

# SILICON GLOBALIZATION AND ITS CONSTRAINTS: THE DIFFIDENT RISE OF THE INDIAN AND CHINESE SEMICONDUCTOR INDUSTRIES

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# Country conditions a decade ago

- Intellectual property rights protection
  - How to measure the gap?
    - World Bank metrics?
    - EFW (Gwartney et al)?
  - Consistent narrative from participants on the ground of strong IPR practices in India and poor ones in China within the IC industry
    - China is a story of how to manage and mitigate risk but risk ever present even if the overall IPR environment has improved greatly from the past
      - IP concerns in China diminished between 2007-2008 and 2014
- Large downstream manufacturing industry in China and very limited one in India
- Successful ITS industry in India
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# Evolving Divergent Models: India

- MNC attracted to India's better IPR regime as practiced in this industry
- ITS firms willing to ease the path of MNCs by branching out into IC design service
- Earlier MNC investment in design activities in India
  - 8 of top 20 global IC firms (2008) had design activities in India prior to 2000
- Design service model as template led to many start-ups
  - These new design service firms eased entry of MNCs as MNCs bought up these firms to start their own Indian subsidiaries
- India creates a MNC-centric design service model characterized by high technological capabilities and few opportunities for value capture through product creation

# Evolving Divergent Models: China

- MNCs deterred from setting up design activities because of the poor IPR environment
  - Only three of the global top 20 firms had set up design operations in China prior to 2000
- Chinese design firms concentrated on products to sell to downstream manufacturers; design service not a focus
  - Lack of ITS template
  - Large amount of venture capital targeting the sector from 2000-2006
  - Downstream manufacturers as the market
- Product focus of local firms probably heightened concerns about IPR from MNCs
- China had more value capture but less sophisticated technological activities in IC design than India

# Potential Changes to the Industrial Structure in 2007/8 compared to 2014 Structure: India

## India 2007/8

- Design service firms planned to try to capture more value via several mechanisms
  - Move to control more of the design process: from simple design function (low-end) to turn-key solution provider managing the entire design process through post-fab testing
  - More aggressive patenting in conjunction with licensing IP

## India 2014

- Design service firms value capture still constrained
  - Even for the firm regarded as the largest and most sophisticated of the design service firms:
    - time and materials body-shopping is 50% of revenue and high-end revenue sharing/royalties model is less than 10%
    - Abandon efforts to do IP licensing because not profitable and fear of competition with customers

# Potential Changes to the Industrial Structure in 2007/8 compared to 2014 Structure: China

## China 2007/8

- MNCs built up their presence from 2005 onwards
- Venture capital gradually lost interest in fabless start-ups
  - Product model beginning to lose its allure?

## China 2014

- Many MNCs have dramatically scaled back Chinese design ops despite lessened fears of IP theft
- Fabless design firms thriving (just surviving?) in wireless space and application processor space
  - Are these sustainable trends?
- Renewed government investment push

# Greater Technological Activities in India for MNCs (2008)

## India

- 14 of 19 MNCs had design leads
- 12 firms employ more than 100 designers
- 6 MNCs had large AMS teams

## China

- Only 5 of 10 MNCs had design leads
- Only 4 firms employ over 100 designers
- One MNC had large AMS team

# Technological Activities among MNCs in 2014: India still deeper

## India

- Interviewed 10 of the 17 (2 firms acquired by others) MNCs interviewed in 2007-8
- 8 of the 10 have grown the size of their design teams—the two firms which shrank their ops reorganized globally, closing down or selling Bus worldwide
- 9 out of 10 have grown the sophistication of their design teams i.e. more AMS, more design leads

## China

- MNCs have much less commitment to Chinese design ops
- Seven of ten MNCs cut back or eliminated their China design ops from 2009 onward
  - Includes just one which sold the relevant BU
- Only 2 MNCs with design ops as large or larger in China than India
  - One only partially confirmed as did not interview India site

# Technology Creation and Value Capture

## India Led in Technology Creation in 2003-2007

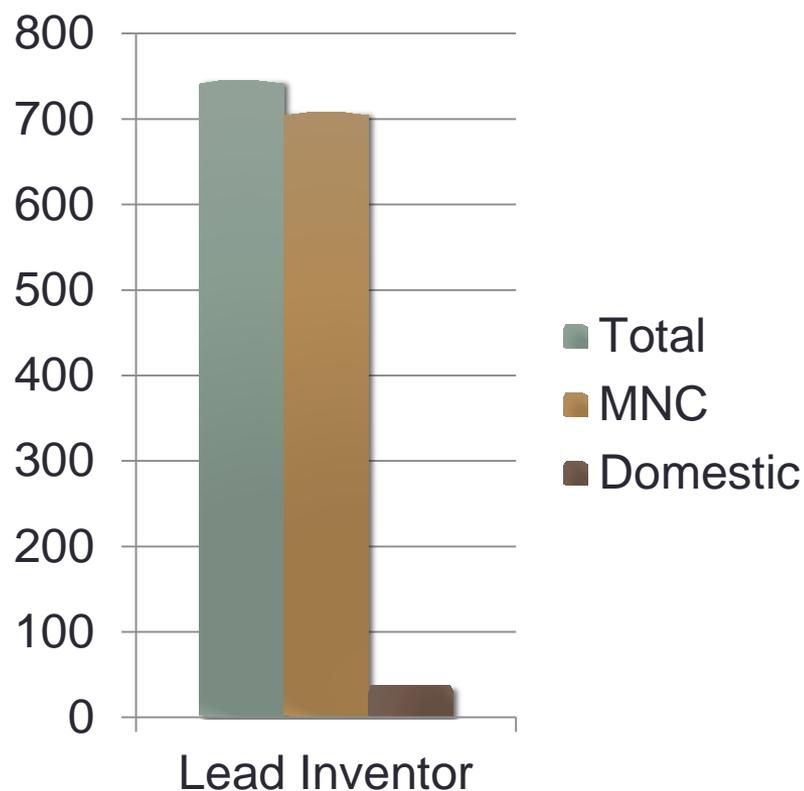
- India had 333 lead inventor patents in ICs from 2003-2007 but NONE owned by a domestic firm
- China had only 83 lead user patents in 2003-2007 but nearly half (38) owned by local/hybrid firms

## China Leads in Value Capture

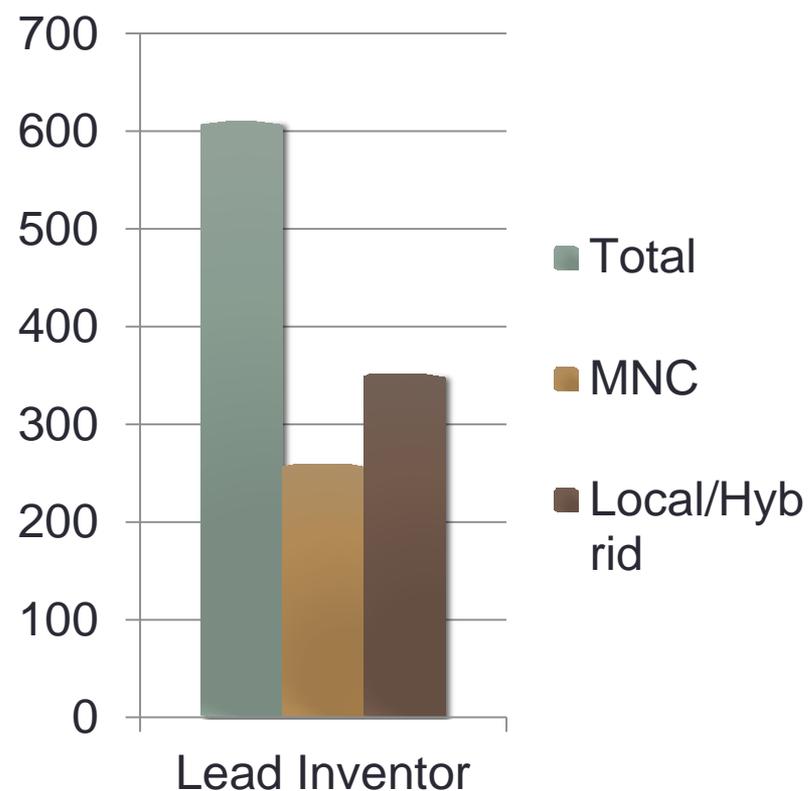
- China
  - 2004: 7000 designers create US\$1 billion in revenue
  - 2010/11: 15000 designers (2011) create US\$7 billion in revenue (2011)—\$9.3 billion (2012) and \$5.4 billion (2010)
  - Profitability?
- India:
  - 2005: 11000 designers create US\$200-300 million in revenue
  - 2010/11: 14600 designers (2010) create US\$1.1 billion in revenue

# Lead Inventor Utility Patents, 2007-2011: China Closing the Gap

India



China



# IC Designer Labor Markets

## India

- Cost differential for MNCs:
  - Fresh MSc Bangalore:US 1:7
  - Senior management Bangalore:US 1:2
  - Bangalore slightly more expensive
- Deep market (demand and supply)
  - Engineers with experience look for places with interesting work
    - Such opportunities are available—even TI is not considered as highly as in the past
    - Design service companies offer neither interesting work nor good pay
  - Individual firm lay-offs do not impact perception of industry because easier to find another MNC job
  - Controlling for experience, only leading web MNCs pay more e.g. Facebook, Google
- Virtuous Cycle
  - IC design seen as appealing profession so lots of engineers are entering and staying in this area

## China

- Cost differential for MNCs:
  - Fresh MSc Shanghai:US 1:2.5 or 1:3; Shanghai more expensive than Taiwan now
  - For senior management cost is quite narrow
  - Much cheaper inland but enough engineers?
- Labor market not deep
  - Lay-offs from MNCs a big deal because hard to find another MNC job quickly
  - MNC jobs pay well but tech glass ceiling
    - Counterbalanced by better work environment, better pay and possibly better education in organizational processes of running large IC business
  - Local firms do not pay as well but offer better opportunities to do end-to-end chip design/design management
    - Counterbalanced by regimented work environment
    - Some called these work environments “Korean” in atmosphere
- Constraints leading to Cap on Labor Pool?
  - Recent trends suggest engineers will begin to opt for other career options
  - Push for upgrading?

# Continued Constraints

## India

- MNCs dominate—trend toward moving more design capabilities to India but HQs still located abroad
  - Ultimately keep some critical skills at HQ?
- Design services have proven to be a low margin business
  - Hard to increase value capture
- Product design handicapped by lack of electronics manufacturing base

## China

- Labor market constraints?
- MNCs not committed to moving more capabilities to China
- Local product design firms generating revenues but are they generating sustainable profits?

# Industrial Policy 2014

## India: Time to Build a Manufacturing Base?

- India aiming to address basic electronics infrastructure issues
  - Subsidies for electronics manufacturing clusters (EMCs) (National Electronics Policy 2012): 25% K cost in SEZs; 20% outside of SEZs
  - Electronics Development Fund-seed funding for firms
  - Government procurement for local Electronics System and Design Manufacturing (ESDM) firms
  - Karnataka state issued similar state-level initiatives in 2013
- Post-election details to follow on National ESDM policy
  - First greenfield EMC in Odisha approved in principle in June 2014—supported by Odisha and Department of Electronics and Information Technology—50% of K cost
  - Fabs?
  - Venture capital funding?

## China: Throw More Money at the Problem!

- China (local and central state) has spent approximately 300 billion RMB over the last 3 FYPs (2001-2015)
- Heightened security concerns and IC trade deficit
- New Plan
  - Crazy headline figure: 3 to 5 trillion RMB investment over 5 to 10 years
    - Local governments are following central government's lead in drawing up plans
  - Central government wants 120 billion RMB investment fund of which central government will provide 40 billion and "society" will provide the rest OR 120 billion with 300 from government, 450 from social security fund and the rest from society
    - 30% in IC design; 40% in fabrication
  - OR is it a 600 Billion RMB investment fund?
  - June announcement mentions an IC Leading Small Group on IC Industry, an Investment Fund and the support of banks for the industry