Regulatory sandboxes and fintech funding: evidence from the UK

G Cornelli (BIS), S Doerr (BIS), L Gambacorta (BIS) and **O Merrouche (Nanterre)**

Bank of Italy, 17 March 2022

The promises of financial innovation

- The rise of fintech poses new challenges:
  - Disruptive growth creates a trade-off between benefits to competition/inclusion and risks to financial stability/consumer welfare

- Yet, fintechs are usually young firms that operate in a rapidly changing regulatory environment with high uncertainty
  - Asymmetric information and regulatory costs pose obstacles for access to funding

- Challenge for regulators is to foster innovation while keeping alert to emerging risks

Regulatory sandboxes

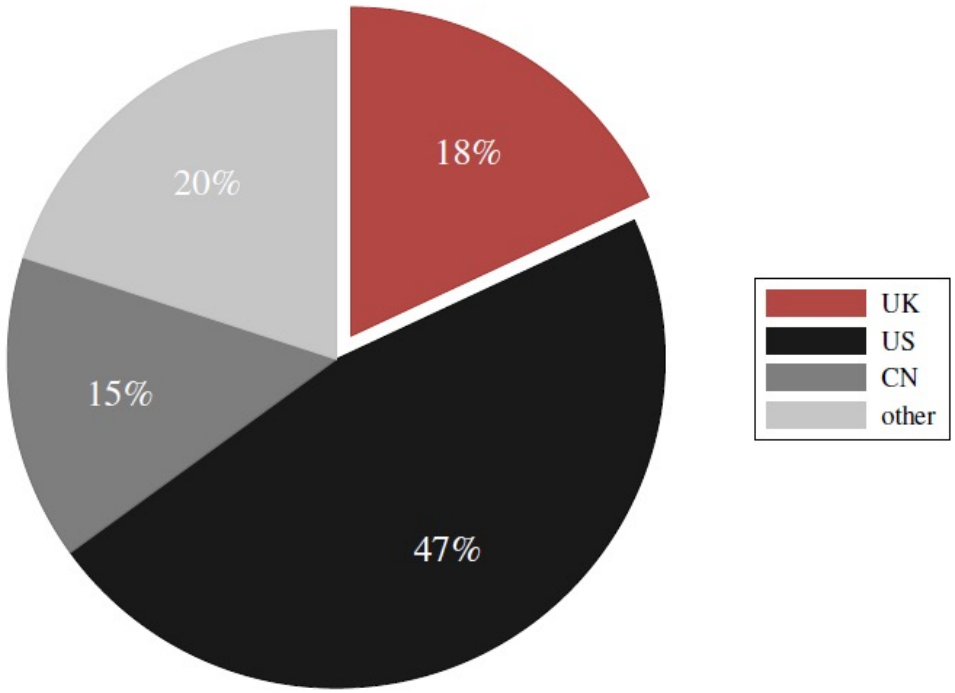
- Sandboxes: regulatory tool to foster innovation in the financial sector while keeping alert to emerging risks
  - Almost 60 countries have already introduced them!
- Goals differ
  - Facilitate fintechs access to financing
    - Foster innovation, competition, and ultimately consumer welfare
  - Learn about new technologies before they hit the mass market
    - Digital economy implies large economies of scale and scope
    - Could threaten consumer protection and financial stability
  - (Nurture the fintech sector in general)

Our setting: the UK sandbox

- World's first sandbox, established in the UK by the FCA in 2015
- 5 cohorts from 2016-2019
  - Firms that offer genuine innovation
- Explicit goal to attract investments toward fintechs by reducing informational frictions

Figure 1: **Total funding raised by fintech start-ups**

(a) On average (2010-2019)

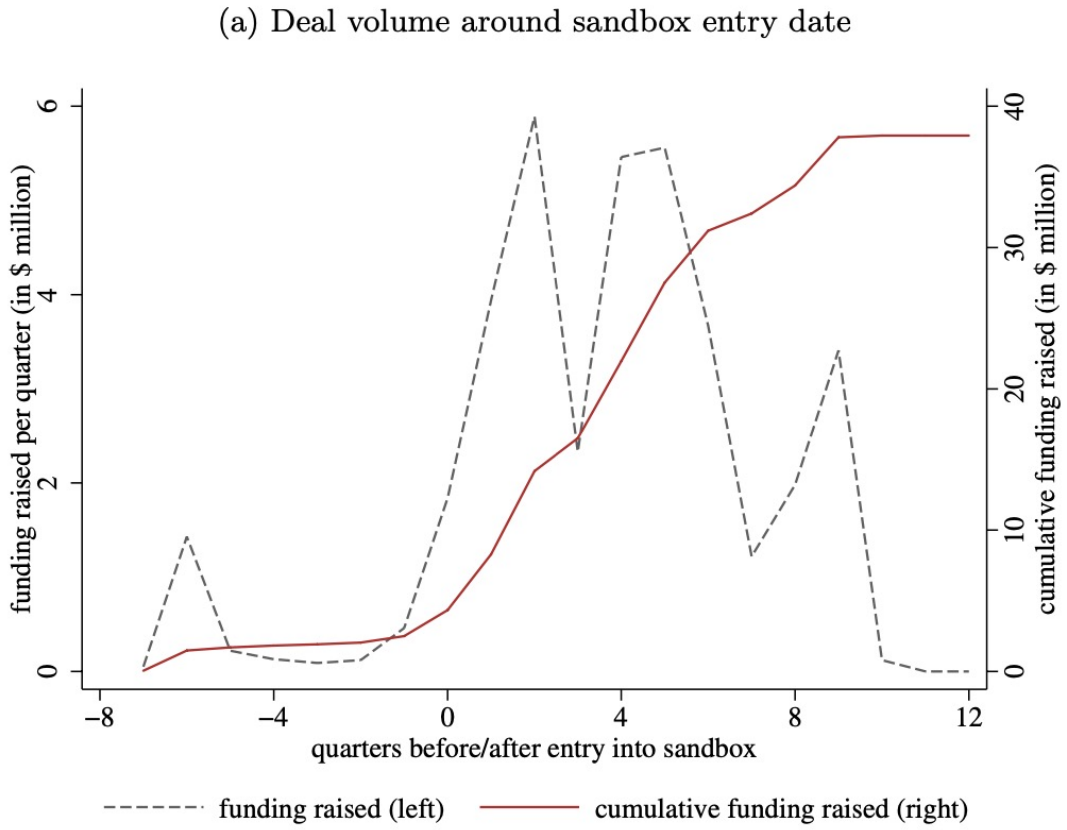


The UK sandbox process

- Process: Application, authorisation, testing, exit
- FCA selects firms that offer genuine innovation
- 5 cohorts, 118 firm accepted in total (3x as many applications)
  - Nov 2016, June 2017, Dec 2017, July 2018, April 2019
- Firms are assigned a dedicated case officer
- Test their products in a limited market environment, subject to regular reporting requirements
- Over 75% of firms successfully complete test

Sandbox entry improves access to funding

- Entry into the sandbox:
  - 15% increase in capital raised
  - 50% increase in probability to raise funding



How does the sandbox help fintechs?

1. By reducing asymmetric information
    - Effect of sandbox entry on capital raised is stronger for smaller and younger firms
    - Firms raise more capital from first-time investors or foreign investors post-entry

2. By reducing regulatory uncertainty/costs
    - Anecdotal evidence suggests that firms headed by CEOs with limited experience in the financial sector benefit more
    - Supported by our evidence

➢ Note that results are also consistent with general signalling effect: sandbox entry reveals firms' quality

Identification

- We focus on the set of firms that enter the sandbox at some point
  - Exploit staggered introduction and different cohorts
  - Assumption: firm observables and unobservables *among* sandbox firms are uncorrelated with cohort entry date
- Strategy 1: firm-level
  - No differential pre-trends
  - Cohort/entry date uncorrelated with firm-level observables
- Strategy 2: firm-investor level
  - Including firm*time fixed effects leads to no change in coefficients (but R2 up)
  - Including investor*time fixed effects increases magnitude

Literature

- Incubators, accelerators, and R&D grants to foster innovation
  - Gonzalez-Uribe and Leatherbee, 2018; Howell, 2017; Yu 2020; Gonzalez-Uribe and Reyes, 2021
  - See also Kerr and Nanda, 2015; Lerner and Nanda, 2020
- How to regulate fintechs
  - Zetzsche, Buckley, Barberis and Arner, 2017; Buchak et al, 2017
  - Algorithmic discrimination and changes in consumer behaviour (Bartlett et al, 2019; Berg, Burg, Gombovi ć and Puri, 2020; Fuster et al, 2021)
- ➢ Sandboxes have emerged as the most prominent tool to foster innovation and inform regulation. Yet no evidence on their effectiveness

The UK sandbox

- Established in November 2015 by the Financial Conduct Authority
  - Explicit goal to attract investments toward fintechs
  - … but long-term objective to foster competition and increase consumer welfare
- Four steps: Application, selection, testing, exit
- Operates on a cohort basis
  - 5 cohorts, 118 firm accepted in total (3x as many applications)
  - Nov 2016, June 2017, Dec 2017, July 2018, April 2019
- FCA selects firms that
  - offer genuine innovation that benefits UK consumers
  - …and fulfil "need for support criteria"

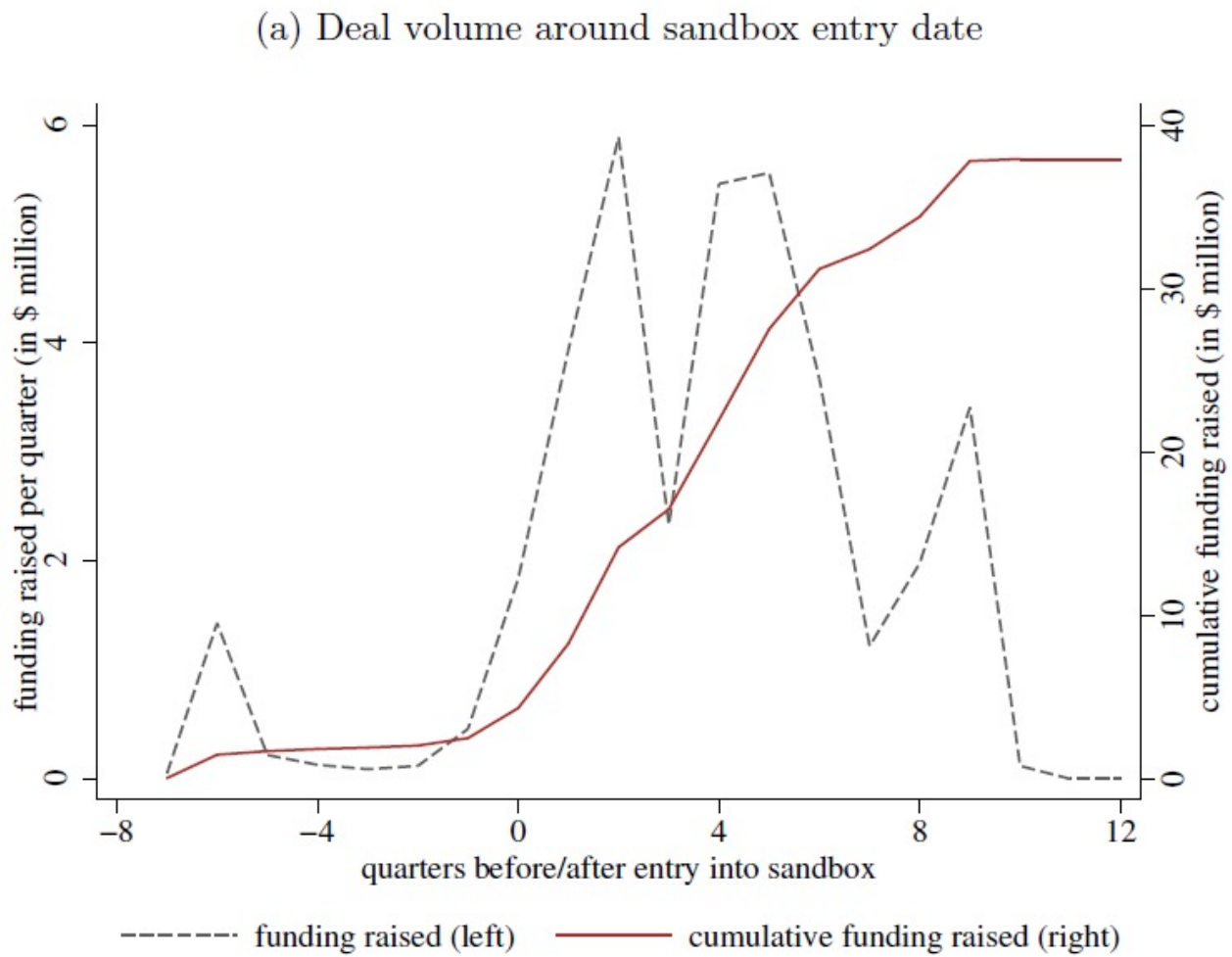
The sandbox process

- Firms are assigned a dedicated case officer
  - Helps to design test setup
  - Provides guidance to fulfil regulatory guidelines
- Firms test their products in a limited market environment, subject to regular reporting requirements
- After around 6 months, firms submit final testing report and exit
  - Over 75% of firms successfully complete test
- Firms apply for a permanent authorisation upon completion
  - “Fast-tracked” process

The data: Pitchbook

- Data on all individual deals by sandbox firms over the period 2014q1 to 2019q2
  - Detailed deal characteristics such as issuer name, deal date, deal amount, and type/purpose of the deal.
  - Each deal contains information on the individual investors and their location.
  - Other data: company age, industry/vertical classification, and location; plus CEO gender and degree
- Aggregate data to firm-quarter level with balanced panel
- Average deal size of $4.7 million and a standard deviation of $27.5 million. Out of all firm-quarter observations, firms raise debt in 6.1% of all cases

Capital raised around the entry date



Empirical strategy – firm level

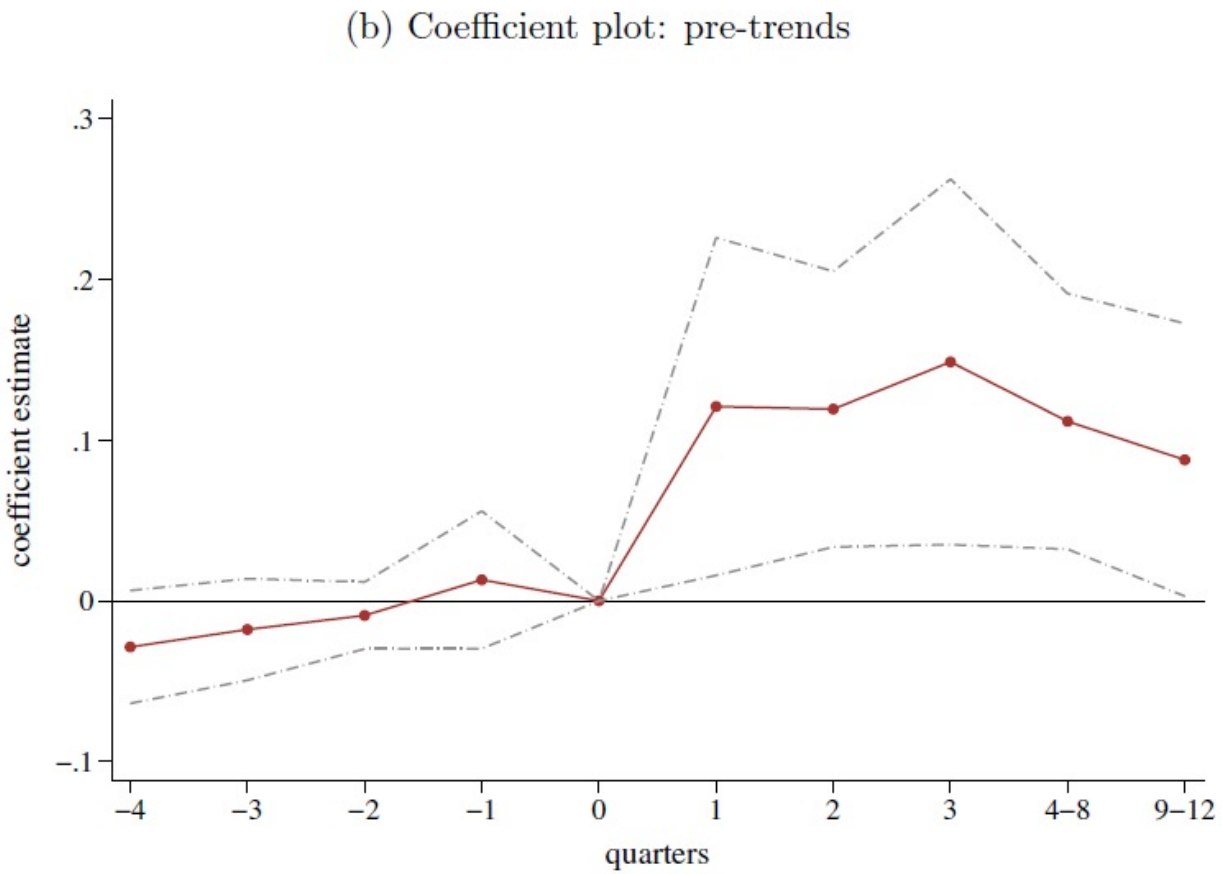
$$y_{f,t} = \beta\ post\ SB\ entry_{f,t} + controls_f \times post\ SB\ entry_{f,t} + \theta_f + \tau_t + \varepsilon_{i,t}.$$

- Outcome: log(1+deal amt) or dummy *capital raised*, which takes a value of one if the firm raises capital in a given quarter.
- Dummy *post SB entry* takes a value of one after sandbox entry, and zero for all quarters prior to entry
- All pre-entry firm controls interacted with post SB dummy
- Firm + (industry*) time fixed effects

Identification #1

- Entry into the sandbox could be correlated with unobservable firm characteristics
  - Exploit the staggered design of the sandbox: firms enter in different cohorts.
  - Identifying assumption: *among* the group of firms that join the sandbox, a firm's observable and unobservable characteristics are not systematically correlated with its entry date.
- We test for this directly:
  - No differential pre-trends
  - Entry date uncorrelated with observable firm characteristics
- (Below: firm*time and investor*time FE)

No pre-trends: coefficient plot



Entry date: balancedness

Table 2: **Firm characteristics and sandbox cohort**

VARIABLES	(1) age	(2) london	(3) revenue	(4) CEO male	(5) Nr CEOs	(6) firm FE
sandbox cohort 2	-3.448	0.097	0.260	0.221	0.052	0.028
	(3.872)	(0.207)	(0.202)	(0.181)	(0.170)	(0.018)
sandbox cohort 3	-4.716	-0.045	0.295	0.364**	0.034	0.015
	(3.817)	(0.243)	(0.225)	(0.152)	(0.153)	(0.019)
sandbox cohort 4	-3.424	0.055	0.079	0.164	0.042	-0.002
	(3.964)	(0.206)	(0.207)	(0.187)	(0.129)	(0.014)
sandbox cohort 5	5.784	-0.420**	-0.080	0.114	-0.091	-0.007
	(8.136)	(0.199)	(0.239)	(0.221)	(0.091)	(0.014)
Observations	56	56	56	56	56	56
R-squared	0.114	0.112	0.074	0.077	0.017	0.125

Note: This table reports results for firm-level regressions with different firm characteristics as outcome variables. As explanatory variable, we include dummies for each cohort, where *sandbox cohort 1* is the reference group. The outcome variables (from left to right) are firm age, a dummy with a value of one if a firm is located in London, a dummy with value one if a firm reports that it is already generating revenue, a dummy with a value of one if the CEO is male, and the number of CEOs. Column (6) uses the firm fixed effects, resulting from a regression of log deal amount on firm fixed effects, as dependent variable. Standard errors are robust. *** p<0.01, ** p<0.05, * p<0.1

Entry into the sandbox helps fintechs raise capital

Table 3: **Entry into the sandbox and capital raised**

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	capital raised	capital raised
post SB entry	0.093*	0.137**	0.148**	0.150**	0.031*	0.031**
	(0.054)	(0.056)	(0.064)	(0.070)	(0.017)	(0.014)
Observations	908	908	908	855	908	616
R-squared	0.016	0.076	0.093	0.157		
Firm FE	-	✓	✓	✓	-	✓
Time FE	-	-	✓	-	-	✓
Industry*Time FE	-	-	-	✓	-	-

Note: This table presents results from firm-quarter level regression Equation (1), based on the sample of firms that entered the sandbox at some point during our sample. The dependent variable is either the logarithm of 1 plus the total deal amount for firm f in quarter t in columns (1)–(4); or the dummy *capital raised* that takes on a value of one if the firm raises a positive amount of capital in a given quarter in columns (5)–(6). *post SB entry* is a dummy with a value of one after sandbox entry, and zero for all quarters prior to entry. All regressions include time-invariant firm characteristics log age, CEO gender, and London dummy, interacted with *post SB entry*, as controls. Standard errors are clustered at the firm level. Columns (5)–(6) report average marginal effects from logistic regressions with robust standard errors. *** p<0.01, ** p<0.05, * p<0.1

Potential mechanisms

1. General signalling effect: entry into the sandbox signals quality, benefitting all firms
2. Reducing asymmetric information
   - Fintechs, especially young and small ones, are subject to informational frictions; especially acute in early-stage VC markets and for foreign/first-time investors
   - Sandbox could alleviate information asymmetries
3. Reducing regulatory uncertainty/costs
   - Fintechs offer products in environment of regulatory uncertainty
   - Passing the test + having a dedicated case officer could reduce regulatory costs/uncertainty

Disentangling the mechanisms

- Small and young firms, VC deals
  - Small and young firms are informationally more opaque; similar argument for early stage VC deals
  - They should benefit more from sandbox entry if asy info declines
- Foreign and first-time investors (later)
  - They have inferior information about UK firms, so should benefit more when asy info is resolved
- Regulatory costs: CEO background
  - Anecdotal evidence that firms with CEO that has finance background benefit less

Evidence on the mechanism

Table 4: **Information asymmetry and CEO background**

VARIABLES	(1) log(deal amt)	(2) log(deal amt)	(3) log(deal amt)	(4) log(deal amt)	(5) log(deal amt)	(6) log(deal amt)	(7) log(deal amt)	(8) log(deal amt)
post SB entry	0.106**	0.109**	0.229**	0.101*			0.193***	0.215***
	(0.043)	(0.046)	(0.092)	(0.054)			(0.072)	(0.075)
post SB entry × old firm	-0.072**	-0.064*						
	(0.031)	(0.034)						
post SB entry × large firm			-1.832***	-0.906***				
			(0.582)	(0.054)				
venture capital					0.178***	0.182**		
					(0.054)	(0.086)		
post SB entry × venture capital					0.191**	0.187**		
					(0.094)	(0.097)		
post SB entry × law degree							-0.103*	-0.121*
							(0.058)	(0.065)
Observations	908	855	995	931	908	855	908	855
R-squared	0.098	0.161	0.239	0.383	0.390	0.450	0.095	0.160
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	-	✓	-	✓	-	✓	-
Industry*Time FE	-	✓	-	✓	-	✓	-	✓

Investor-firm analysis

$$log(1+amt)_{i,f,t} = \delta_1\ post\ SB\ entry_{f,t} + \delta_2\ investor\ type_i + \delta_3\ post\ SB\ entry_{f,t} \times\ investor\ type_i + \theta_{i,f} + \tau^1_{i,t} + \tau^2_{c,t} + \nu_{i,f,t}.$$

- Outcome: log(1+deal amt), split by pro-rata basis
- Dummy *post SB entry* takes a value of one after sandbox entry, and zero for all quarters prior to entry
- Investor type is either foreign or first-time investor
- Include granular fixed effects
  - Investor*firm
  - Investor*time
  - Firm*time

Investor-firm analysis: identification

- Entry date could be correlated with unobservable **time-varying** firm characteristics, even among the group of sandbox firms
  - Entry date could be correlated with eg change in the quality of the offered product or service
  - ➢ Include **firm*time** fixed effects
- Investors could be subject to unobservable shocks that are correlated with sandbox entry
  - Eg a change in tax rate that reduces capital taxes on investments in fintechs could relax investors' constraints
  - ➢ Include **investor*time** fixed effects
- ➢ With FE we compare the same firm raising capital from the same investor at different dates of entry into the sandbox

Sandbox firms raise more capital from foreign and first-time investors

(a): Accounting for investor and firm characteristics

VARIABLES	(1) log(deal amt)	(2) log(deal amt)	(3) log(deal amt)	(4) log(deal amt)	(5) log(deal amt)	(6) log(deal amt)
post SB entry	0.027**	0.044**	0.034**		0.027**	
	(0.011)	(0.020)	(0.020)		(0.013)	
post SB entry × foreign investor			0.013**	0.013***		
			(0.005)	(0.004)		
post SB entry × new investor					0.018***	0.019***
					(0.007)	(0.006)
Observations	41,745	41,717	34,249	34,249	34,249	34,249
R-squared	0.031	0.267	0.267	0.592	0.266	0.593
Investor*Firm FE	✓	✓	✓	✓	✓	✓
Time FE	✓	-	-	-	-	-
Investor*Time FE	-	✓	✓	✓	✓	✓
Firm*Time FE	-	-	-	✓	-	✓

Does the number of (foreign) investors increase?

(b): The share of new and foreign investors

VARIABLES	(1) Nr inv	(2) Nr inv	(3) % UK inv	(4) % US inv	(5) % nonUK inv
post SB entry	0.309**	0.629*	0.003	0.201**	0.163
	(0.121)	(0.327)	(0.084)	(0.078)	(0.136)
Observations	800	769	769	769	769
R-squared	0.005	0.143	0.207	0.129	0.117
Firm FE	-	✓	✓	✓	✓
Industry*Time FE	-	✓	✓	✓	✓

Further specifications

- Narrow the “event window“
  - Do investors gradually learn about firms’ quality as they age, or is it about the sandbox signal?
- Matching
  - Collect information on ca. 1,000 non-sandbox firms
  - Compare effect of sandbox entry by comparing sandbox to non-sandbox firms, based on CEM, NN, and PS matching
- Investor-firm analysis
  - Examine robustness to alternative methods of splitting deal volumes across investors

Alternative specifications

(a): Alternative specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	q1-2	q3+	q5+	-8 to +12	-4 to +8	Neg Bin	Tobit	Cohort FE
VARIABLES	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	deal amt	log(deal amt)
post SB entry	0.161**	0.136*	0.043	0.138**	0.188**	0.113**	0.149*	0.148**
	(0.083)	(0.075)	(0.064)	(0.066)	(0.081)	(0.053)	(0.088)	(0.064)
Observations	643	812	716	762	591	908	908	908
R-squared	0.106	0.110	0.108	0.105	0.127			0.093
Firm FE	✓	✓	✓	✓	. ✓	-	-	✓
Time FE	✓	✓	✓	✓	✓	-	-	✓

CEM matching

(b): Matched control firms – CEM

VARIABLES	(1) log(deal amt)	(2) log(deal amt)	(3) log(deal amt)	(4) log(deal amt)	(5) capital raised	(6) capital raised
post SB entry	0.107**	0.119**	0.124**	0.151**	0.025***	0.033***
	(0.053)	(0.055)	(0.056)	(0.063)	(0.009)	(0.008)
Observations	3,820	3,819	3,819	3,779	3,820	2,007
R-squared	0.026	0.087	0.093	0.133		
Firm FE	-	✓	✓	✓	-	✓
Time FE	-	-	✓	-	-	✓
Industry*Time FE	-	-	-	✓	-	-

NN and PS matching

(c): Nearest neighbor and propensity score matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NN	NN	NN	NN	PS	PS	PS	PS
	nn(1)	nn(3)	nn(1)	nn(3)	nn(1)	nn(3)	nn(1)	nn(3)
VARIABLES	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)	log(deal amt)
post SB entry	0.027***	0.027***	0.030**	0.030**	0.042***	0.064*	0.053***	0.040**
	(0.008)	(0.008)	(0.015)	(0.015)	(0.011)	(0.021)	(0.011)	(0.016)
Observations	3,820	3,820	2,132	2,132	3,820	3,820	2,839	2,839
age	✓	✓	✓	✓	✓	✓	✓	✓
london	✓	✓	✓	✓	✓	✓	✓	✓
CEO gender	✓	✓	✓	✓	✓	✓	✓	✓

Other splits in investor analysis

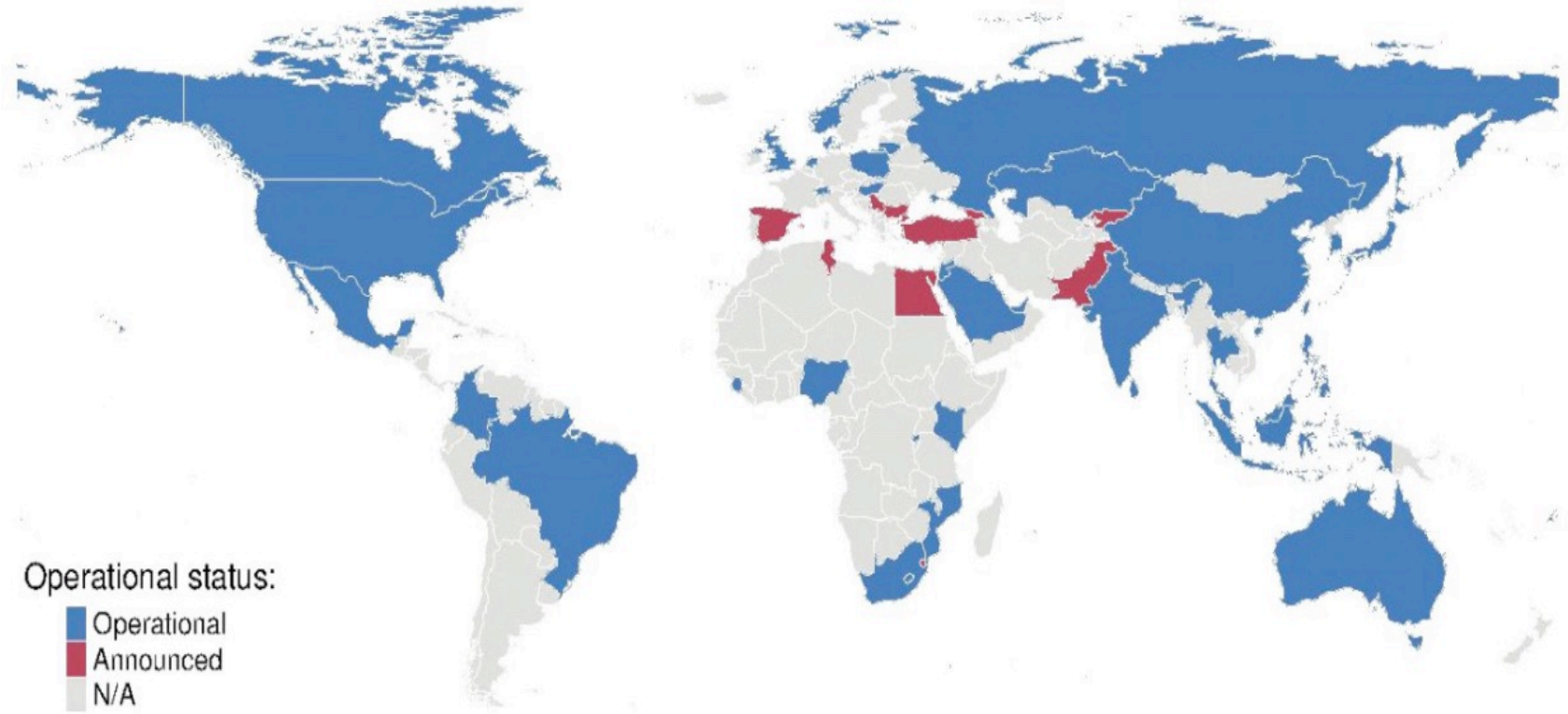
Table 7: **Investor-firm analysis – alternative outcome variables**

VARIABLES	(1) by size log(deal amt)	(2) by size log(deal amt)	(3) by size log(deal amt)	(4) by size log(deal amt)	(5) by size log(deal amt)	(6) by size log(deal amt)	(7) dummy debt raised	(8) dummy debt raised	(9) dummy debt raised	(10) dummy debt raised	(11) dummy debt raised	(12) dummy debt raised
post SB entry	0.040***	0.062**	0.041**		0.040**		0.104*	0.161**	0.155**		0.159**	
	(0.014)	(0.027)	(0.026)		(0.027)		(0.061)	(0.053)	(0.056)		(0.051)	
post SB entry × foreign investor			0.025**	0.027**					0.082**	0.090***		
			(0.010)	(0.011)					(0.034)	(0.027)		
post SB entry × new investor					0.028**	0.028**					0.107***	0.105***
					(0.009)	(0.010)					(0.012)	(0.012)
Observations	41,745	41,717	34,249	34,249	34,249	34,249	41,745	41,717	34,249	34,249	34,249	34,249
R-squared	0.033	0.236	0.236	0.561	0.237	0.562	0.024	0.263	0.263	0.616	0.262	0.616
Investor*Firm FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	-	-	-	-	-	✓	-	-	-	-	-
Investor*Time FE	-	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
Firm*Time FE	-	-	-	✓	-	✓	-	-	-	✓	-	✓

Sandboxes and fintech funding globally

- Over 70 sandboxes in around 60 countries globally
- Differ vastly in scope and design
  - Nurture fintech sector in general
  - Foster innovation
  - Learn about risks
  - …
- Yet, often have the goal to nurture the local fintech sector

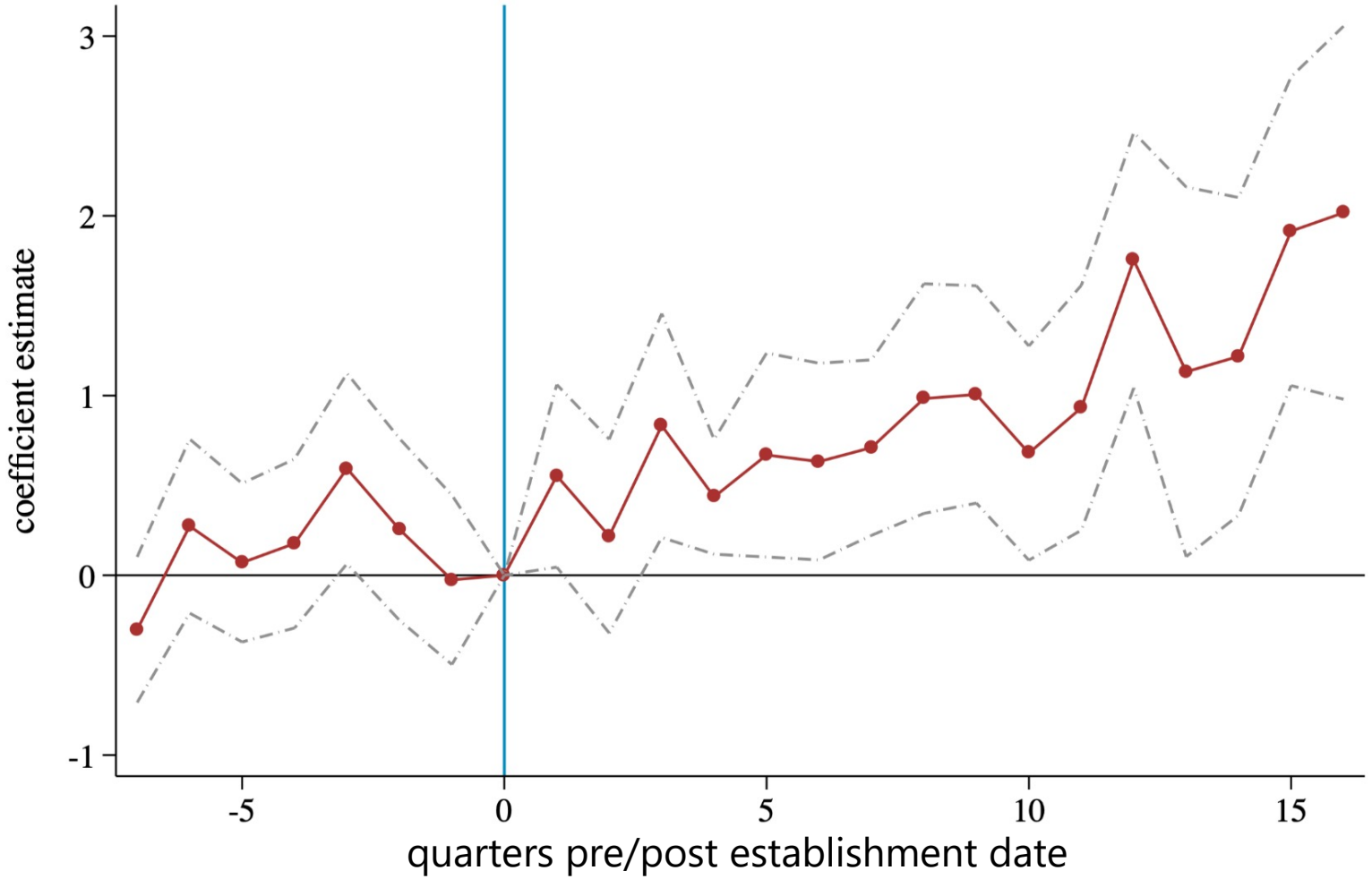
Sandboxes around the world



The use of this map does not constitute, and should not be construed as constituting, an expression of a position by the BIS regarding the legal status of, or sovereignty of any territory or its authorities, to the delimitation of international frontiers and boundaries and/or to the name and designation of any territory, city or area.

Source: World Bank, Global Experiences From Regulatory Sandboxes.

Sandboxes and fintech funding globally



Conclusion

- UK sandbox helps fintechs raise capital
- Results consistent with a reduction in asymmetric information and regulatory costs/uncertainty
  - Effects stronger for young and small firms
  - More capital raised from foreign and first-time investors
  - Effects stronger for firms with no “finance CEO”
- Effects not explained by observable or unobservable firm or investor characteristics

Caveats & outlook

- Important caveat: what are the welfare implications?
  - Too early to judge implications for financial stability and consumer welfare
  - Yet, encouraging evidence: sandboxes can improve fintechs access to capital
- Sandboxes differ greatly in their design – UK sandbox could serve as role model
  - Design of sandbox and selection process of companies could be crucial
  - Exploit differences in sandbox design across countries to learn about best practices?