	-0.03*** (0.00)	-0.02*** (0.00)	-0.26*** (0.02)	-0.15*** (0.02)
Observations	21036	20696	21036	20696	21036	20696
R^2	0.488	0.486	0.192	0.192	0.390	0.387

Panel B: investment-level regressions

	Log company age		Dev. stage dummy		Log nb. of prior rounds	
Ratio of exits to investments	0.27*** (0.06)	0.15*** (0.05)	0.18*** (0.03)	0.12*** (0.02)	0.34*** (0.04)	0.22*** (0.03)
Observations	42248	41944	42248	41944	42248	41944
R^2	0.158	0.158	0.138	0.136	0.160	0.159
Fund level controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
VC firm FE	Yes	No	Yes	No	Yes	No
VC firm \times Year FE	No	Yes	No	Yes	No	Yes

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Aggregate implications

► Timeseries regressions

Panel A: Age of companies receiving their first VC investment

Dry powder horizon	0.32*** (0.09)	0.25** (0.10)		
Log dry powder	-0.04 (0.08)	-0.07 (0.08)		
Dry powder horizon, BO funds			0.31*** (0.11)	0.29*** (0.11)
Log dry powder, BO funds			0.03 (0.06)	-0.00 (0.06)
Age of companies receiving their first inv., CVC and Evergreen		0.15** (0.07)		0.14** (0.06)
Past year Nasdaq cumulative returns	-0.22 (0.33)	-0.27 (0.33)	-0.36 (0.33)	-0.38 (0.33)
Observations	120	120	120	120
R^2	0.131	0.165	0.170	0.203

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Aggregate implications

► Cross-sectional regressions

Panel A: Age of companies receiving their first VC investment

Age at exit	0.47*** (0.05)	0.36*** (0.05)		
Cohort adjusted age at exit			0.33*** (0.06)	0.26*** (0.05)
Log nb. of investments	-0.29** (0.14)	-0.20 (0.12)	-0.39*** (0.15)	-0.26** (0.13)
Age of companies receiving their first inv., CVC and Evergreen		0.24*** (0.02)		0.26*** (0.02)
Observations	423	423	423	423
R^2	0.184	0.376	0.090	0.327

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