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Intangible Capital, Innovation, and Growth in China

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# Intangible Capital, Innovation, and Growth in China

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## Introduction

- China's economic growth cannot be sustained by the reallocation of labor or investments in physical capital
  - Increasing wages indicate scarcity of "cheap labor" (Fleisher et al., 2011)
  - Falling returns to physical capital (Bai, Hsieh, and Qian, 2006)
- Future growth prospects will hinge on the accumulation of intangible knowledge capital (IKC) and human capital (Corrado, Hulten, and Sichel, 2005)

Table 1|Intangible Investment as Share of Market Output

	Germany	France	Japan*	UK	US	China
Share of Intangible Investment in Market Output (2000-2006)	6.73%	7.42%	10.19%	9.67%	10.35%	7.06%
Share of Intangibles in Labor Productivity Growth (2000-2006)	24%	29%	16%	26%	30%	17%

Source: Hulten and Hao (2012)

\*Data for Japan cover 2000-2005

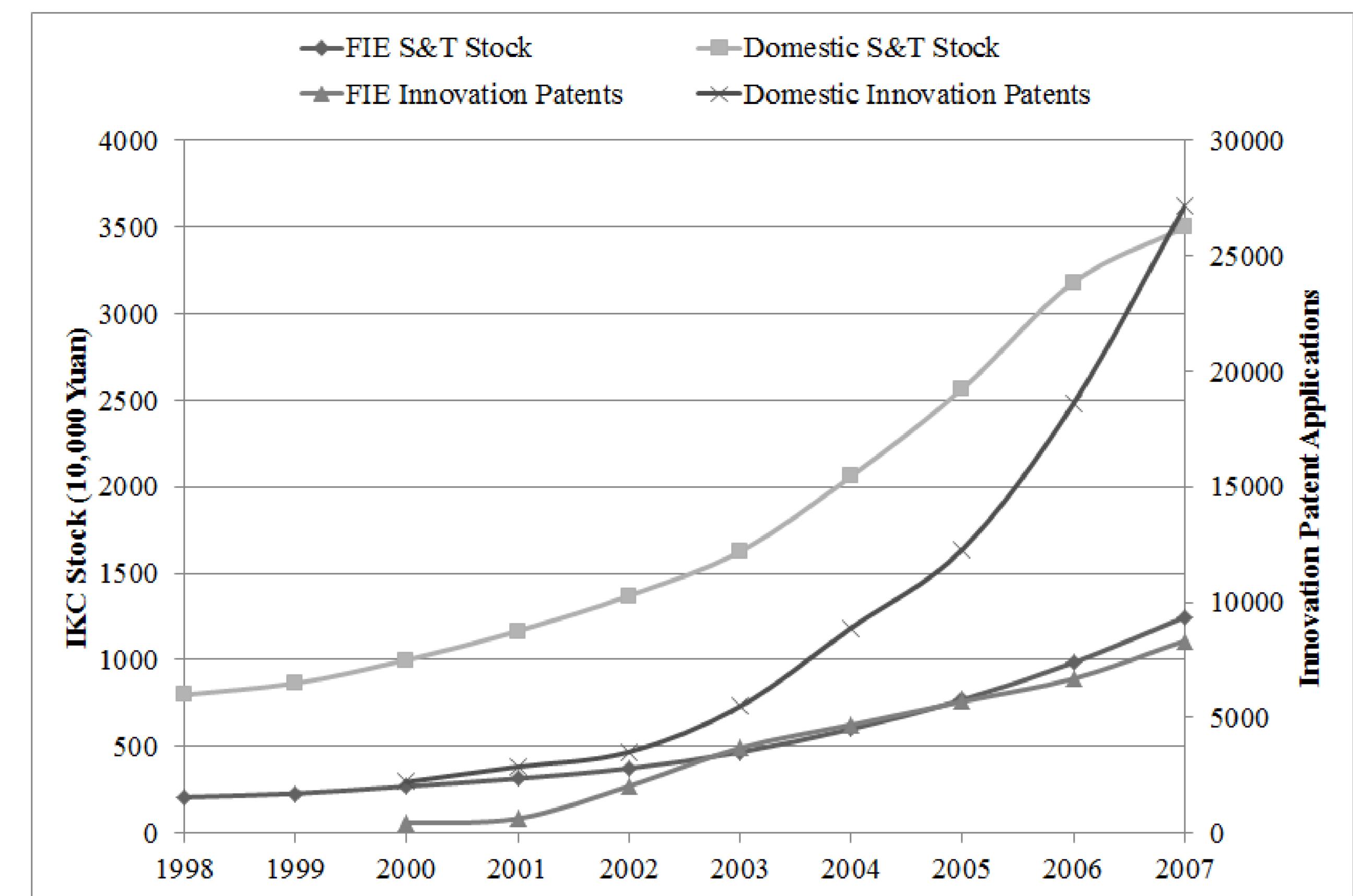
- Investments in IKC have been rising, but China still lags behind the developed world
- Previous studies have shown positive marginal effects of IKC investment on firm productivity (Hu, Jefferson, and Qian, 2005) as well as the propensity to patent (Hu and Jefferson, 2005).
- Existing evidence pre-dates China's accession to the WTO, which may have had important effects on the productivity of IKC.
- Our study reexamines the relationship between IKC investments and economic performance in China's post-WTO era.

## Objectives

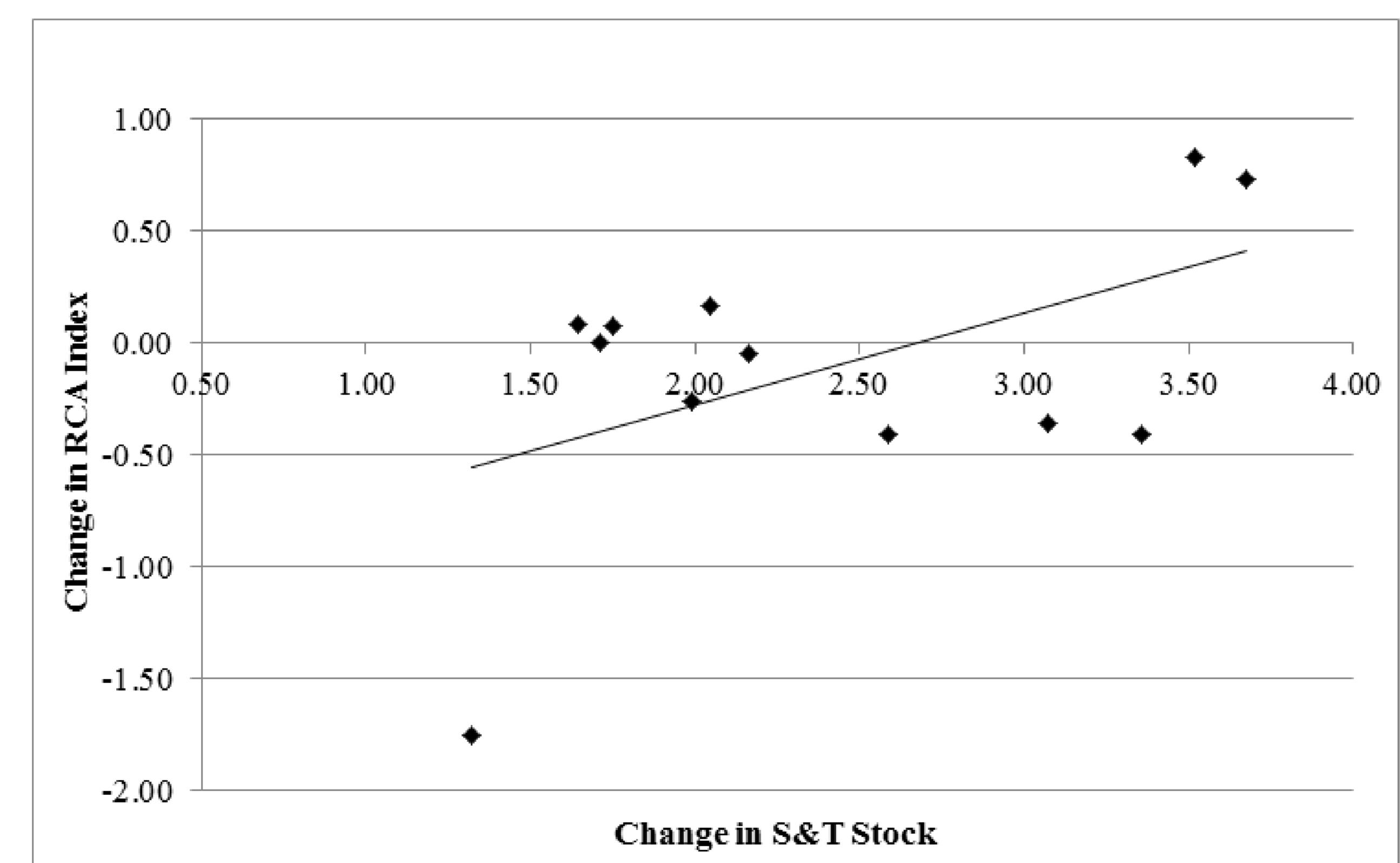
- Estimate the relationship between investments in IKC and three indicators of economic performance:
  - Industry-level Total Factor Productivity (TFP)
  - Frequency of domestic innovation patent applications
  - The Revealed Comparative Advantage (RCA) index
- Explore potential differences in the productivity of IKC from different sources (i.e. domestic vs. foreign-invested enterprise)

## Data

- Data are industry aggregates collected from statistical yearbooks published by China's National Bureau of Statistics (NBS).
- Data cover the period 1998 - 2007, covering the period of China's WTO accession
- The stock of IKC is calculated as the depreciated sum of investments in Science and Technology, defined by the NBS as "...activities closely related with the creation, development, dissemination and application of scientific and technical knowledge."
- Closely related to the "innovative properties" component of IKC accounting
- Stock of IKC investment is depreciated at 15% per year (Hall, 2007)



- Apparent relationship between stock of IKC and propensity to innovate, which has previously been linked to growth.



- Relationship between IKC and RCA appears positive, though possibly driven by outliers

## Methods

- Estimate the relationship between IKC stock and TFP
  - Begin with two-way fixed effects specification
  - Check robustness with Levinson-Petrucci estimator to account for endogeneity
- Estimate the relationship between IKC stock and the propensity of file innovation patents
  - Focused on domestic innovation patents, as foreign patents may not represent true innovations
  - Estimate using a negative binomial model with fixed industry effects

- Estimate the relationship between IKC stock and the RCA index
  - Employ two-way fixed effects to control for unobserved heterogeneity

## Results

### TFP Model Results

Table 2  
Production Function Estimates: Two-Way Fixed Effects

Two-Way Fixed Effects	Production Function Estimates: Two-Way Fixed Effects			
	(1) TWFE Log VA	(2) TWFE Log VA	(3) LP Log VA	(4) LP Log VA
Log Labor	0.45*** (0.00)	0.45*** (0.00)	0.47*** (0.00)	0.49*** (0.00)
Log K	0.57*** (0.00)	0.57*** (0.00)	0.38 (0.15)	0.09 (0.74)
Log Domestic S&T Stock (t-1)	-0.12 (0.23)	-0.12 (0.23)	0.31* (0.07)	0.32** (0.03)
Log FIE S&T Stock (t-1)	-0.04 (0.16)	-0.04 (0.16)	-0.23 (0.15)	-0.25* (0.05)
Log Total S&T Stock (t-1)				
Log S&T Spillover (t-1)		0.00 (1.00)		0.50*** (0.00)
Observations	141	141	145	145
R-squared	0.81	0.81		
Industry FE	YES	YES	N/A	YES
Year FE	YES	YES	N/A	N/A

- Positive effect of domestic IKC on TFP most prominent in LP specification. Some evidence of inter-industry IKC spill-overs

Table 3  
Domestic Invention Patents

	(1) Domestic Invention Patents	(2) Domestic Invention Patents	(3) Domestic Invention Patents
Domestic Invention Patents (t-1)	1.00 (0.81)	1.00 (0.79)	1.00 (0.72)
Log Labor	1.36 (0.12)	1.38 (0.14)	1.23 (0.36)
Log Domestic S&T Stock (t-1)		1.89** (0.01)	2.26*** (0.00)
Log FIE S&T Stock (t-1)		0.95 (0.85)	0.90 (0.62)
Log Total S&T Stock (t-1)	2.02*** (0.00)		
Log S&T Spillover (t-1)			1.61* (0.06)
Observations	143	143	143
Prob > F	0.00	0.00	0.00
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

- Domestic investments in IKC increase the propensity to file innovation patents. Also some evidence of inter-industry spillovers

Table 4  
RCA Model Results

VARIABLES	(1) RCA	(2) RCA	(3) RCA
Domestic S&T Stock (t-1)	0.04*** (0.00)	0.04*** (0.00)	
FIE S&T Stock (t-1)	-0.02* (0.06)	-0.01 (0.42)	
Total S&T Stock (t-1)	0.02 (0.37)		
S&T Spillover (t-1)		-0.04** (0.05)	
S&T Spillover (t-1, weighted)			
Observations	78	78	78
R-squared	0.06	0.09	0.11
Industry FE	YES	YES	YES
Year FE	YES	YES	YES

- Domestic investments in IKC increase competitiveness on international markets, as measured by the RCA index. Foreign IKC investments appear oriented toward China's domestic market.

## Conclusions

- Evidence suggests investments in IKC continue to improve economic performance in China's post-WTO era.
- Domestic investments in IKC seem to have more positive effects compared to foreign investments in IKC.
- These results support China's continued progress toward designing institutions that promote domestic investments in new technologies.

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