

From California Dreaming to Silicon Success:

The Rise of China's Semiconductor Industry

Douglas B. Fuller

**Stanford Project on Regions of
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**Shorenstein APARC
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Catching Up to the International Technological Frontier

Chinese Semiconductor Fabrication Technology

Data not yet publicly available, contact
author later

Current Debate on Globalization and Development

- What are the prospects for development in the developing world under economic globalization?
- Washington Consensus versus the Revisionists
- Debate among the revisionists
 - Optimists-
 - Global networks of production (Ernst, Linsu Kim)
 - Transnational technology communities (Saxenian, Bresnahan, J. Hsu).
 - Pessimists-End of state or state-societal alliances for development (Stiglitz, Milanovic, Strange, Sanchez, Nolan)

Research Overview

- Questions:
 - Did China experience technological upgrading in the IT industry?
 - And if it did, what were the routes of this upgrading?
- Findings:
 - China experienced upgrading
 - Not the product of state industrial policy
 - Not the product of transnational networks alone

Findings from China

- Foreign firms drive technological upgrading
- China's industrial policies ineffective
- Domestic environment mediates influence of transnational networks

Research Methods

- **Qualitative data:** 318 semi-structured interviews; primary and secondary sources on industry and policy
- **Quantitative data:** industry and government statistics; data derived from interviews

Geographic Distribution of Interviews

Region	Number of Interviews
Beijing	96
Shanghai	82
Guangdong	42
Taiwan	33
Jiangsu	32
Zhejiang	20
Tianjin	6
International	4
Western China	3
Total	318

The Types of Interviews

Interview Type	Number of Interviews
Foreign Business	150
Domestic Business	78
Government	81
NGOs	5
Academia	4
Total	318

Dependent Variable: Technological Upgrading

- Technological Upgrading comprises **technological learning** and **technological innovation**
- Technological Upgrading is measured by
 - Relative to the international technological frontier
 - For commercial products
 - Embedded through training local personnel and local suppliers

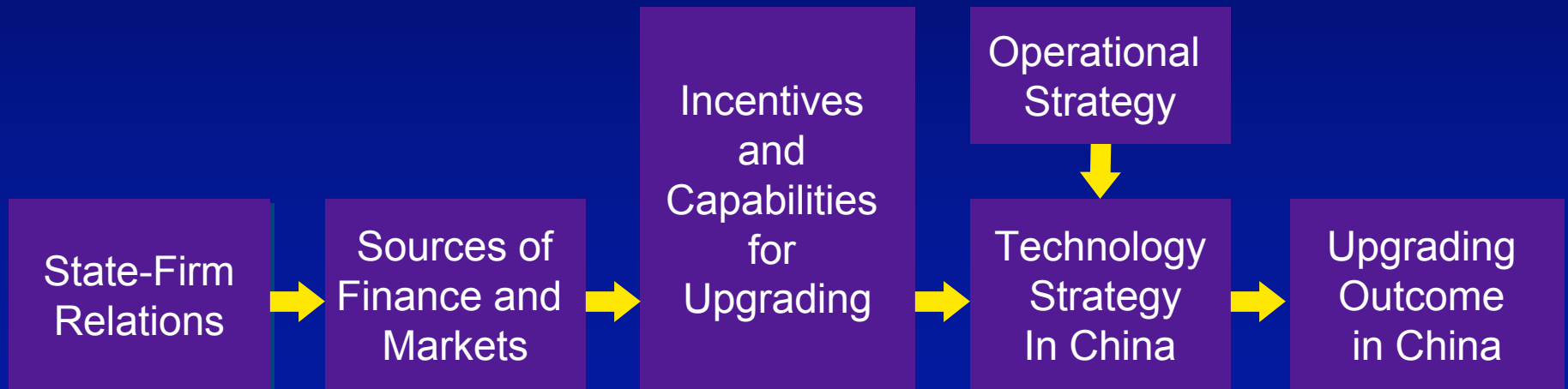
Firm Types

- **Favored Domestic Firms**: domestic registration and state finance and procurement
- **Neglected Domestic Firms**: domestic registration and little access to state finance/procurement
- **Regular FIEs**: foreign registration and finance
- **Hybrid FIEs**: foreign registration and finance and China-based operational strategy

Two Independent Variables (IVs)

- Sources of Finance
 - No finance versus domestic state versus foreign private
 - Determines the different upgrading paths between foreign and domestic firms
- Operational Strategy
 - China-based vs. foreign-based
 - Definition of China-based Operational Strategy: a strategic commitment to developing core firm resources in China
 - Ethnic Chinese entrepreneurs have the propensity to adopt China-based operational strategy for ideational and interest-driven reasons
 - Determines the different upgrading contributions between hybrid and regular FIEs

Causal Flow



Outcomes: Firms and the Causal Chain

Firm Type	Finance	Capabilities/ Incentives	Motivation from Operational Strategy	Technology Activities in China	Contribution to Upgrading
Neglected Domestic	Little finance	Low Capabilities	High but irrelevant	Do not pursue	Low
Favored Domestic	Lavish state support	Low capabilities/ low incentives	High	Few attempts and execution poor	Low
Regular FIEs	Access to hard budget finance	High capabilities& incentives	Variable	Variable	Moderate
Hybrid FIEs	Access to hard budget finance	Same as above	High	Pursue tech in China	High

Semiconductor Production Chain



Domestic Failure in IC Manufacturing

- State Initiatives
 - 908 Project (Huajing)
 - Created no products
 - Empty factory-rent to foreigners
 - 909 Project (Huahong NEC)
 - Japan controls technology
 - HHNEC has lost almost 1 billion USD

Foreign Success in IC Manufacturing

- Hybrid FIEs
 - CSMC turns around Huajing
 - SMIC and Grace have brought advanced manufacturing
 - SMIC and Grace produce over 80% of China's advanced ICs
- Regular FIEs-limited commitment to China
 - UMC, TSMC have one 200mm fab each
 - Motorola sold its fab to SMIC

China's Chip Design

Data not yet publicly available, please contact author at later date

Three Cases from Semiconductor Design

- Role of the returnee technologist
- Failure of the state-favored firms
- The dangers of becoming part of the state's network of patronage

Innovation in China: The Story of Howard Yang

- 1991: Howard Yang returned from Silicon Valley to Shanghai Belling
- 1997: Founds Newave with foreign finance
- 1999: Newave creates innovative chip
- 2001: Newave sold to IDT for 80 million USD
- 2004: Yang founds Montage

Lessons from Howard Yang

- Returnee technologists are only part of the answer
- Firms with state finance are difficult to turn around
- State strategic industrial policy not necessary
- Developing the same dynamics found in centers of innovation

The Stifling Embrace: State Support and Stagnation at BLX

- BLX is a spin-off from Chinese Academy of Science
- Recruited some returnees
- Target of state industrial policy for CPUs
- Firm produces out-of-date CPUs at high prices
- Customers are other state-connected firms
- No progress towards commercial products

The Connected Foreign Firm: The Chinese State and Arca

- Arca is a foreign-registered design house
- Fostered links to the Beijing Municipality and the Ministry of Information Industry
- Receives state contracts through Beijing Oriental Electronics
- Sells old CPUs at high prices to the state
- Potential technological promise unfulfilled

Lessons for Developing Countries under Globalization

- Foreign investment imports foreign institutions
- High state capacity is not required
- Foreign firms can be prime drivers of development
- Motivational mechanism is required
 - China's transnational co-ethnic technology network
 - Other developing nations can use a similar mechanism