

Avoid Putting Knowledge at Stake: Selective Sino-Foreign R&D Linkages of MNEs

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Industry Policies and MNEs' Global R&D

- **Industry policy => innovation policy => industry policy, again**

TABLE 2 Intangible asset rents in manufacturing GVCs by stage

GVC stage ^a	2000	2007	2013	2019
Upstream stage	40.9	46.4	46.9	45.2
Production stage	29.5	27.6	26.1	27.5
Downstream stage	29.6	26.0	27.0	27.3
Total intangible asset rents ^b	100.0	100.0	100.0	100.0

Buckley, P. J., Strange, R., Timmer, M. P., & Vries, G. J. (2022). Rent appropriation in global value chains: The past, present, and future of intangible assets. *Global Strategy Journal*, 12(4), 679-696.

- **Nations develop national innovation systems/strategies/policies in order to**
 1. Cultivate technological innovations; and
 2. Keep the innovations, and the economic rent from the innovations within their territories
- **MNEs, with their globalized R&D, help governments with goal 1, but erode goal 2.**
 - Governments loves knowledge inflow, but hates knowledge outflow.
 - Back in 1990s scholars already argued to distinguish the technological competitiveness of nations from the technological competitiveness of their MNEs (Ham, Linden, & Appleyard, 1998; McCulloch, 1990).

MNEs' In-House Cross-Border R&D Linkages

- **MNEs engage in global R&D activities in order to**
 - Tap into local talent pool and knowledge networks (Castellani, Jimenez & Zanfei, 2013)
 - Innovate close to market and manufacturing facilities (De Simone et al., 2020)
- **In particular, MNEs use in-house cross-border R&D linkages for**
 - More effective cross-border knowledge transfer and integration (Meyer et al., 2011; Mao et al., 2023; Singh, 2008)
 - Better protection of proprietary knowledge, especially in weak IP regime (Zhao, 2006) and highly competitive clusters (Alcácer & Zhao, 2012; Polidoro et al., 2022).
 - *In-house co-R&D linkage => More intra-firm interdependency & control*
- **Expensive to manage, this global innovation strategy enables MNEs to source valuable knowledge from places where both world-class knowledge (Giarratana & Mariani, 2014) and world-class competitors (Wang & Zhao, 2018) are concentrated.**
- ***Research Question: As China increasingly become such a place, do MNEs use more in-house cross-border R&D linkages there?***

- **Data and sample**

- Orbis IP & USPTO patent database, Foreign Relations dataset (developed by the Institute of International Relations at Tsinghua University); 2008-2022
- Co-invented patents with at least one inventor from China and another inventor from main countries listed in Foreign Relations dataset in all patent offices
- 29,572 firm-tech field-year-level obs

- **Measures** (f=firm, t=tech field, y=year, c=home country)

- Dependent variable
 - ***Co-invention linkage*** = *n of co – invented patents*_{f,t,y}
- Independent variable
 - ***CN Relative Revealed technology advantage (RTA)*** (Patel & Pavitt, 1997)

$$= \frac{CN RTA_{t,y}}{\text{firm } RTA_{f,t,y}}, \text{ where } y \text{ means up to year } y$$

Partner country	Number of co-patents
US	184,878
DE	26,101
JP	25,332
KR	18,394
IN	18,015
GB	15,026
FR	10,534
AU	5,128

DV = Co-invention linkage _{f,c,t,y}	Only controls	All tech areas	Strategically important tech areas	All tech areas	All tech areas
CN relative RTA _{f,t,y}		-0.26*** (0.03)	-0.30*** (0.04)		
CNstrong/MNEweak (H1)				-0.38*** (0.07)	
CNweak/MNEstrong (H1)					0.43*** (0.04)
Controls	YES	YES	YES	YES	YES
Observations	29,572	29,572	25,684	34,617	34,617
Firm FE	YES	YES	YES	YES	YES
Tech Field FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
R_squared	0.475	0.481	0.510	0.459	0.461

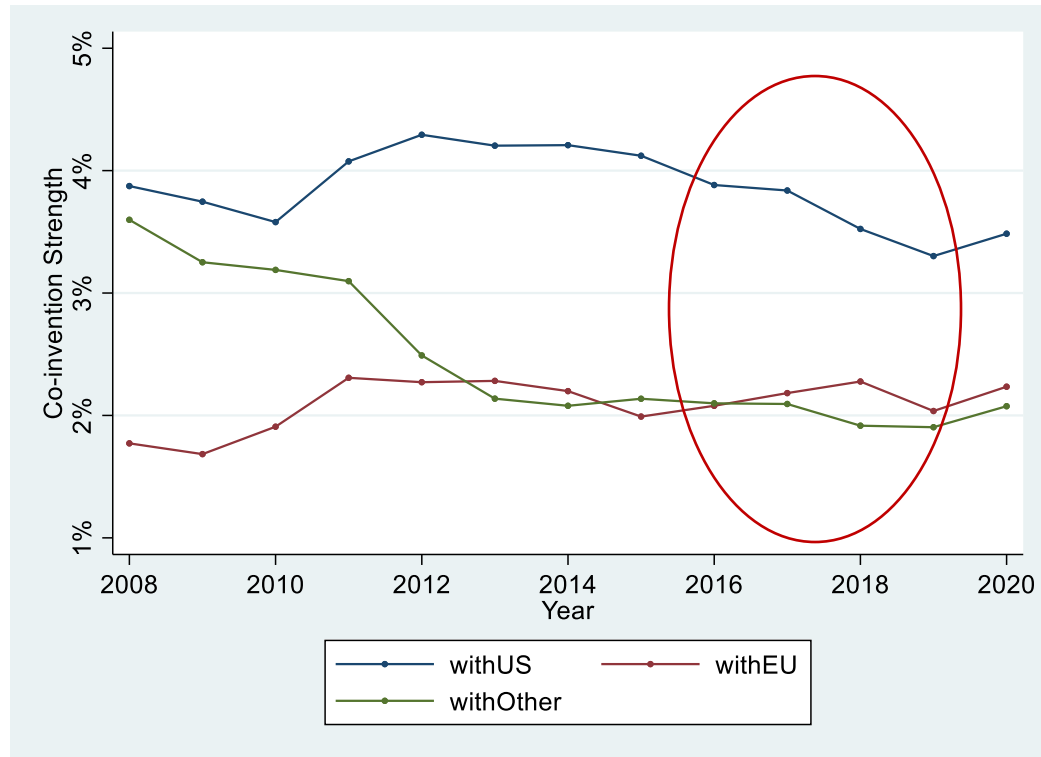
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

- **Relative technological competence of host location**
 - The knowledge appropriation capability is determined by the relative technological competence with the innovating entity (Wang & Zhao, 2018).
 - When host location is relatively weak in terms of technology
 - Not many learning opportunities, mainly exploitative innovation (e.g. local adaptation)
 - MNEs do not worry about knowledge misappropriation due to 1) limited local absorptive capacity, and 2) low level of local competition
 - When the technological competence in host location is growing higher
 - More learning opportunities and exploratory innovation (Zhou et al., 2024)
 - More knowledge misappropriation concerns (Giarratana & Mariani, 2014; Wang & Zhao, 2018).
- **Reasons specific to China**
 - **Rivalry: business & politics, amplifying the knowledge misappropriation concerns**

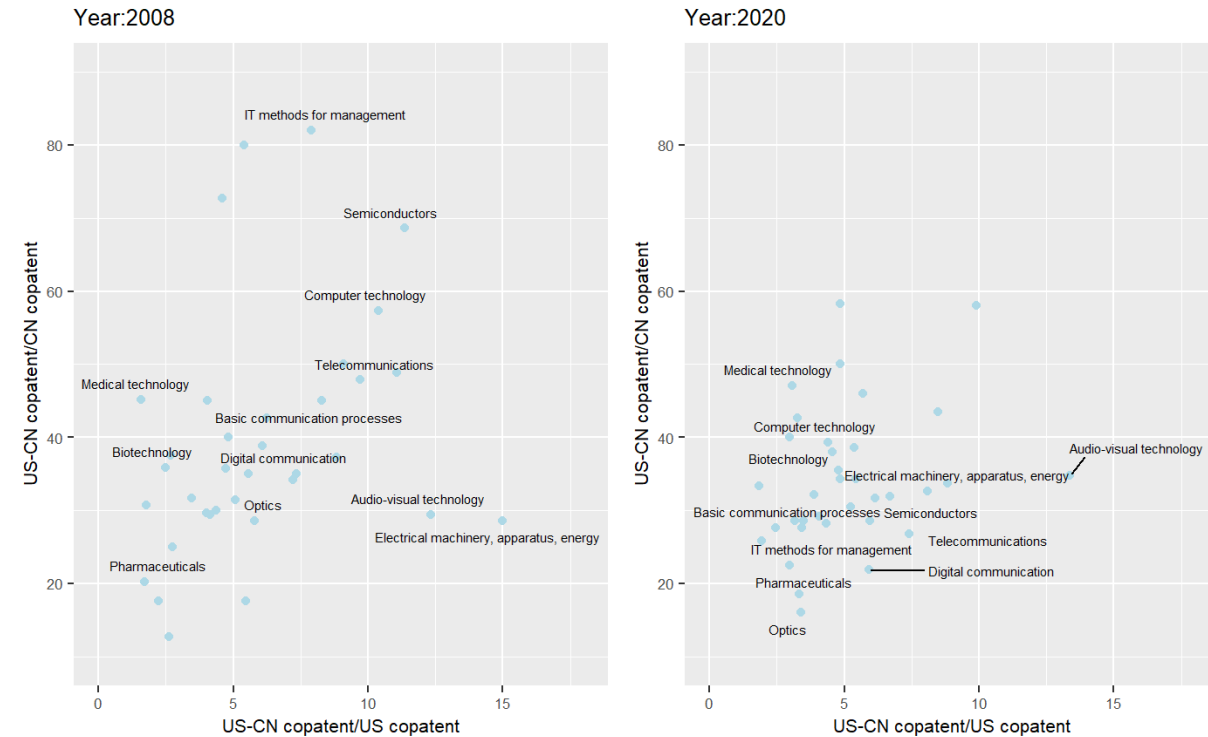
Evidence: The Diverging Trend

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Sino-foreign co-invention strength



% of Sino-US co-invented patents in 35 tech sectors



Note:
$$\frac{n \text{ of co-invented patents}}{\sqrt{n \text{ of CN patents} \times n \text{ of partners' patents}}}$$

Data source: USPTO, accessed 23 December, 2023

- **The moderating effects of business rivalry on technology**
 - *Vary across technology fields*
 1. Technology nature: technology boundaries in some fields are less clearly defined than those in other fields.
 2. Competitors' relative capabilities and intentions
 - Intensified business rivalry in a technology field could be manifested by **high litigation rate**.
 - IP protection regime has been improving in China
 - Chinese firms' absorptive capability and global competitiveness also increases
 - Both Chinese firms and MNEs have increasing capabilities and intentions to engage in IP litigation.
 - In technology fields with high litigation risk, MNEs would rather give up potential learning opportunities, in return of protection of their own knowledge reducing the deployment of internal R&D linkages.

- **The moderating effects of political tension**
 - *Vary across MNEs' country of origin*
 - Knowledge concerns related to national security
 - The logic of new techno-nationalism directly links competitiveness to a country's national security (Luo, 2022), implying the role of knowledge as strategic assets for national security.
 - Country-level concerns & MNEs' decisions
 - The technological catching-up of China denotes their increasing knowledge appropriation capability, which further raises national security concerns for the rest of the world.
 - Embedded in global value chains, MNEs' global R&D decisions are sensitive and vulnerable to knowledge concerns related to country-level geopolitical concerns (Cui et al., 2023).

- Moderators
 - ***Political tension***
= relationship score_{t-1} – relationship score_t if relationship score_{t-1} – relationship score_t ≥ 1 (or 0.5, 1.5 for robustness); = 0 otherwise
 - ***IP litigation risk***
= n of IP infringement litigation cases involving foreign firms' patents in a certain tech field in China
- Controls
 - *Firm age_{f,y}*(logged), *Patent stock_{f,y}*(logged),
 - *Number of cross – border co – patents_{f,y,t}*
 - *Bilateral Trade flow_{c,y}*(logged)
 - *Number of CN co – patents_{t,y}* (logged)
 - *Firm–, tech field–, year – fixed effects*
- Analysis
 - Negative binomial model with high-dimensional fixed effects (Stata command “ppmlhdfe”)

Result

Only Controls

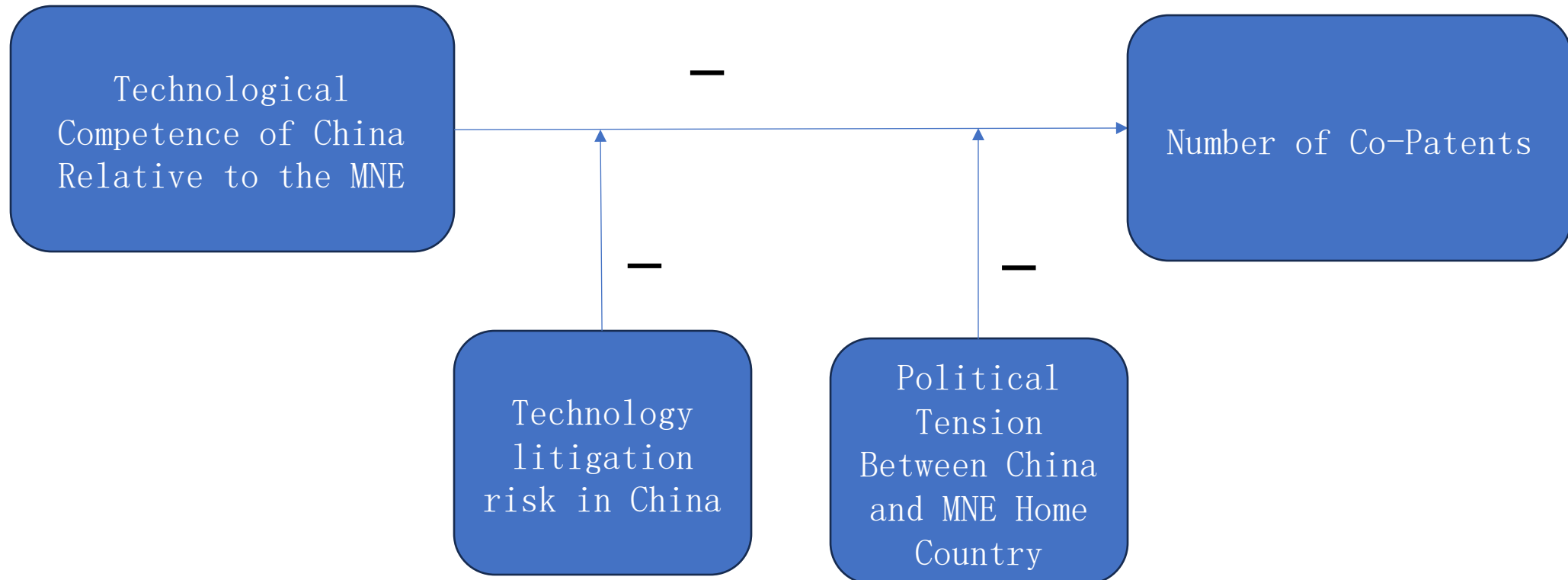
Full Model

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DV = Co-invention linkage _{f,c,t,y}	Model 1	Model 2	Model 3	Model 4	Model 5
CN relative RTA _{f,t,y}		-0.26*** (0.03)	-0.26*** (0.03)	-0.26*** (0.03)	-0.26*** (0.03)
IP litigation risk _{t,y}			-0.00 (0.01)		-0.00 (0.01)
CN relative RTA _{f,t,y} ×IP infringement risk _{t,y}			-0.03* (0.02)		-0.03+ (0.02)
Political tension _{c,y}				-0.02 (0.01)	-0.02 (0.01)
CN relative RTA _{f,t,y} ×Political tension _{c,y}				-0.04* (0.02)	-0.04* (0.02)
Controls	YES	YES	YES	YES	YES
Observations	29,572	29,572	29,572	29,572	29,572
Firm FE	YES	YES	YES	YES	YES
Tech Field FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
R_squared	0.475	0.481	0.481	0.482	0.482

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

- For MNEs from some **country** and in some **technology fields**, the motive of knowledge sourcing is transcended by the concerns of **rivalry, both business rivalry and political rivalry**.
- MNEs still prefer sourcing China knowledge in technology areas where MNEs have superiority.
- MNEs don't benefit much from the advancement of technologies in China.



	Model S1	Model S2	Model S3	Model S4	Model S5
	Patent Scope	Diversity		Originality	
		HHI	Entropy	HHI	Entropy
CN relative RTA _{f,t,y}	0.02*** (0.00)	0.03*** (0.01)	0.04*** (0.01)	0.01* (0.01)	0.02* (0.01)
Controls	YES	YES	YES	YES	YES
Observations	18,982	18,568	18,568	10,848	10,848
Firm FE	YES	YES	YES	YES	YES
Tech Field FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
R_squared	0.0522	0.0512	0.0708	0.0376	0.0750

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

- MNEs that manage to source knowledge from China's advantageous technological areas, though rarely, create **high quality innovations**.

Thank you!



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- The RTA index denotes:
 - Comparatively advantaged technological competence (Le Bas & Sierra, 2002; Patel & Pavitt, 1997)
 - Patterns of technological specialization (Cantwell & Janne, 1999)
 - Relative strategic importance (core VS non-core) (Du, 2021)
- RTA can be calculated either for countries or for firms (Le Bas & Sierra, 2002)

$$RTA_{ij} = \frac{\left(P_{ij} / \sum_i P_{ij} \right)}{\sum_j P_{ij} / \sum_{ij} P_{ij}}$$

where P_{ij} denotes the number of patents in technological field j to firm (or country) i

- In our current study
 - For comparability: use patent data from a single patenting authority (i.e., USPTO)
 - Time variance: calculate the accumulative number of patents up to the focal year
 - The country-level RTA in a certain technological field was scaled by the firm-level measure
 - Technological competence of a field at the country level
 - Relative to the technological competence of the focal firm in the same field

Result Descriptive Statistics and Correlation Coefficients

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	M	Sd	Min	Max	1	2	3	4	5	6	7	8
Co-invention linkage _{f,c,t,y}	2.91	7.37	0.00	68.00								
CN relative RTA _{f,t,y}	1.39	3.25	0.00	29.40	-0.06*							
IP litigation risk _{t,y}	0.40	0.94	0.00	5.00	0.03*	0.04*						
Political tension _{c,y}	0.66	1.10	0.00	5.10	-0.01	0.02*	0.06*					
Firm age _{f,y}	3.56	1.10	0.00	5.86	-0.00	-0.04*	-0.04*	-0.07*				
Patent stock _{f,y}	8.79	2.45	0.69	12.54	0.12*	0.07*	-0.10*	-0.06*	0.42*			
N of cross-border co-patents _{f,t,y}	16.73	41.49	0.00	328.00	0.71*	-0.10*	0.05*	-0.02*	0.05*	0.21*		
Bilateral trade flow _{c,y}	19.83	0.55	17.96	20.38	0.03*	0.07*	0.02*	0.29*	-0.24*	-0.18*	-0.06*	
N of CN cross-border co-patents _{t,y}	58.03	104.24	0.00	570.00	0.19*	0.17*	0.25*	0.08*	-0.13*	-0.07*	0.24*	0.07*

Note: N=29,572, * Indicates a correlation significant at the $p \leq 0.05$ level of confidence.

- Conclusion
 - MNEs' cross-border co-invention linkages in China is negatively related to China's relative revealed technological advantage.
 - The negative relationship is strengthened by IP litigation risk and bilateral political tension.
- Contribution
 - Global R&D
 - Business rivalry concerns behind cross-border co-invention linkages in China
 - New deglobalization logic – political rivalry
 - Effects on firms (or MNEs)' R&D activities
- Limitations and future directions
 - China as the focal point => a more comprehensive picture
 - Other aspects of R&D or IP-related activities (e.g., international patenting, global litigation)