Firm Concentration and Innovation: An Empirical Study in China

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INTRODUCTION

China, one of the fastest-growing and largest economies in the world, has recently experienced a rapid increase in patent boom. The spread of knowledge is commonly known as the knowledge spillover. There are two types of knowledge spillover: Marshall-Arrow-Romer (MAR) spillover and Jacobs spillover. The MAR theory of spillover argues that firms in the same industry will experience higher knowledge spillover if they are located closely to each other. The Jacobs spillover theory, on the other hand, argues that firms in different industries will experience higher amount of knowledge spillover if they are located close to each other. While MAR focuses on common industry knowledge spillover, Jacobs focuses on diversity driven knowledge spillover.

There are numerous studies that research knowledge spillover in developed countries, the number of studies of knowledge spillover in China is limited due to data constrains. The current studies that investigate knowledge spillover in China are at higher levels of aggregated data such as industry-level and provincial-level. To our knowledge, no studies have investigated knowledge spillover in China at the firm level. Studying knowledge spillover at the firm level allows us to understand if there is MAR spillover in China. Moreover, understanding the spillover of knowledge geographically can help policymakers implement the type of policies that promote high and even distribution of economic growth, especially in under-developed and poorer regions.

OBJECTIVE

The purpose of this research is to investigate the knowledge spillover at the firm level. Specficially, how neighboring patent applications affect firm level innovation as distance increases.

MODEL

We construct a reduced form model to test our main hypothesis:

$$P_i = a_{i,d} + b_{i,r}Pat_{i,r} + c_{i,r}C_{i\,r} + d_iX_i + R + FE$$

r: {1, 2, 5, 10, 25, 50} (in kilometers or km)

- P_i: number of successful patent applications submitted by firm i
- $Pat_{i,r}$: number of total successful patent applications within radius r around firm i
- $C_{i\,r}$: control for the count of firms within radius r around firm i
- X_i: firm-level control variables: profit, capital expenditure, number of workers, R&D expenditure, and state-ownership of the company
- R: regional control at the province level: 22 provinces, 5 autonomous regions, and 4 major municipalities
- FE: industry fixed effects and science park fixed effects

METHODS

We follow a similar method outlined by Wallsten (2001). First, we use GIS software to plot the parent firm's location using registered address provided in the dataset – see Figure 1 on the right. Once we pinpoint the location of each firm, we can calculate the number of firms and number of total successful patents within a certain radius range; this variable will serve as our variable of interest. Next, we use OLS to identify the effect of total number of successful patent applications with in the radius *r* around firm *i* on firm *i*'s innovation measured by successful patent applications.

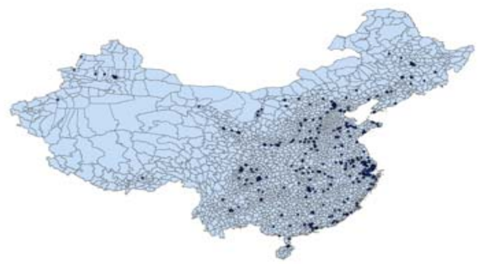

Figure 1: Location of Firms

DATA

We collect and aggregate our data from several sources which result in a cross-sectional data for year 2010 that contains 590 companies on either the Shanghai Stock Exchange or the ShenZhen Stock Exchange. All patent related data were retrieved from the China's State Intellectual Property Office. All firm level controls were retrieved from a Chinese financial database - WIND. All provincial level data were retrieved from the National Bureau of Statistics of China. The patent data were already matched to the respected firms thanks to He et al. (2017).

DESCRIPTIVE STATISTICS

Variable Name	n	Mean	Std. Dev.	Min	Max
Firm *i* patent applications	590	77.22712	283.7619	0	3851
Patent applications (r=1)	590	123.9678	444.5429	0	3851
Patent applications (r=2)	590	173.0441	555.8447	0	4168
Patent applications (r=5)	590	374.9678	971.3475	0	6268
Patent applications (r=10)	590	857.0424	1971.09	0	11005
Patent applications (r=25)	590	1824.237	3577.895	0	13332
Patent applications (r=50)	590	2087.651	3860.979	0	13352
Profit	590	6.05e+08	3.46e+09	-2.74e+09	7.68e+10
Capital Exp	589	7.99e+08	4.93e+09	66932.61	1.14e+11
R&D	590	1.16e+08	5.64e+08	12075	8.82e+09
Workers	590	7591.705	21528.25	21	373375
State-ownership	590	.1060378	.1937945	0	.8619848

PRELIMINARY RESULTS

Table on the right shows the regression results from our OLS estimation. We present the results for radius: 1, 2, 5, 10, 25, and 50 km. For every one unit increase in successful patent application within one kilometer of radius of firm *i*, the number of successful applications by firm *i* increase by 0.39 units. This effect decreases to 0.23 when r = 2km and to 0.078 when r = 5 km. This observation is economically intuitive because the cost of knowledge transfer increases as distance increases.

RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**r=1**	**r=2**	**r=5**	**r=10**	**r=25**	**r=50**
Patent applications (r=1)	0.388***					
	(0.130)					
Patent applications (r=2)		0.232***				
		(0.0204)				
Patent applications (r=5)			0.0778***			
			(0.0143)			
Patent applications (r=10)				0.0284**		
				(0.0110)		
Patent applications (r=25)					0.0260*	
					(0.0136)	
Patent applications (r=50)						0.0268*
						(0.0147)
Profit	2.85e-08*	3.43e-08***	4.41e-08***	5.11e-08***	5.00e-08***	4.95e-08***
	(1.50e-08)	(7.33e-09)	(7.91e-09)	(7.96e-09)	(7.98e-09)	(8.00e-09)
Capital Exp	-3.04e-08***	-3.71e-08***	-4.76e-08***	-5.18e-08***	-5.06e-08***	-5.05e-08***
	(8.24e-09)	(6.20e-09)	(6.63e-09)	(6.70e-09)	(6.72e-09)	(6.74e-09)
R&D	1.35e-07	1.62e-07***	1.76e-07***	1.90e-07***	1.89e-07***	1.88e-07***
	(1.19e-07)	(2.13e-08)	(2.29e-08)	(2.33e-08)	(2.34e-08)	(2.34e-08)
Worker	0.00457*	0.00592***	0.00685***	0.00719***	0.00713***	0.00729***
	(0.00238)	(0.000933)	(0.00100)	(0.00102)	(0.00103)	(0.00102)
State-ownership	-30.48	-2.930	7.040	29.19	25.72	20.78
	(46.49)	(44.27)	(47.93)	(48.98)	(49.24)	(49.17)
Observations	589	589	589	589	589	589
R-squared	0.708	0.642	0.581	0.563	0.560	0.559
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Science Park FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

CONCLUSIONS AND FUTURE PLANS

The patent variable is positive and significant across all specifications. However, the magnitude of impact decreases as the range of radius increases. As expected, a firm experiences and benefits the most from knowledge spillover if there are other innovative firms that locate close in distance. The benefit of this knowledge spillover decreases as the distance increases because the cost of spreading knowledge increases with distance.

The next step for this study is to run our regressions with the panel dataset we have at the firm level. The panel data is unbalanced that consists of approximately 1600 firm-year observations that range from years 2006 – 2010.

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