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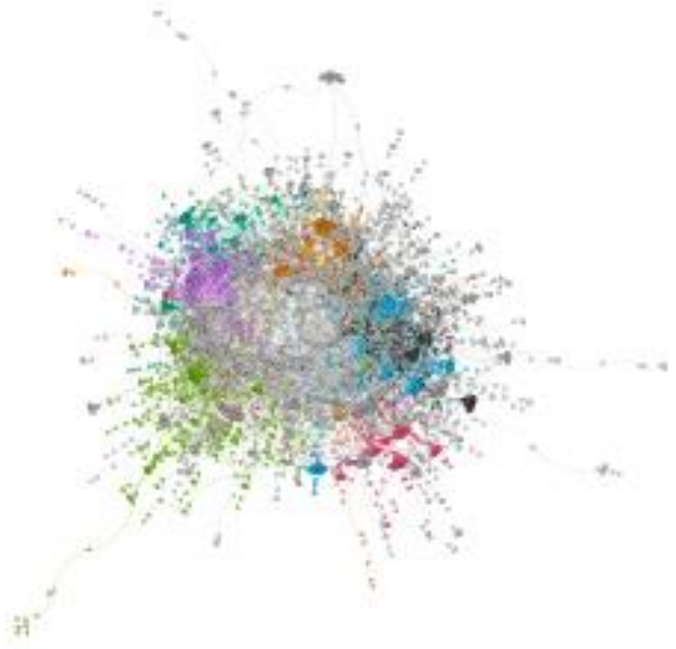
Financing Sustainability: Exploring Counterfactuals



Dimitris Christopoulos
Network Lab, Edinburgh Business School

in collaboration with

David Dekker, Mary Peterse-Bloem, Matthew Smith, Yueh Huang, Stefan Koeppl, George Tzougas, Arno Scharl, Rik Lustermans & Victor Rosenberg

Networks Lab @ EBS

Members Edinburgh Business School & HWU

- Prof Dr Dimitris Christopoulos (economics, network analysis, policy)
- Dr David Dekker (network methods, economics, link trace analysis)
- Alex Jose (neural nets, actuarial mathematics, statistics)
- Rik Lustermans (finance, statistics, applied econometric modelling)
- Dr Matthew Smith (network science, economics, methods)
- Dr George Tzougas (statistics, neural networks, actuarial science)
- RA climate modelling & neural nets (appointed)
- RA policy & network science (advertised)

UKRI Funded Projects

- IDRIC 3.3 Risk in Decarbonization Finance
- IDRIC 3.6 Opportunities in Financing the Green Transition
- IDRIC 9.3 Knowledge Transfer and Innovation Diffusion
- ECO-AI WP4: Sectoral Targets for CO2 and Innovation Advantage

Current Collaborators

- Prof Amir Amel-Zadeh, Said-Oxford U (accounting & finance)
- Prof Dame Heather McGregor, HWU-Dubai (qualitative analysis, corporate governance, EDI)
- Prof Karin Ingold, U-Bern (environmental policy, policy analysis)
- Dr Carla Inguaggiato, U-Bologna (policy networks, deforestation, sustainability)
- Prof Dr Mary Peterse-Bloem, Erasmus U-Rotterdam (finance, econometrics)
- Prof Arno Scharl, MU-Vienna (media analytics, sentiment analysis)

PhD Students

- Ragnar Gudmundarson (finance, ESG)
- Stefan Koeppl (venture capital, finance)
- Lubjomir Janusevic (operational efficiency)
- Victor Rosenberg (venture capital, policy)
- Claudine Salgado (corporate governance)
- Mei Schulte (ESG, sentiment analysis)

Projects

- Governance Robustness & Resilience
- Deforestation in Argentina
- Venture Capital Syndication
- Risk in Decarbonization Finance
- Knowledge Networks & Cluster Analysis in Decarbonization Research
- Opportunities in Financing the Green Transition
- Net Zero & AI

Research Questions

- The Green Turn in Private Equity and **Venture Capital**
- Green Bonds & **Financial Innovation**
- **Innovation** Rates, Patent Networks and Technological Competition
- Industrial Cluster **Innovation** and Decarbonization
- **Liquidity** in the Green bond market
- **Scientific Collaboration** Networks & Research Funding
- Sectoral Differences in **Policy** and Regulatory Compliance in GHG
- Robustness and Resilience in **Policy** Networks
- **Policy** Implementation and Deforestation in Argentina
- Stakeholder Analysis & **Expert Survey Methods**
- Network **Power Audits**
- **ESG** and Corporate Valuations
- **ESG** and Corporate Governance

Contents lists available at ScienceDirect

Finance Research Letters

journal homepage: www.elsevier.com/locate/frl

Rethinking greenium: A quadratic function of yield spread

Chih-Yueh Huang [a,*], David Dekker [a], Dimitrios Christopoulos [a,b]

[a] Edinburgh Business School, Heriot-Watt University, Edinburgh, United Kingdom
[b] MODUL University Vienna, Vienna, Austria

Network Science **11** (1): 143–173, 2023
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CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Understanding collaboration patterns on funded research projects: A network analysis

Matthew Smith[1*], Yasaman Sarabi[2] and Dimitris Christopoulos[2]

[1]The Business School, Edinburgh Napier University, Edinburgh, Scotland and [2]Edinburgh Business School, Heriot-Watt University, Edinburgh, Scotland
*Corresponding author. Email: M.Smith3@napier.ac.uk

The drivers of social entrepreneurship: agency, context, compassion and opportunism

Rebecca Stirzaker
Department of Business, Strategy and Political Sciences, University of South-Eastern Norway-Campus Drammen, Drammen, Norway
Laura Galloway
Edinburgh Business School, Heriot-Watt University, Edinburgh, UK
Jatta Muhonen
University of Helsinki, Helsinki, Finland, and
Dimitris Christopoulos

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sustainability

Article

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People
Public Sector
Patents
Venture Capital

People and the Decarbonization Challenge

Citizens

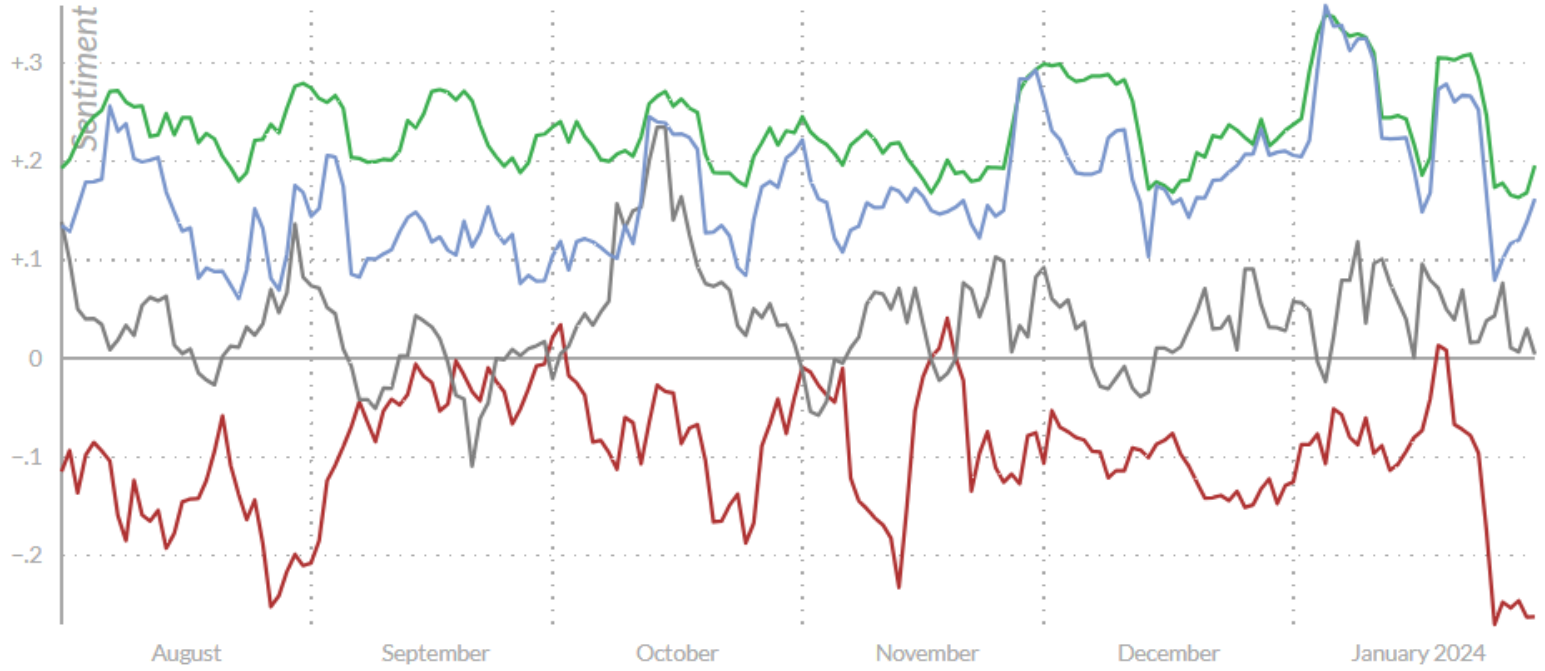
- Long-term commitment in government support, i.e. accept:
  - Higher taxes
  - Climate as a policy priority
- The dangers of populism
- Free-riding challenge
  - Tragedy of the Commons
- Collective action

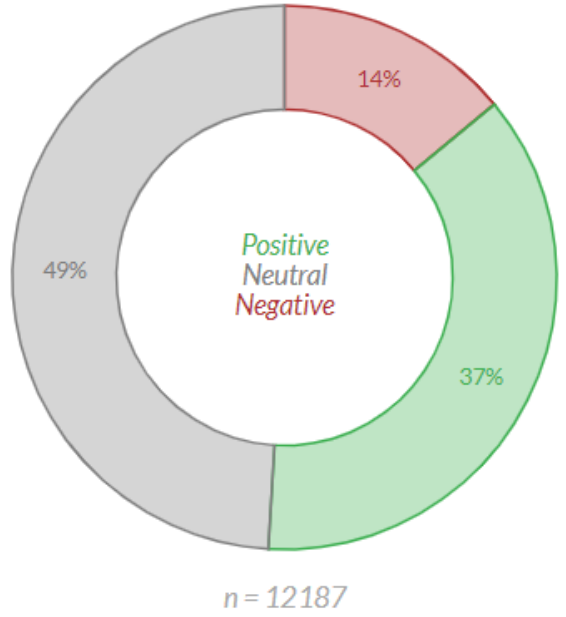
Consumers

- Green choices
- Unequal distribution of costs
- Unequal distribution of benefits
- Horizon of costs & benefits to consumption
  - In the long-run...

UK & US Media on Hydrogen AUG 2023-JAN 2024

Graphics and Data by WebLyzard Technology GmbH





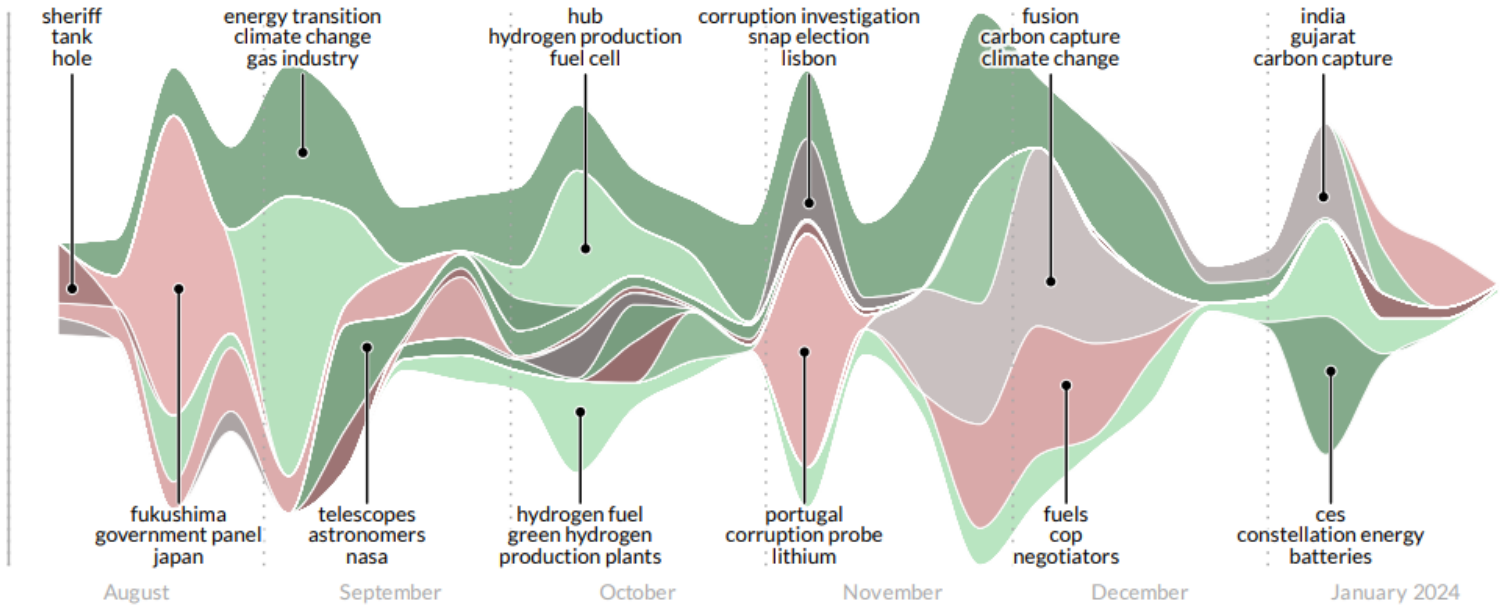
Story Detection

Graphics and Data by WebLyzard Technology GmbH

Search Term: **Hydrogen*** (9032) *Content Sources:* **News Media / English** *Date Range:* **01 Aug 2023 — 31 Jan 2024**

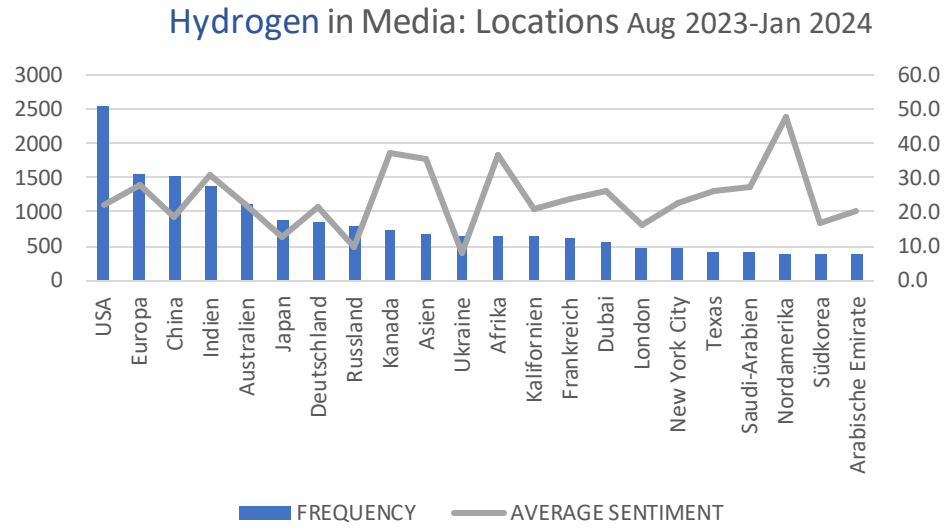
negative 2340 positive 5933 neutral 759

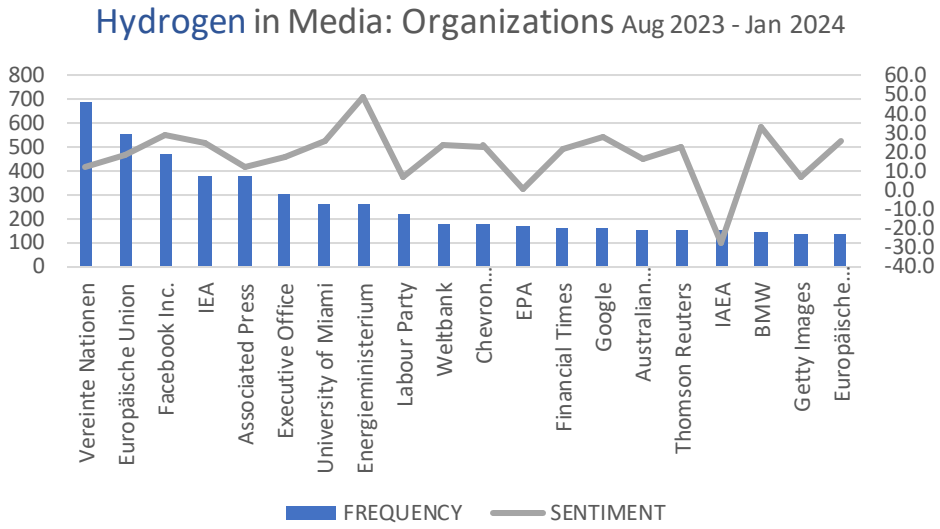
Story Graph



Locations & Organisations in the Hydrogen Discourse

notice the variance in sentiment





Financing Decarbonization: Public Sector

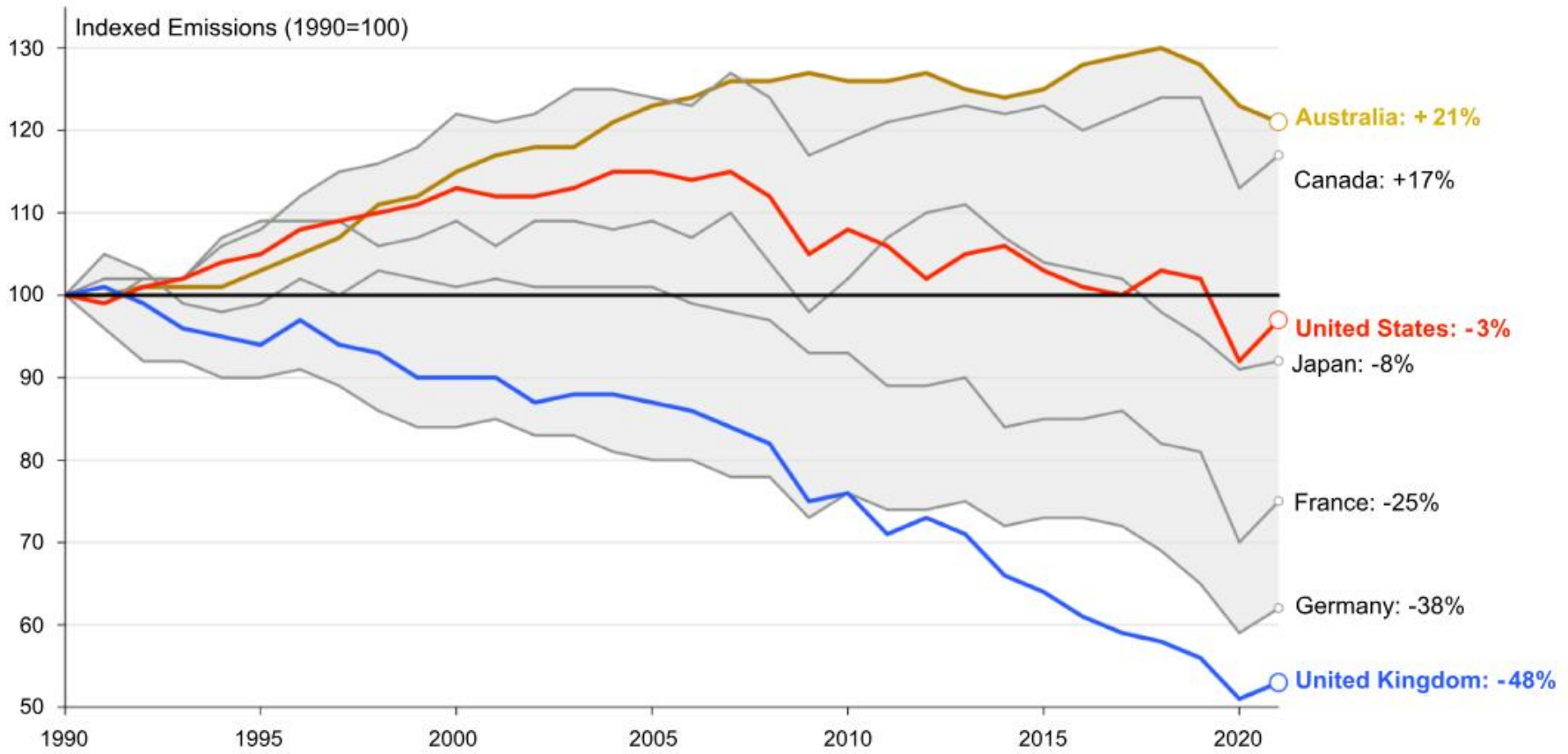
- EU Green Deal (since Jan 2020)
  - €100 billion committed 2021-2027
  - €1 trillion to be mobilized 2028-2037?
  - Climate neutral by 2050
- US Inflation Reduction Act (since August 2022)
  - $370 billion committed
  - Potential cost of $800 billion over next decade
  - Target to reduce carbon emissions by 40%
- UK Net Zero Growth Plan (since April 2023)
  - £11.6 billion committed 2022-2026
    £100 billion to be mobilized to support developing country finance

Government Regulation & Industry Compliance: Canada

Sector	2005 Emissions	2019 Emissions	2030 Target	To Go	Δ 2005-2030	Δ 2019-2030 (base 2005)		Technological Domain*
Buildings	84Mt	91Mt	52,92	38,08	-37%	-45%	-8%	• Non-fossil-fuels for heating systems • Low Carbon Building Materials Innovation
Electricity	118Mt	61Mt	14,16	46,84	-88%	-40%	48%	• Non-fossil-fuels transition • geothermal, tidal, SMRs**, carbon capture and storage, and electricity storage
Heavy industry	87Mt	77Mt	53,07	23,93	-39%	-28%	11%	• Carbon Capture, Storage and Utilization technologies
Oil and gas	160Mt	191Mt	110,4	80,6	-31%	-50%	-19%	• Carbon Capture, Storage and Utilization technologies
Transportation	160Mt	186Mt	142,4	43,6	-11%	-27%	-16%	• Zero-Emission Vehicles • public and active transportation infrastructure • hydrogen trucking
Agriculture	72Mt	73Mt	71,28	1,72	-1%	-2%	-1%	• fertilizer emission reduction • methane reduction
Waste	31Mt	28Mt	15,81	12,19	-49%	-39%	10%	• methane reduction • food waste reduction • transforming into fertilizer and renewable energy

**other policy instrument fall mainly in the legal and administrative domains (codes and regulations, subsidies); **SMR=Small Modular Reactors*

Tragedy in the Global Commons:
Making an effort, being lukewarm or not really trying



Note: GHG excluding LULUCF.
Figures may differ slightly from official inventory submissions.

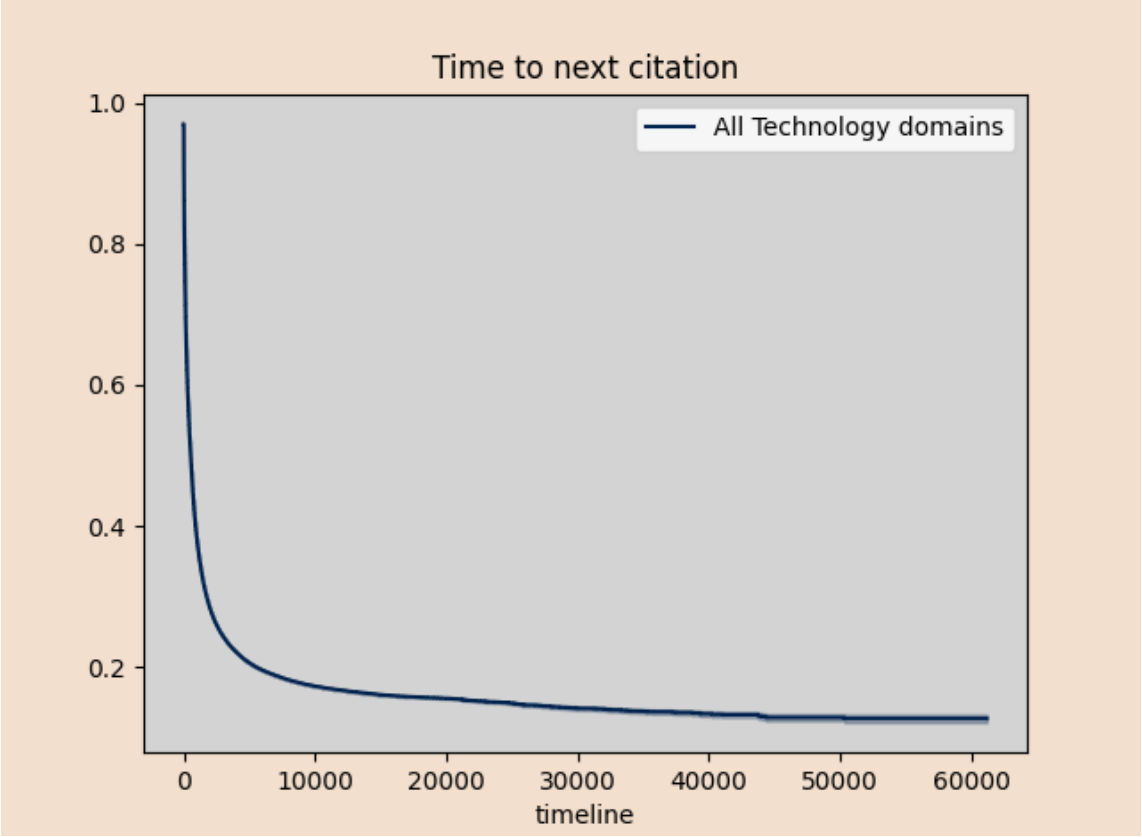
PRIMAP-hist national historical emissions time series, 2022.

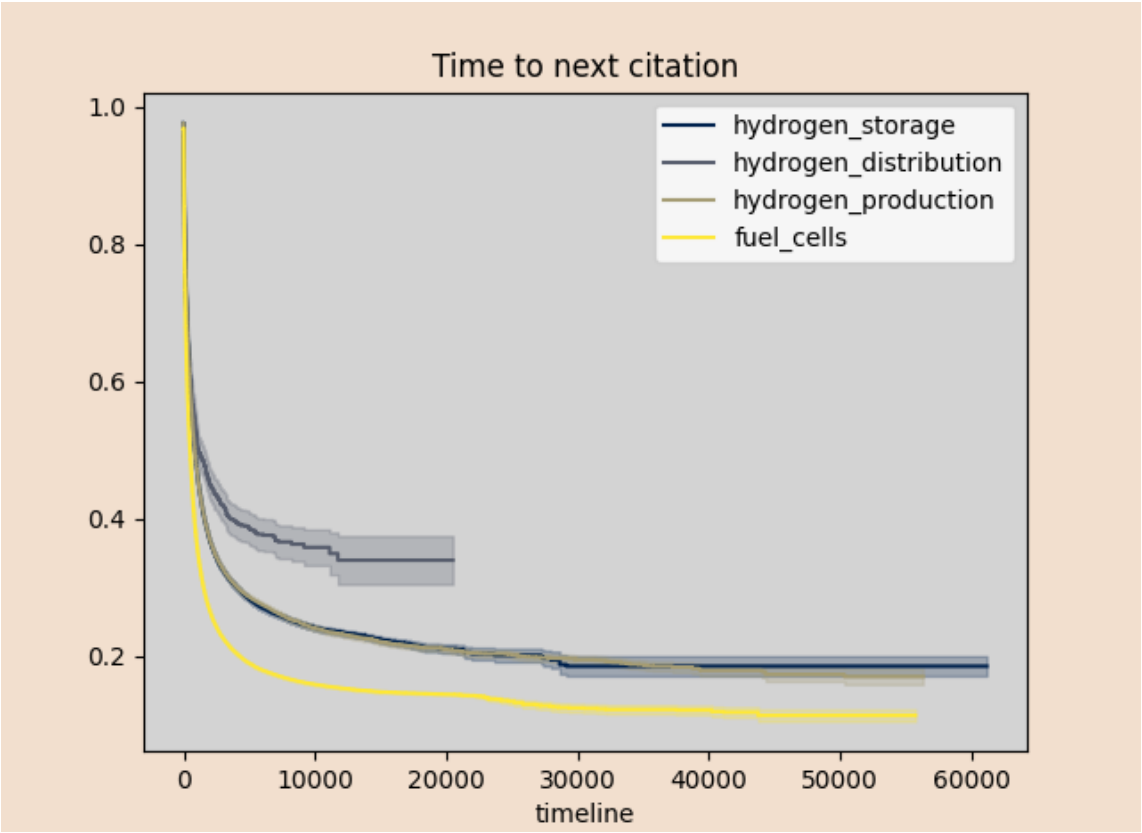
Invention, Innovation & the (Network) Analysis of Patents

Speed

Kaplan-Meier for **hydrogen technology domains**

(univariate duration model)





Blue Hydrogen Production Plants

KEY EUROPEAN BLUE HYDROGEN PROJECTS

Project name	ISD	Country	Platts normalized annual capacity (tonnes/yr)
Magnum, Eemshaven	2023	Netherlands	144,444
Sakhalin	2024	Russia	30,000
Hynet North West 1	2025	United Kingdom	90,009
H2H Saltend	2026	United Kingdom	150,000
H-Vision	2026	Netherlands	300,000
HyDEMO	2026	Norway	218,000
H2Teesside	2027	United Kingdom	260,000
HyNet North West 2	2027	United Kingdom	119,586
Humber Zero VPI Immingham	2027	United Kingdom	400,299
DelpHYnus	2027	United Kingdom	400,000
H2M	2027	Netherlands	294,000
HyNet North West 3	2030	United Kingdom	900,090
Grangemouth	2030	United Kingdom	190,000
Normandy plant	2030	France	93,075

Source: S&P Global Platts Analytics Hydrogen Production Asset Database

Insights from analysing innovation in hydrogen

- Risk aversion among research funders likely to lead to more exploitative research
- Hydrogen distribution is a bottle-neck technology & presents a weakness in the hydrogen infrastructure
- Governments need to subsidise
  - public distribution network
  - Invest in key technological frontiers
- Venture capital likely to flow towards faster developing technologies

Venture Capital in Clean Tech Investments

Financing Decarbonization: Venture Capital

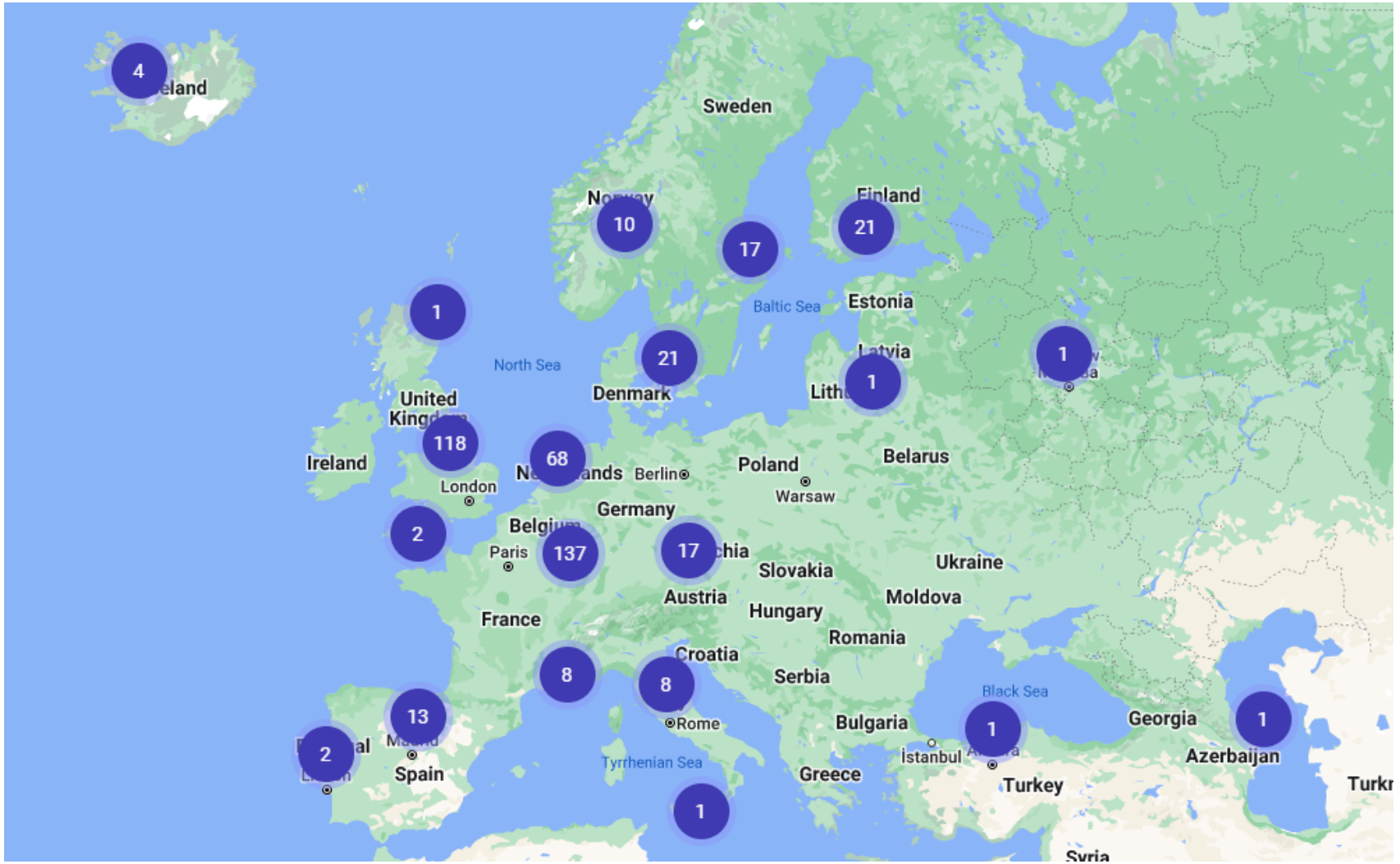
Achieving economic sustainability depends on high levels of invention and innovation:

- Venture capital (VC), is investment capital with an appetite for high-risk and high-reward
- high risk capital is also critical in achieving the level of innovation required
- Venture capital is critical to a sustainable future by funding clean-tech start-ups and green ventures

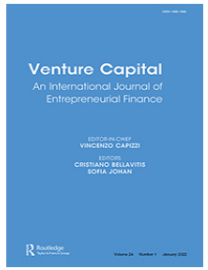
Achieving sustainability also goes beyond risk finance and involves the complex interaction between:

- Accelerating the rate of inventions
- Accelerated innovation
- Business climate
- Global politics
- Regulations & tax
- Markets

Concentration of Clean-Tech Funds in Europe & the network of all VCs



PROJECT 1:
Venture Capital and Clean Tech Investments



Routledge
Taylor & Francis Group

Venture Capital
An International Journal of Entrepreneurial Finance

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tvec20

Syndication networks and company survival: evidence from European venture capital deals

Dimitris Christopoulos, Stefan Koeppl & Monika Köppl-Turyna

Summary findings:

- Syndicated investments have better chances of success, measured by the survival probability of portfolio companies or by successful exits.
- Network centrality of syndicates is associated to survival between different financing rounds, the former being more important in early-stage investments and in the first round of financing.
- Network ties of investors is associated with the sales growth of portfolio companies, both in the selection and value-added channels.

Methods: Model for performance

- For each company, we code as time=0 the event of a deal.

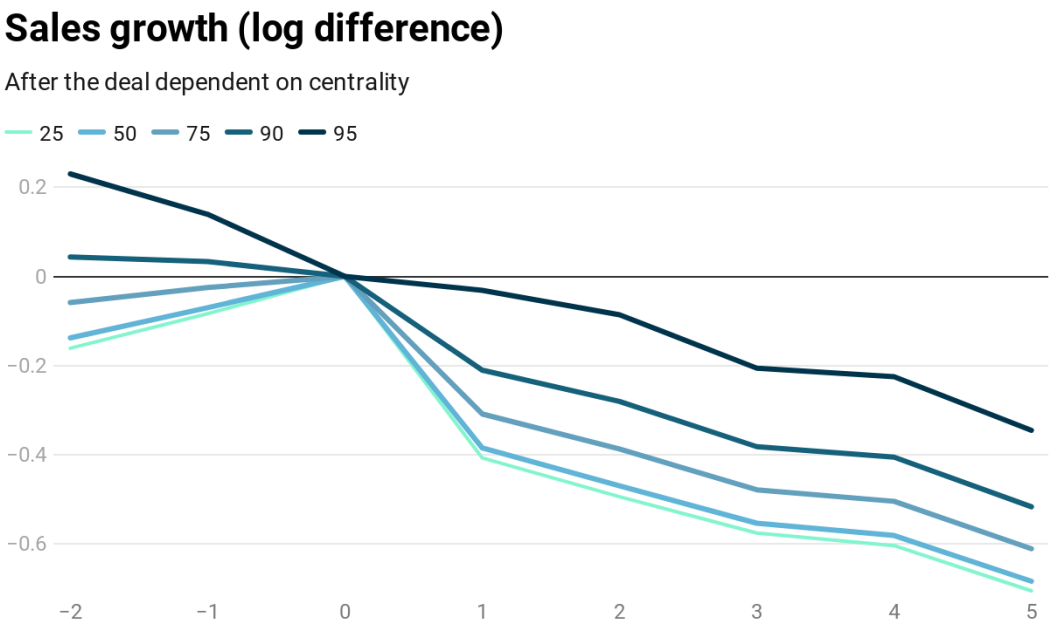
$$log(sales_{t,i}) - log(sales_{t-1,i}) = \sum_{n=-N}^{n=N} \gamma \times I_n + X_{t,i} + YE_t + u_{i,t}$$

- Company-year panel data
- About 2,700 observations
- Model accounts for the mean centrality of all VC investors in a syndicate or the centrality of the “lead” investor

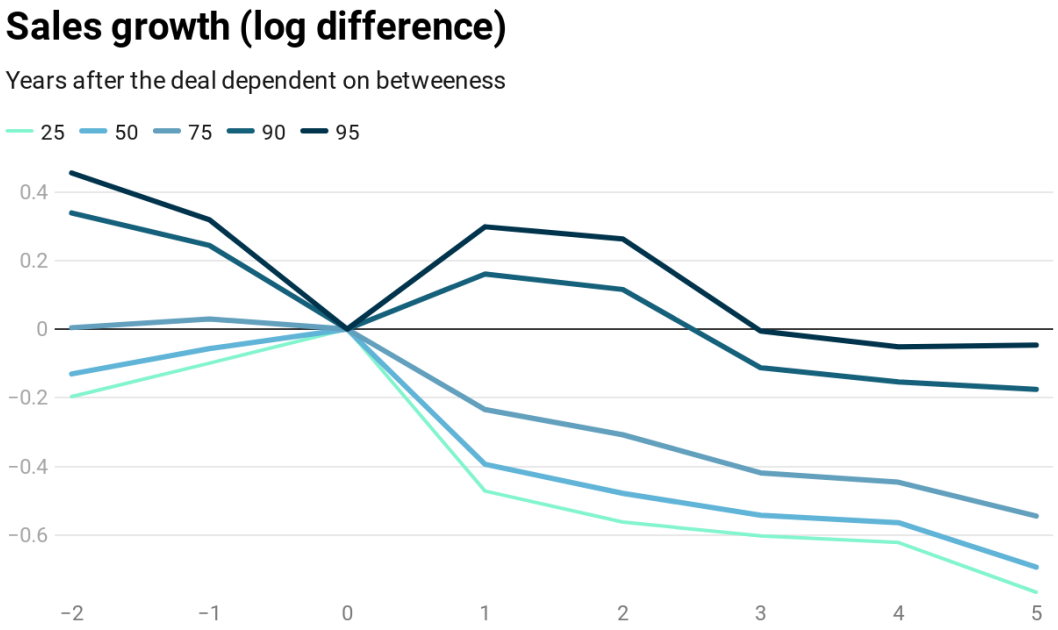
Results

The centrality of lead investors has a strong and significant effect on the success of future investment rounds

eigenvector



betweeness



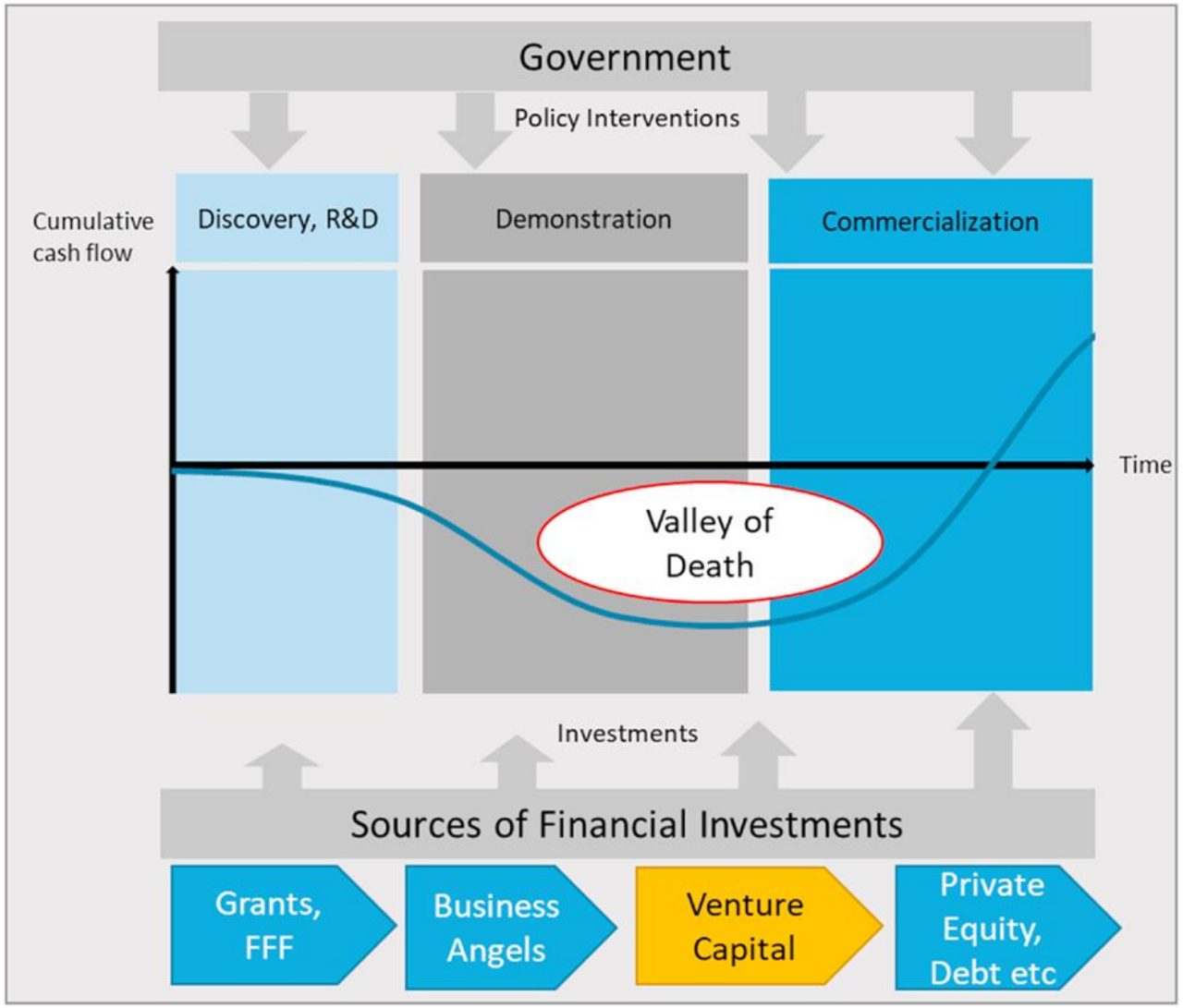
So, what did we find about syndication?

- Syndication and strong network ties of investors are positively associated to success of portfolio companies
  - The association is stronger for early-stage
  - The association is stronger for clean-tech investments
- Correlational analysis suggests the presence of a selection effect in the selection of VC partners (vs. just a value-added effect)
- When controlling for the endogeneity of syndicate formation we observe larger coefficients
- There is evidence that betweeness of the lead investor has a stronger effect on investor success than eigenvector centrality,
  - i.e. **information control (and trust?) appear to have a higher impact than connections to those with high reputation**

Project 2
Government vs Private VCs

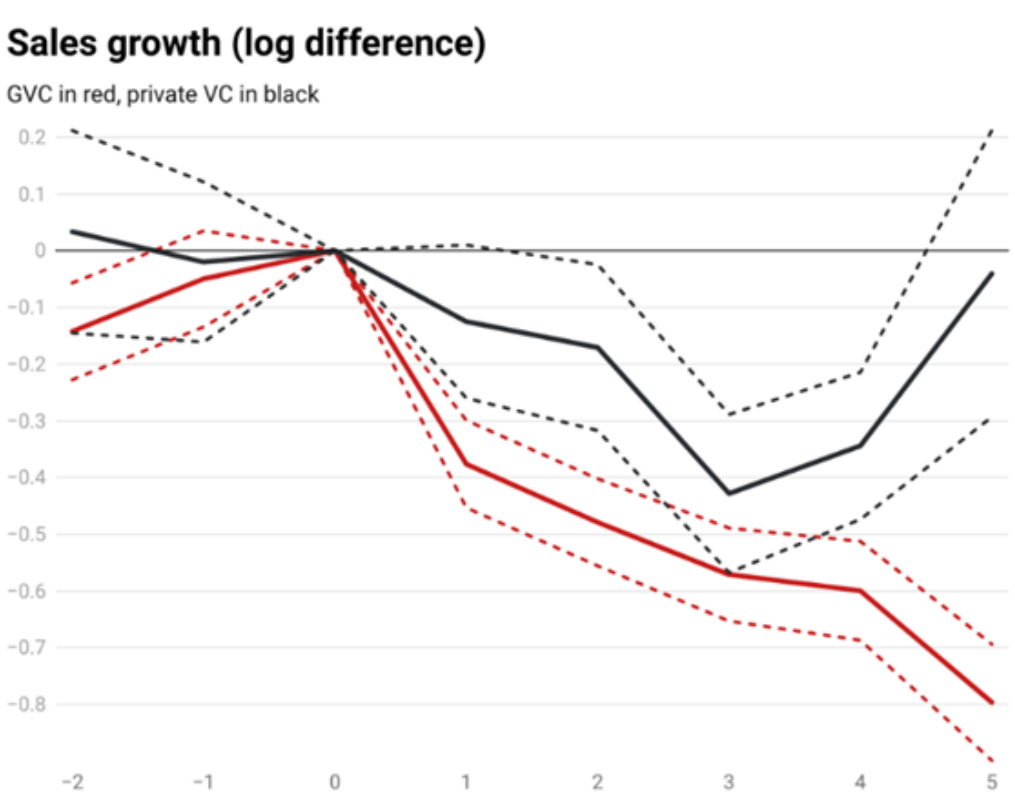
Governments can intervene with policies or funds to support startups survive the “valley of death” via:

- Supporting research that will benefit startups
- Provide tax breaks and regulatory incentives
- Directly invest in startups through managing public VC funds
- Indirectly invest in startups by underwriting Hybrid VC Funds



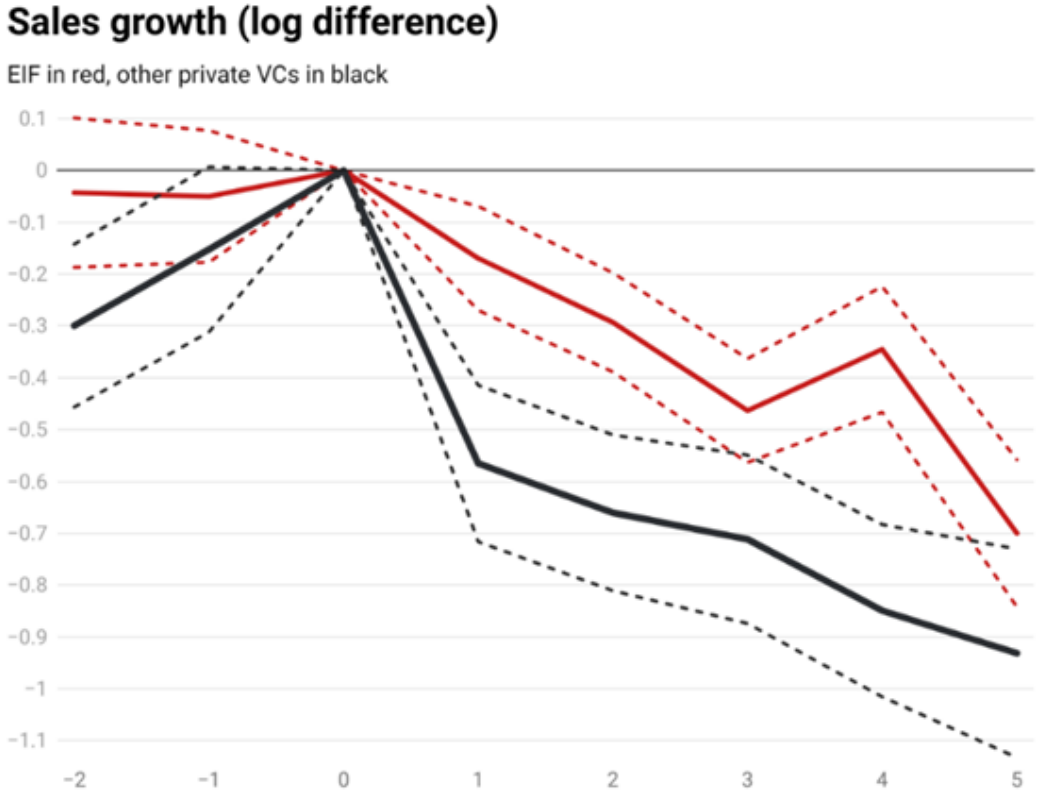
Comparing Government, Independent & Hybrid VCs (The performance of government-backed venture capital investmens)

Government VCs vs Independent VCs



Zero corresponds to the year of the deal; Estimates from the fixed effects model with country and year effects.

Hybrid Indirect Public-Private vs Other VCs



Zero corresponds to the year of the deal; Estimates from the fixed effects model with country and year effects.

PROJECT 3

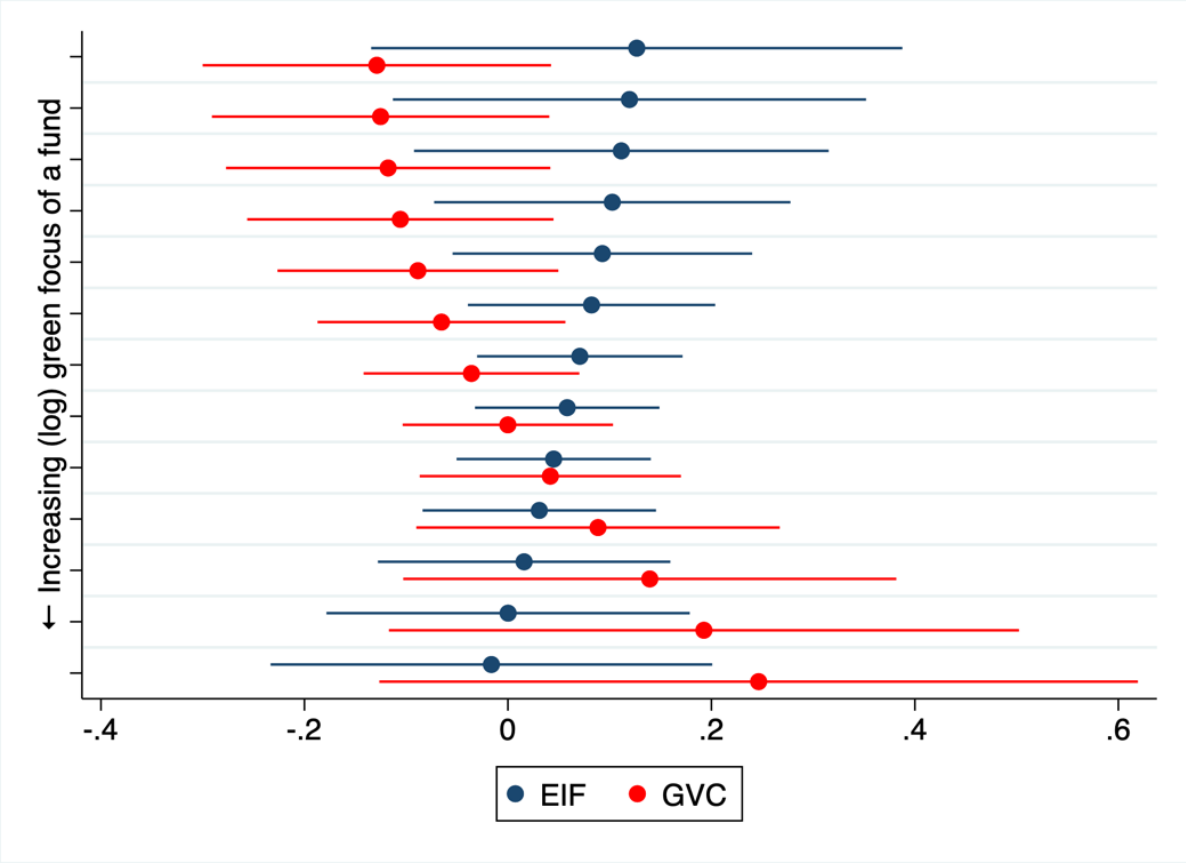
Key Traits in the Cleantech Startup Landscape (under review)

Successful exit probability dependent on VC type			
	EIF	GVC	private
Clean	**0.247**	**0.154**	**0.150**
Non-Clean	**0.316**	**0.214**	**0.267**

	Non Cleantech		**Cleantech**	
	Mean	SD	**Mean**	SD
Number of rounds	**1.863**	2.426	**1.961**	2.187
Stage	**3.434**	2.108	**3.606**	2.104
Deal Size (in Mio Eur)	**22.56**	127	**42.54**	213.8
Total Funding (in Mio Eur)	**82.27**	361.5	**148.4**	729.2
Syndicate Size	**4.632**	4.96	**3.913**	3.303
Industry Expertise	**14.25**	27.87	**4.738**	12.83
Successful Exit	**.2516**	.4339	**.1494**	.3565

Shining a green light on success: Key Traits in the Cleantech Startup Landscape (under review)

Marginal effects of EIF & GVC at different levels of clean focus



	Not Cleantech		Cleantech	
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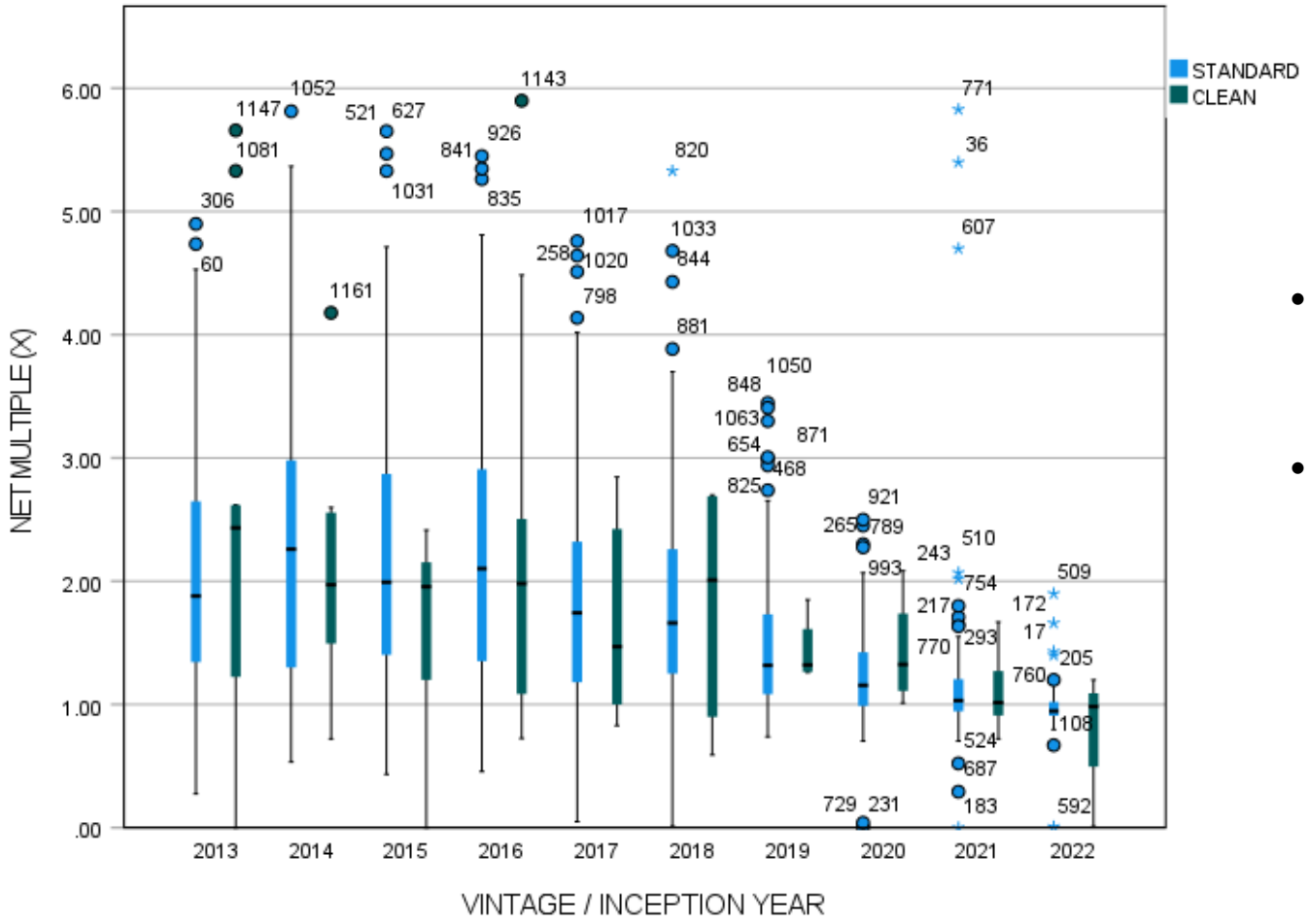
Performance of “standard” and cleantech funds

outliers excluded, closed funds, 2013-2022, >10mil$, 1165 cases



- Mean values of performance for *cleantech* higher for half the years under observation
- Variance for for clean-tech is lower

Future of cleantech VC funding

Cleantech dedicated funds (2013-22)

- concentrate in Europe
- entail less risk for investors
- perform at least as well as standard funds

Cleantech dedicated funds also have

- higher valuations
- tied to higher positive syndication externalities
- entail more complex innovation patterns (more risk?)

The Challenge of Counterfactuals

- Citizens are asked to consistently & over the very long term subsidise decarbonization. Multiple roadblocks can derail the process
  - Populism
  - Countries can “defect” and pollute the global commons
  - Crises of confidence in industries and experts
  - Misunderstood risks of financial innovations such as green bonds and green VC
- Economic sectors appear to strategize GHG compliance on the assumption of government subsidies to critical industries
- Achieving sustainability will depend on getting clean-tech innovation right but the analysis of patented inventions reveal gaps in the technological frontier
- Hybrid public-private VC funds have the best economic performance across all economic sectors (but this contravenes competition rules in the EU)
- Direct subsidies (such as the US IRA) likely responsible for inflating startup valuations and therefore increase systemic risk

Thank you

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POSTSCRIPT ON UN SUSTAINABILITY GOALS

This work contributes to the UN's Sustainable Development Goals of: Affordable and Clean Energy (7); Decent Work and Economic Growth (8); Industry, Innovation, and Infrastructure (9); Sustainable Cities and Communities (11); Responsible Consumption and Production (12); and Climate Action (13).

CONCLUSIONS
Venture Capital and Clean Tech Investments

We have produced a number of novel insights:

- All startups benefit by the centrality of their VC syndicate. The effect is stronger for early stage startups.
- Hybrid, private funds backed by government perform better than private and public funds.
- Clean-tech ventures have a higher rate of failure and lower chance of exit, BUT they achieve almost twice the valuations and funds investing in them perform better than their peers.

- Policymakers can support the cleantech sector through both direct and indirect investments
- Indirect hybrid funds have the best economic performance across all economic sectors
- Direct subsidies (such as the US IRS) may be part of the distortion in valuations
- Achieving sustainability will depend on getting clean-tech innovation right

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Factor Analysis, Standard VC vs Cleantech VC

Main difference is on loadings of 2nd Component
Europe invested funds load negatively on standard funds & positively on cleantech
North America invested funds have diametrically reverse loadings

Rotated Component Matrix[a,b]

	Component		
	1	2	3
NET MULTIPLE (X)	**.818**	.128	.369
DPI (%)	.243	.063	**.955**
EUROPE	-.047	**-.790**	-.024
North America	-.058	**.807**	.026
NET IRR (%)	**.595**	-.018	.149
RVPI (%)	**.804**	.102	-.438
PREQIN QUARTILE RANK	**-.917**	.063	-.104
QUARTILE RANK	**-.910**	.075	-.144

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

b. Only cases for which DUM_CLEAN = 0 are used in the analysis phase.

Rotated Component Matrix[a,b]

	Component		
	1	2	3
NET MULTIPLE (X)	**.708**	.541	.284
DPI (%)	.160	.065	**.980**
EUROPE	-.041	**.790**	.004
North America	-.187	**-.707**	-.026
NET IRR (%)	**.923**	.052	-.016
RVPI (%)	**.625**	.524	-.489
PREQIN QUARTILE RANK	**-.979**	-.015	-.024
QUARTILE RANK	**-.913**	-.182	-.200

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

b. Only cases for which DUM_CLEAN = 1 are used in the analysis phase.

Endogeneity of syndicates

- Finding syndication partners is affected by certain **characteristics of VC firms**, which may affect the performance of portfolio companies.
- If a strong correlation exists between the unobserved factors affecting how successful an investor is at forming syndicates and their value-adding to firms, then **coefficients from our regressions would be underestimated** and the true coefficient larger.
- We construct an index, of how often a particular investor invests outside of her regular **scope of business**, by calculating the index of variation of the investment stage invested by a particular investor.

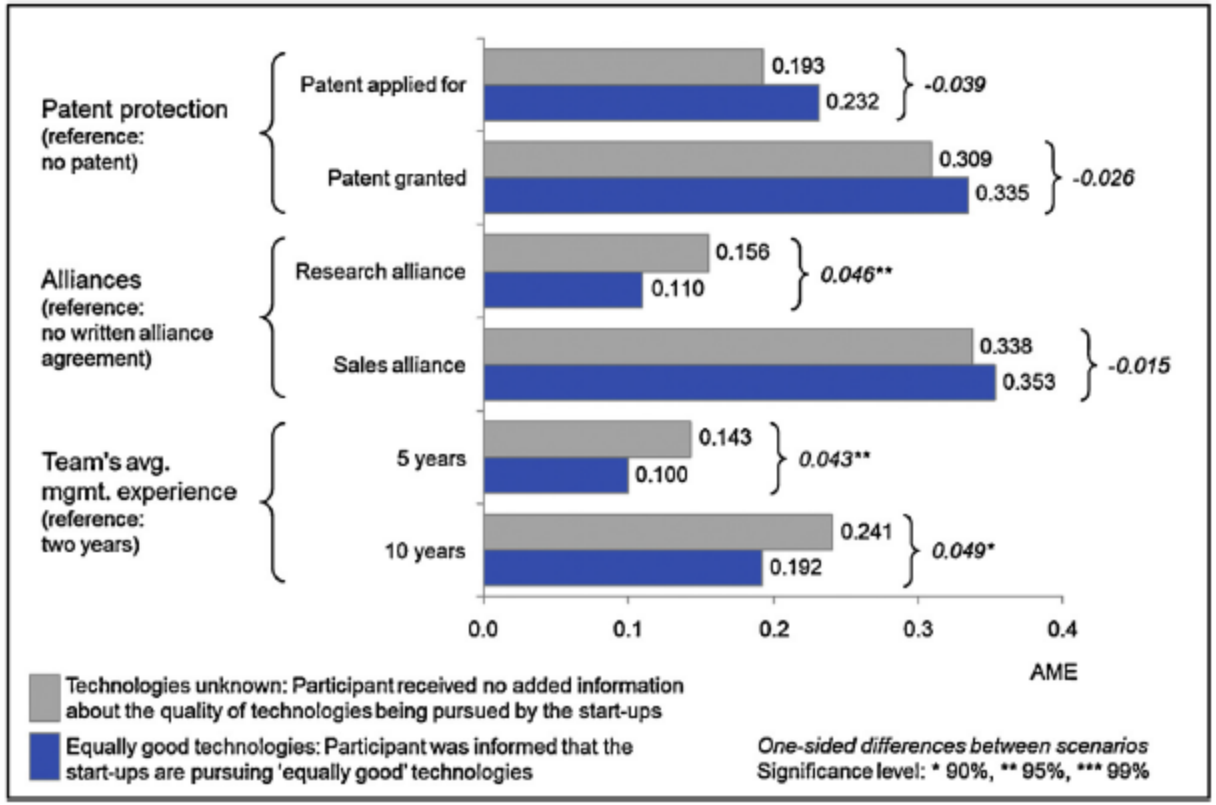
Conclusions

- Syndication and strong network ties of investors are positively associated to success of portfolio companies
  - The association is stronger for early-stage
  - The association is stronger for clean-tech investments
- Correlational analysis suggests the presence of a selection effect in the selection of VC partners (vs. just a value-added effect)
- When controlling for the endogeneity of syndicate formation we observe larger coefficients
- There is evidence that betweeness of the lead investor has a stronger effect on investor success than eigenvector centrality,
  - i.e. **information control (and trust?) appear to have a higher impact than connections to those with high reputation**

Financing Sustainability: Venture Capital and Clean Tech Investments

The Importance of Signalling

- Patents, alliances and the experience of teams is perceived to signal the quality of the technology in a startup venture (Hoenig & Henkel, 2015)
- The authors find that alliances are a good indication of quality, with team experience also playing a role. Patents do not appear to play a strong role in signalling quality.

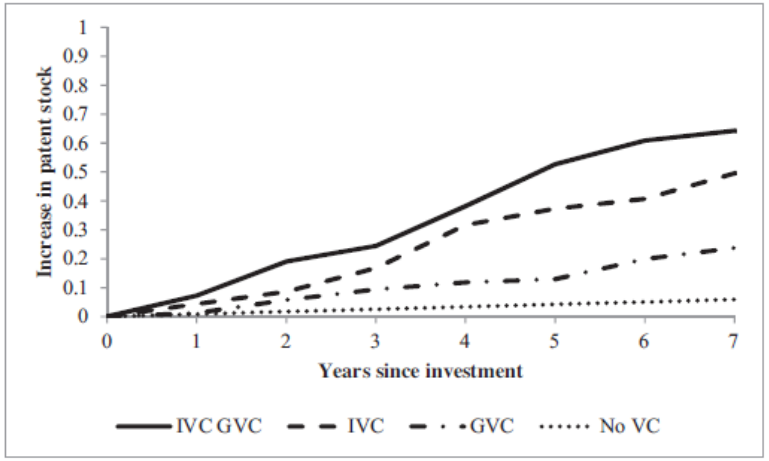


Venture Capital and Clean Tech Investments

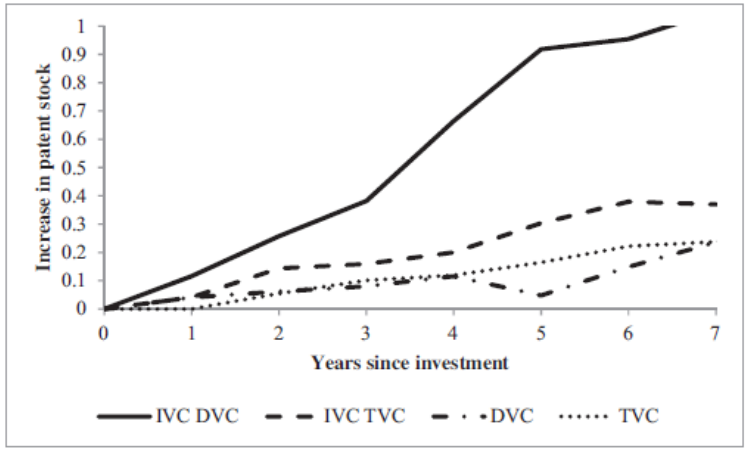
The Value of Patents

- Analysis of biotechnology startups in Europe up to 2010 (Bertoni & Tykvova, 2015) find that increase of patents is
  - stronger for hybrid government/independent VCs (Panel A)
  - but also that development orientated VCs outperform technology orientated ones (Panel B).
- However, the value of patents among technology oriented funds is higher, even if development funds have a higher volume of patents
- The authors conclude that Government VC funds are most effective where there is abundance of Independent VC capital

Panel A: IVC, GVC and IVCGVC



Panel B: TVC and DVC



Journal of Cleaner Production
Volume 294, 20 April 2021, 126315

Why do they do it? Corporate venture capital investments in cleantech startups

Puck D. Hegeman, Roger Sørheim

- Corporate motivations to invest venture capital include
  - exploitative learning,
  - building legitimacy,
  - exploring a green opportunity,
  - copying an activity undertaken by a competitor.

Financing Sustainability: Venture Capital and Clean Tech Investments

- In a series of research projects we explore the performance of venture capital funds investing in cleantech startups.
- In clean-tech, government underwritten venture capital performs equivalently to private funds
- Comparative advantage of hybrid public-private venture capital to both private and public VCs.
- Funds run with private criteria of investment, but funded with public money perform best of all investment vehicles.

October 22, 2021

September 11, 2023

Insights unique to Network Analysis of Syndication

- **Eigenvector** centrality shows not only that a particular investor has many co-investors, but that she has many important co-investors (co-investors with multiple other syndicated partners).
- **Betweenness** captures the degree to which a VC firm may connect or bring together other VCs or facilitating investment opportunities
  - Potentially also captures how particular VCs are capable to control valuable information flow between other VCs active in a market,
  - this may be particularly relevant if assessments of technological or market edge depend on **expertise** and are therefore contingent on **trust** relations

Methods: Model for survival

- We define survival of a portfolio company as the probability of obtaining one more round of financing.
- Any of these events: **Merger, PIPE, Pre-IPO, and Secondary Stock Purchase** are considered an "ultimate success" for the VC investors
- Two models:
  - The number of survived rounds in a standard panel Poisson regression: $\log(E(Y|x))=\theta'x$ with random effects and error clustering at portfolio company level
  - A panel logit model, in which we define as a binary variable the whether a portfolio company survived to round N, conditional on surviving to round N-1.
- Control variables:
  - overall funding,
  - 74 industry dummies,
  - 16 country dummies,
  - size of the syndicate.

Results 1/2

Table 4: Poisson regressions: Number of financing rounds.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expertise	0.01***	0.01***	0.01***	0.01***	0.00	0.00	0.00	0.00
	(5.79)	(5.72)	(4.91)	(5.29)	(1.31)	(1.30)	(1.37)	(1.29)
Syndicate Size	0.03***	0.03***	0.02***	0.02***	0.01	0.01	0.01*	0.01*
	(4.33)	(4.28)	(3.66)	(3.22)	(1.38)	(1.37)	(1.77)	(1.75)
Total Known Funding (EUR mn)	0.00***	0.00***	0.00***	0.00***	0.01***	0.01***	0.00***	0.00***
	(7.31)	(7.57)	(6.41)	(7.56)	(6.24)	(6.31)	(5.49)	(6.28)
Centrality	0.03**				0.01			
	(2.33)				(1.25)			
Betweeness		0.02**				0.01		
		(2.31)				(1.39)		
Central Investor Centrality			0.14***				0.12***	
			(5.93)				(4.63)	
Central Investor Betweeness				0.12***				0.15***
				(5.71)				(7.26)
Constant	0.69***	0.68***	0.73***	0.72***	0.30**	0.30**	0.32***	0.34***
	(23.93)	(23.43)	(24.39)	(24.16)	(2.37)	(2.37)	(2.64)	(2.79)
Country	NO	NO	NO	NO	YES	YES	YES	YES
Industry	NO	NO	NO	NO	YES	YES	YES	YES
Industry-Country	YES	YES	YES	YES	NO	NO	NO	NO
Observations	26046	26046	26046	26046	26048	26048	26048	26048

*Pooled Poisson regressions (Columns 1-4) and panel Poisson regressions with portfolio-company random effects (Columns 5-8); not reported: industry and country fixed effects; standard errors clustered at portfolio-company level; Z-statistics in parentheses; significance: * 0.1, ** 0.05, *** 0.01*

The centrality of lead investors has a strong and significant effect on the success of future investment rounds

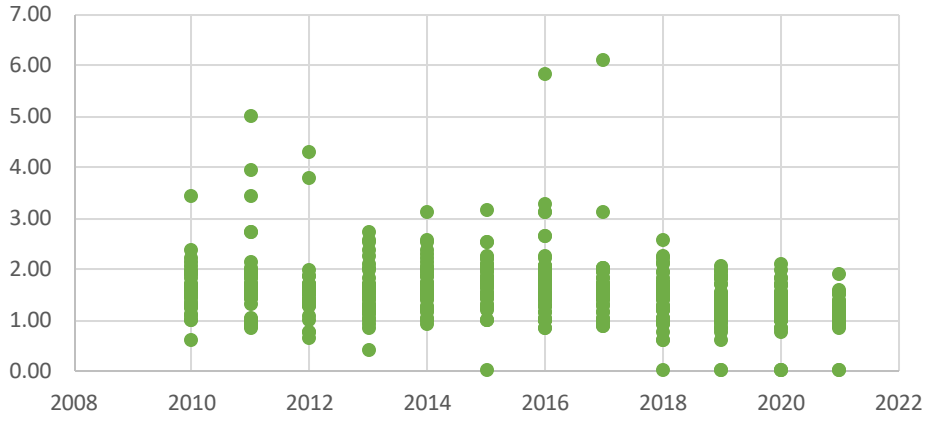
Endogeneity of syndicates

- Finding syndication partners is affected by certain **characteristics of VC firms**, which may affect the performance of portfolio companies.
- If a strong correlation exists between the unobserved factors affecting how successful an investor is at forming syndicates and their value-adding to firms, then **coefficients from our regressions would be underestimated** and the true coefficient larger.
- We have also constructed an index, of how often a particular investor invests outside of her regular **scope of business**, by calculating the index of variation of the investment stage invested by a particular investor.

2010 to 2022 Private Capital & VC

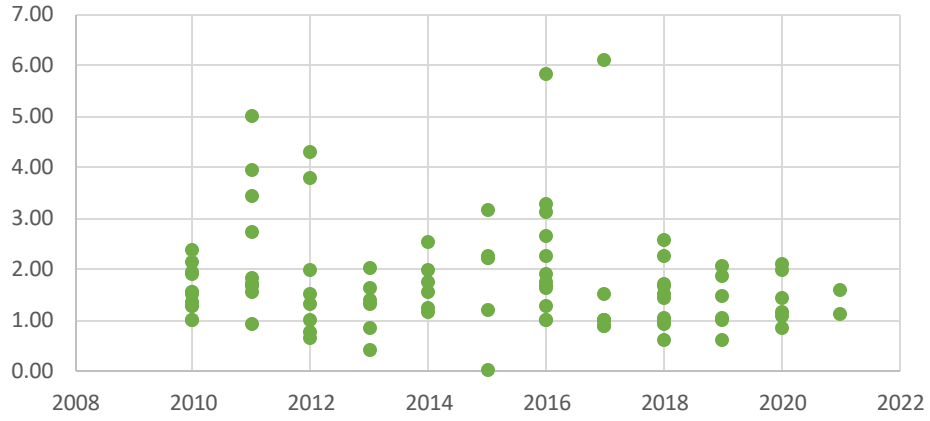
European Funds, 2013-2022, ≥ 10mil$, 1,636 Funds

Fund Performance Net Multiple, excluding Clean Tech



μ=1.46

Fund Performance Net Multiple, Clean Tech

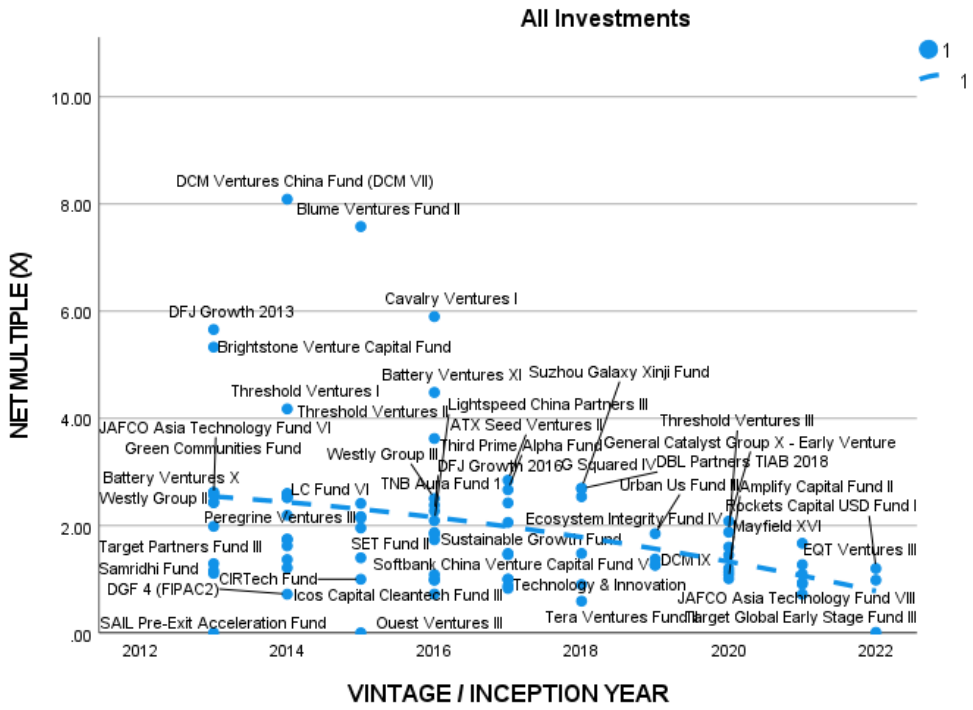


μ=1.72

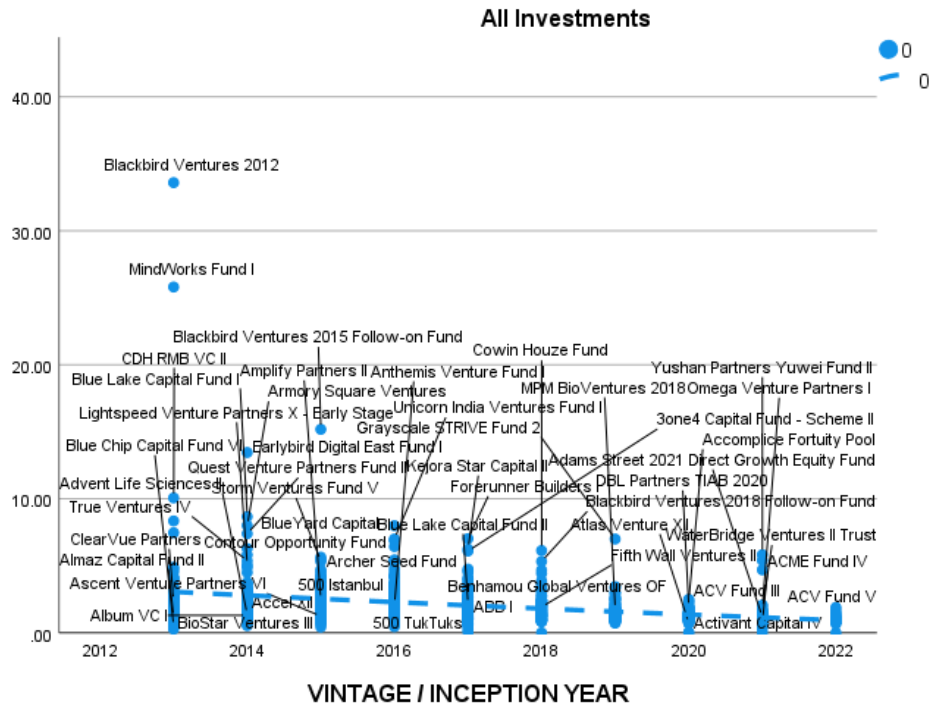
Performance across time

Fitting a quadratic function

Clean-tech



Standard



Financing Decarbonization: Venture Capital

Achieving economic sustainability depends on high levels of invention and innovation:

- Venture capital (VC), is investment capital with an appetite for high-risk and high-reward
- high risk capital is also critical in achieving the level of innovation required
- Venture capital is critical to a sustainable future by funding clean-tech start-ups and green ventures

Achieving sustainability also goes beyond risk finance and involves the complex interaction between:

- Accelerating the rate of inventions
- Accelerated innovation
- Business climate
- Global politics
- Regulations & tax
- Markets

OLS Regression

Mixed log – log and log – semi-log

Dep. Variable:	Ln(Total Funding USD)	**R-squared:**	0.674
Model:	OLS	**Adj. R-squared:**	0.658
Method:	Least Squares	**F-statistic:**	45.78
Date:	Tue, 05 Sep 2023	**Prob (F-statistic):**	5.37e-42
Time:	04:36:54	**Log-Likelihood:**	-317.14
No. Observations:	190	**AIC:**	654.3
Df Residuals:	180	**BIC:**	686.8
Df Model:	9	**Covariance Type:**	HC3

	coef	s.e.	z	P> |z|	[0.025	0.975]
Intercept	-0.6910	22.923	-0.030	0.976	-45.620	44.238
Seed	-2.2654	0.581	-3.901	0.000	-3.404	-1.127
Series A	0.1359	0.560	0.243	0.808	-0.963	1.234
Series B	1.0756	0.558	1.929	0.054	-0.017	2.169
Series C+	2.2178	0.569	3.898	0.000	1.103	3.333
Founded_Year_x	0.0078	0.011	0.690	0.490	-0.014	0.030
Ln(number_of_investors)	0.3415	0.123	2.767	0.006	0.100	0.583
M. of Invest.s' Cliq.Mb.	1.1606	0.407	2.854	0.004	0.364	1.958
M. of Investors' Cliques	-1.0507	0.438	-2.401	0.016	-1.908	-0.193
pred1153	2.0558	1.299	1.583	0.055	-0.049	4.602

Omnibus:	9.189	**Durbin-Watson:**	1.887
Prob(Omnibus):	0.010	**Jarque-Bera (JB):**	10.111
Skew:	-0.409	**Prob(JB):**	0.00637
Kurtosis:	3.780	**Cond. No.**	4.80e+05

Notes: Standard Errors are heteroscedasticity robust (HC3).

Results Knowledge-Funding Model

Data from TRACXN VC investments in Hydrogen companies (mainly fuel cells).

- **Predicted citation probability at day 1153 post founding date.**
- **3.2 years to cite**
- Predictions of a proportional hazard model in the fuel-cell domain.

- Controlling for:
- Stage, founding year, syndication structure.