EFFECTS OF OUTWARD FOREIGN DIRECT INVESTMENT ON FIRMS' INNOVATION

Evidence from Chinese firms

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Outline

- Background
- Literature Review
- Data and Methodology
- Finding and Discussion
- Conclusion

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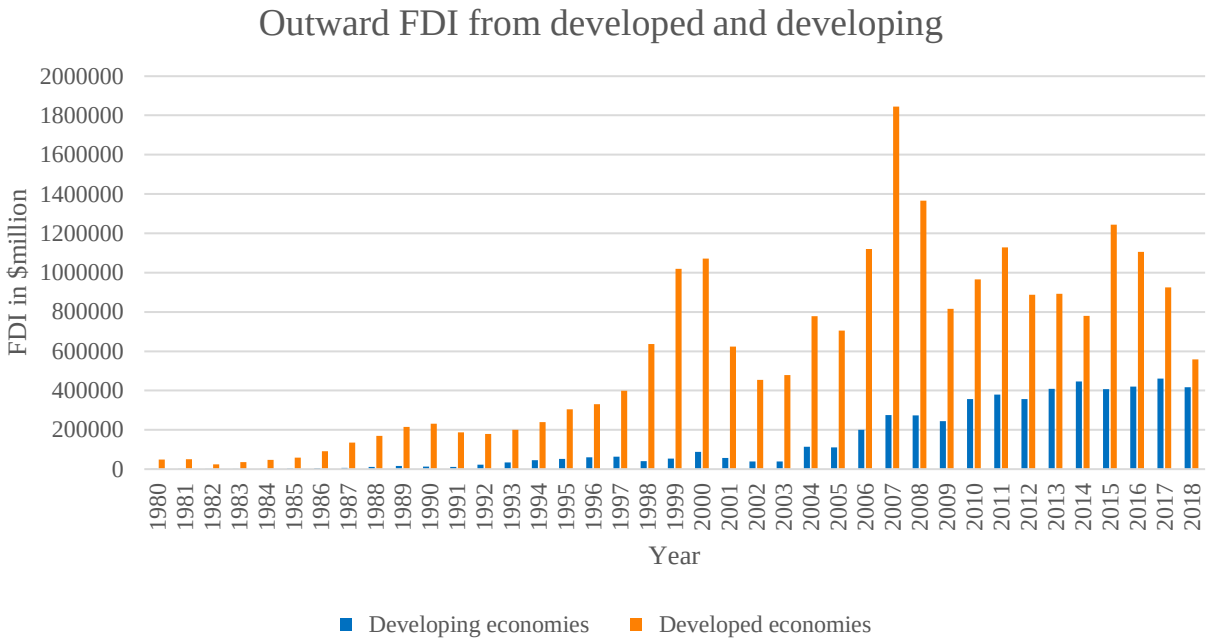
Background

Introduction

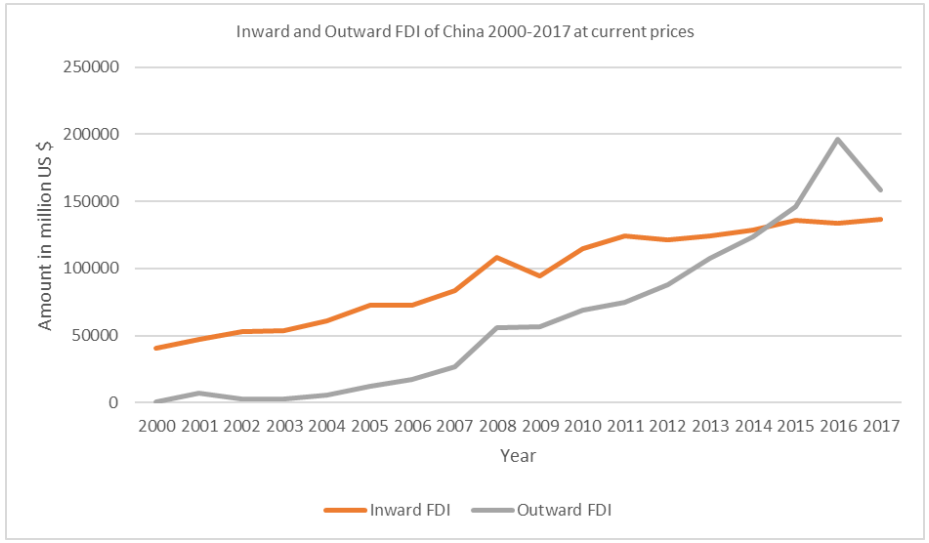
- According to UNCTADSTAT (2019), the share of global outflows from non-developed countries reached almost 24% in 2017 compared to 10% in 2003.
- China is a significant contributor with the massive investment of US$158.29 billion in 2017 up from just US$ 0.83 billion in 1990.

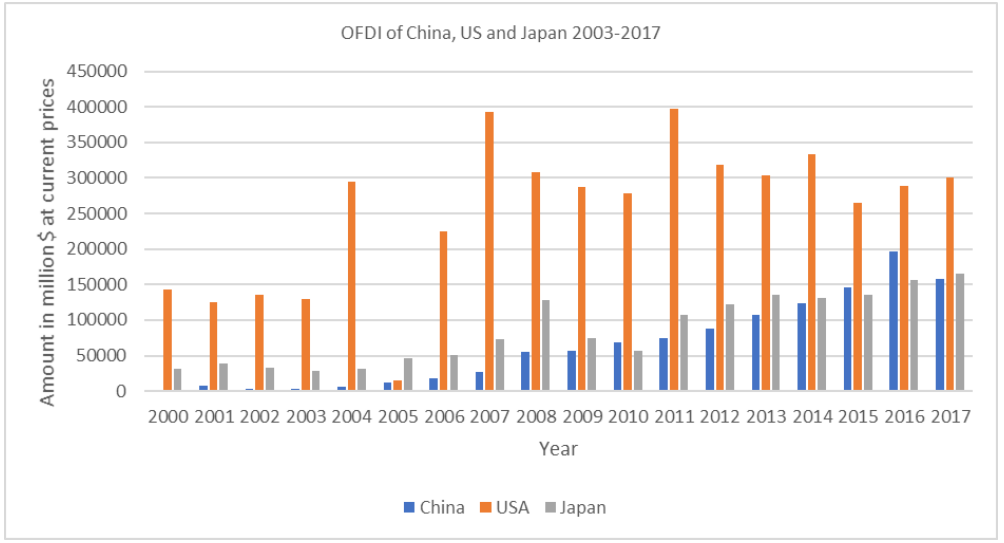


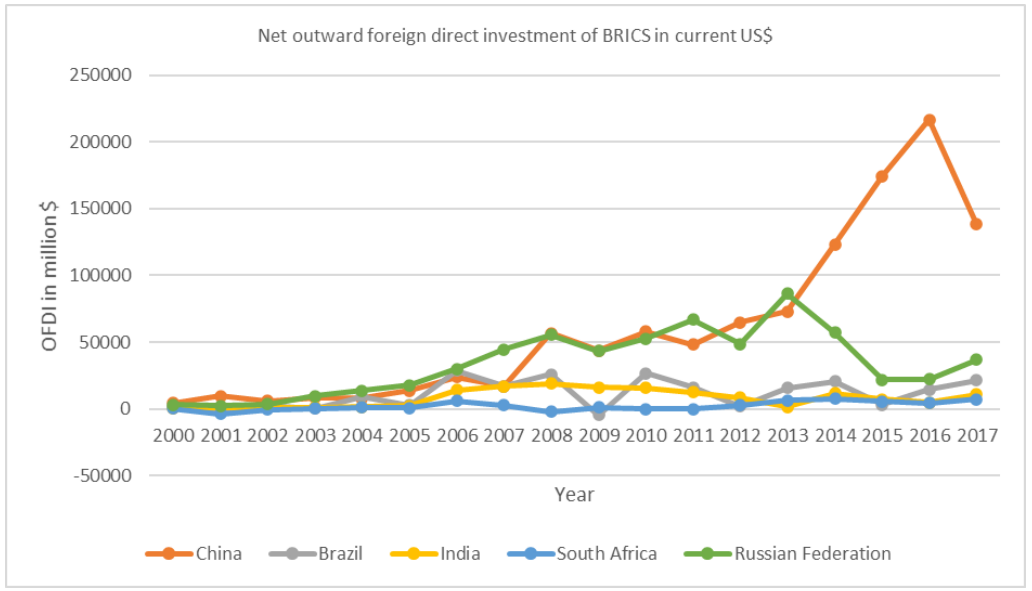
Source: Compiled from UNCTADSTAT (2019)

Background

Chinese OFDI







Source: Compiled from UNCTADSTAT (2019)

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Literature Review

- MNEs from developing countries may be motivated to seek strategic assets to overcome their ownership disadvantages through the investment in developed countries therefore, to quickly catch-up with the technological leaders (Lu, liu, Wang, 2011).

- Positive reverse technology spillover realised through knowledge transfer to subsidiaries, from host countries' firms, which can subsequently transfer the new knowledge to parent firms (Chen et al., 2012; Hong et al., 2019).

- The springboard perspectives argues that international expansion of EMNEs is to overcome their competitive disadvantages, to learn and equip themselves what they lack so that they can compete in the global market (Luo & Tung, 2007).

- Relatively understudied- limited to case studies (Li et al., 2019; Thakur-Wernz et al., 2019; Thakur-Wernz & Samant, 2017; Zhou et al., 2019) or provincial or regional analysis (Shuyan & Fabus, 2019; Wu et al., 2017).

Empirical Estimation

Difference in difference (DID)

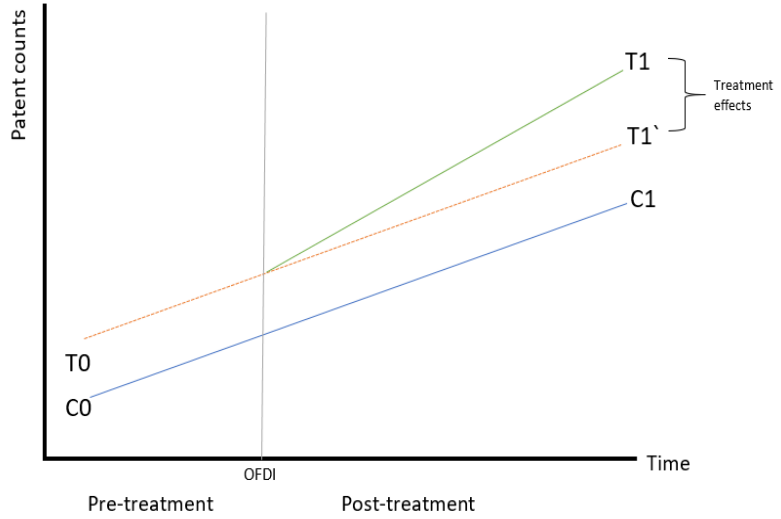
$$DID = (Y_{T1} - Y_{C1}) - (Y_{T1`} - Y_{C1})$$

$$ATT = E(Y_{it}^1 - Y_{it}^0 \,|D_{it} = 1) = E(Y_{it}^1 \,|D_{it} = 1) - E(Y_{it}^0 \,|D_{it} = 1)$$

$$y_{it} = \alpha_i + \alpha_t + \beta . X_{it} + \theta . D_{it} + \varepsilon_{it}$$

D = 1 if firm engages in OFDI (treated firms)

D = 0 if firm never engage in OFDI (Control firms)



Causal effect on DID model

Matching

- The key identification of DID relies on the parallel trend assumption which states that the treatment group would have followed the same time trend as the control group for the outcome variable of interest in the absence of intervention (Fredriksson & Oliveira, 2019).

- Propensity score matching (Rosenbaum & Rubin, 1983)

    - Nearest neighbour matching

- Different treatment time

- **Matching variables**

    - Total assets
    - Solvency ratio
    - Current ratio

- **Outputs**

    - Innovation quantity
    - Innovation quality

Data Description

	Treated		Control	
	Mean	SD	Mean	SD
Number of patents	0.230	2.939	0.031	2.225
Total assets (in mil $)	13800	116000	121	2090
Current ratio	2.169	4.422	2.008	3.950
Solvency ratio	45.163	24.031	44.013	26.548
OFDI (in mil $)	33.497	451.557	0	0
Age	10.965	9.004	12.809	8.824
Number of firms	1,065		76,852	
Number of obs.	15,975		1,152,780	

OFDI data : fdimarkets / Eikon

Patents : PATSTAT2020 (EPO)

Firm level data : Orbis database (BvD)

Time period : 2003 - 2017

Matching Statistics

Variables	All samples		PSM1		PSM5	
	T	C	T	C	T	C
Total assets (logged)	19.754	15.930	19.938	19.785	19.938	19.733
		(-200)		(-1.085)		(-1.887)
Current ratio	2.147	2.008	2.589	2.663	2.589	2.340
		(-3.219)		(0.173)		(-0.901)
Solvency ratio	45.744	43.999	47.826	49.926	47.826	47.886
		(-6.147)		(1.328)		(0.048)
No. of Observations	15,975	1,152,780	7,125	6,900	7,125	29,805

Note: t-statistics in parentheses

Regression Output

Finding and discussion

Treatment effect of Chinese OFDI on their patenting activities

Outcome variable: Total number of granted patents 2003-17						
VARIABLES	All sample	All sample	PSM1	PSM1	PSM5	PSM5
Treatment effect of OFDI	0.365***	0.594***	0.413***	0.297**	0.475**	0.427**
	(0.115)	(0.223)	(0.160)	(0.134)	(0.196)	(0.214)
Total assets		0.037***		0.453**		0.223*
		(0.010)		(0.223)		(0.118)
Current ratio		-0.002**		-0.004		-0.002
		(0.001)		(0.003)		(0.004)
Solvency ratio		0.001		0.004		0.001
		(0.001)		(0.003)		(0.002)
Age		0.005*		-0.045		-0.005
		(0.003)		(0.030)		(0.023)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.002	-0.580***	0.003	-8.156**	0.007	-4.085*
	(0.005)	(0.152)	(0.051)	(4.043)	(0.108)	(2.134)
Observations	1,168,755	676,644	14,025	10,305	36,930	27,538
R-squared	0.001	0.001	0.010	0.021	0.001	0.002
Number of firms	77,917	73,617	935	926	2,462	2,423

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Innovation quality effect

- Citations received by Chinese firms' patents published in USPTO within 3 years of publication

Summary Statistics

	Treated		Control	
Variables	Mean	SD	Mean	SD
Average citations	3.275	76.963	0.101	8.331
Total assets (in mil $)	22,600	153,000	125	2,540
Current ratio	2.106	4.132	2.001	3.937
Solvency ratio	44.523	26.693	43.941	26.545
OFDI (in mil $)	73.809	668.094	0	0
Age	15.112	8.433	13.014	8.77
Number of firms	807		76,678	
Number of obs.	12,105		1,150,170	

Matching Statistics

Variables	All samples		PSM1		PSM5	
	T	C	T	C	T	C
Total assets (logged)	19.815	15.907	19.635	19.618	19.635	19.562
		(-170)		(-0.12)		(-0.688)
Current ratio	2.168	1.999	2.586	2.585	2.586	2.515
		(-3.366)		(-0.003)		(-0.232)
Solvency ratio	45.149	43.934	47.812	48.192	47.812	47.671
		(-3.671)		(0.246)		(-0.117)
No. of Observations	12,105	1,150,170	7,140	6,930	7,140	29,430

Note: t-statistics in parentheses

Regression Output

Treatment effect of Chinese OFDI on average citations

Outcome variable: average number of citations within 3 years window of patent publication						
VARIABLES	All sample	All sample	PSM1	PSM1	PSM5	PSM5
Treatment effect of OFDI	0.119***	0.160***	0.148***	0.111***	0.175***	0.145***
	(0.027)	(0.042)	(0.040)	(0.035)	(0.042)	(0.039)
Total assets		0.005***		0.081**		0.037**
		(0.001)		(0.040)		(0.016)
Current ratio		0.001		0.001		-0.001
		(0.001)		(0.00191)		(0.001)
Solvency ratio		0.001		0.001*		0.001**
		(0.001)		(0.001)		(0.001)
Age		0.001**		-0.007		-0.002
		(0.001)		(0.008)		(0.003)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.002***	-0.077***	0.011	-1.455**	0.004	-0.656**
	(0.001)	(0.017)	(0.014)	(0.697)	(0.006)	(0.278)
Observations	1,162,275	662,236	14,070	10,303	36,570	27,349
R-squared	0.002	0.003	0.013	0.015	0.011	0.011
Number of firms	77,485	71,313	938	923	2,438	2,409

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Robustness check

- Staggered difference in difference

  Sun and Abraham(2020)

  $$CATT_{e,l} = E\left[Y_{i,e+l} - Y^{\infty}_{i,e+l} \,\middle|\, E_i = e\right]$$

- Event study under differential timing

- Weighted average of $CATT$ for event group e and relative time periods l.

Event study

Finding and discussion

Event study on treatment effect of Chinese OFDI on innovation activities

Year	All sample	PSM1	PSM5
Lag 5	-0.130***	-0.197*	-0.079
	(0.043)	(0.112)	(0.114)
Lag 4	-0.092***	-0.149**	-0.158*
	(0.031)	(0.072)	(0.085)
Lag 3	-0.064**	-0.131**	-0.133*
	(0.029)	(0.065)	(0.071)
Lag 2	-0.028	-0.066	-0.067
	(0.024)	(0.048)	(0.049)
Lead 0	0.037	0.106	0.111
	(0.036)	(0.074)	(0.075)
Lead 1	0.251*	0.374	0.401*
	(0.128)	(0.023)	(0.229)
Lead 2	0.281*	0.422	0.448
	(0.159)	(0.274)	(0.275)
Lead 3	0.206***	0.249**	0.287**
	(0.070)	(0.116)	(0.139)
Lead 4	0.172***	0.186**	0.246*
	(0.057)	(0.082)	(0.147)
Lead 5	0.491**	0.757*	0.800*
	(0.237)	(0.433)	(0.461)
No. of Observations	1,168,755	14,025	36,930
R-squared	0.420	0.346	0.478
No. of firms	77,917	935	2,462

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Event study

Finding and discussion

Event study on treatment effect of Chinese OFDI on average citations

Year	All sample	PSM1	PSM5
Lag 5	-0.051***	-0.083*	-0.083*
	(0.001)	(0.049)	(0.047)
Lag 4	0.014**	-0.052	-0.047
	(0.004)	(0.034)	(0.034)
Lag 3	-0.036***	-0.058	-0.051
	(0.003)	(0.039)	(0.037)
Lag 2	0.018***	0.013	0.177
	(0.003)	(0.034)	(0.033)
Lead 0	0.083***	0.125**	0.131**
	(0.004)	(0.053)	(0.053)
Lead 1	0.084***	0.106	0.117*
	(0.003)	(0.065)	(0.066)
Lead 2	0.051***	0.072	0.082*
	(0.002)	(0.046)	(0.046)
Lead 3	0.077***	0.119**	0.124**
	(0.003)	(0.057)	(0.056)
Lead 4	0.100***	0.129*	0.133**
	(0.004)	(0.067)	(0.066)
Lead 5	0.117***	0.128**	0.136***
	(0.005)	(0.051)	(0.050)
No. of Observations	1,162,275	14,070	36,570
R-squared	0.1645	0.2474	0.2657
No. of firms	77,485	938	2,438

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Conclusion

Summary

- Chinese firms OFDIs are highly motivated by the motive of strategic asset seeking- to learn from host countries through reverse technology spillover.
- OFDI enhances innovative capability which can be reflected through the increase in the number of patent applications.
- We can conclude that OFDI enhances the quality of innovation with increase in forward citations received.
- Robustness test done by using event study as proposed by Sun & Abraham (2020) two way fixed effect model obtained the same conclusion.
- OFDI an effective channel of reverse technology spillover.

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Thank you