

# Japanese firms' innovation responses to Chinese import competition

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# China's Growing Share in World Exports



# China's competitive shock in the world economy: Big policy discussions both developed and developing countries



# **Question and Motivations**

**Data**

**Empirical approach**

**Results**

# ***What is the impact of an expansion of Chinese import competition on technical change in developed countries? (1)***

- Substantial evidence suggest the Chinese import competition leading to skill-biased technological changes (Autor et al. 2013, Autor et al. 2014, Ashournia et al. 2013, Hummels et al. 2013)
  - Creating a loss in employment and wage for unskilled workers
- Import competition shifts labour demand **in favour of skilled and technical workers.**
- Creating a wage gap between skilled and unskilled workers (**skill upgrading**)
- China has been a culprit for the above in developed countries

## ***What is the impact of an expansion of Chinese import competition on technical change in developed countries? (2)***

- Limited more direct evidence on the effects of Chinese import competition on firm-level innovation because of....
  - Chinese import competition on the labour-intensive products (less competitive pressures on technology and innovation) in developed countries.
  - partly due to a lack of micro data on innovation (extremely difficult to match firm-level accounting data to patent statistics)

# ***What is the impact of an expansion of Chinese import competition on technical change in developed countries? (3)***

- Theoretical literature remains inconclusive (e.g. ambiguous effects of competition on innovation & technology adoption)
  - **Competition and innovation of incumbent firms** (Aghion et al. 2004; 2005)
    - “U-shaped” relationship
    - Usually assuming that competition bring new technology
    - The escape effects and the discouragement effects
  - **Trapped factor model of innovation** (Bloom, Romer and Van Reenen, 2010)

## **Bloom et al. (2015) study the impact of Chinese imports on technology in Europe**

Use panel data on ~90,000 firms & establishments in 1990s & 2000s in 12 EU countries. **Bloom, Draca and Van Reenen (2015)** find that higher threat of Chinese imports leads to:

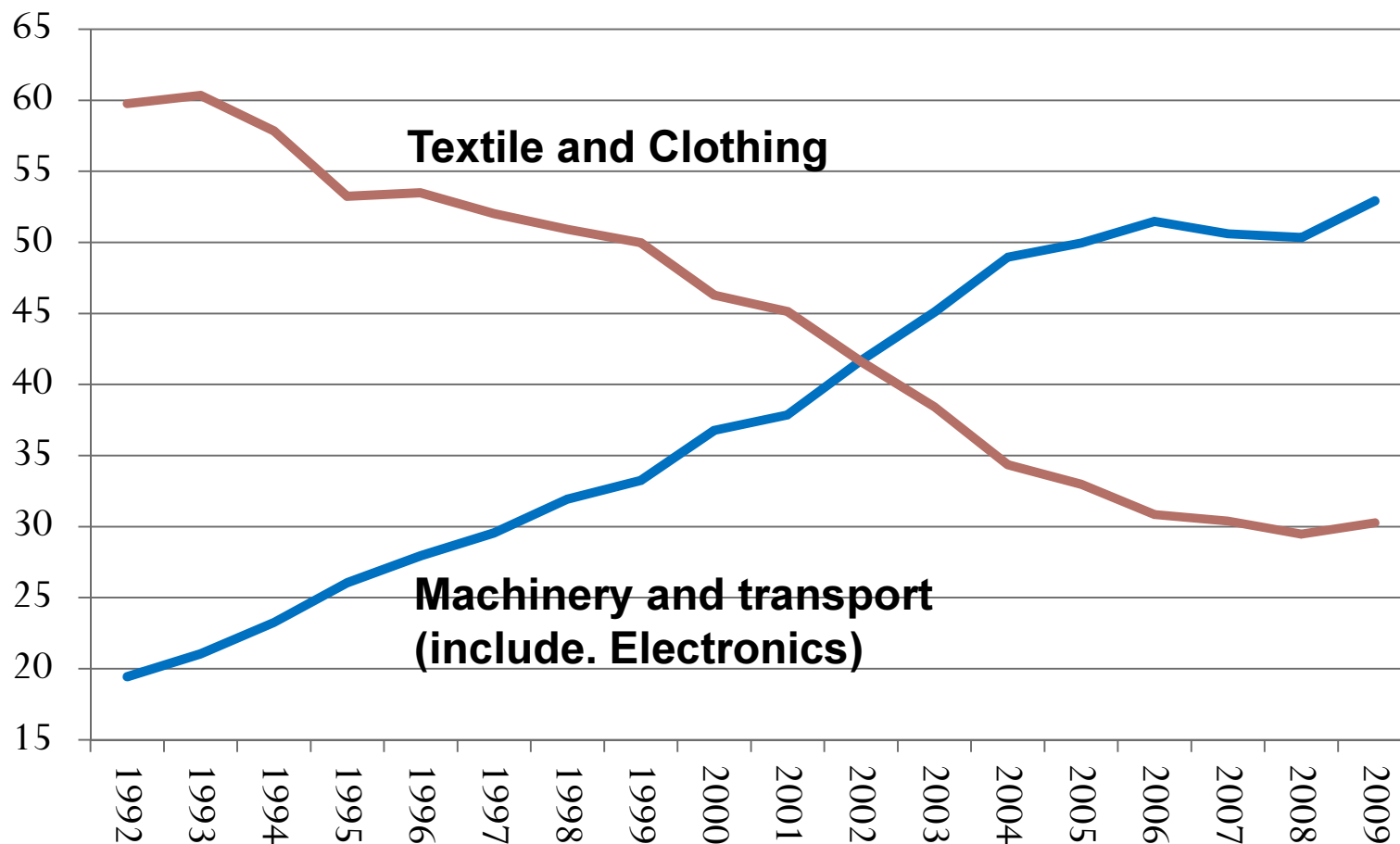
- China “accounts” for:  $\approx 15\%$  of increase in IT, patents & productivity (TFP) 2000-2007



# ***What is interesting about the Chinese competition?***

- China had become one of the fast growing exporters in high-tech products (consumer electronics) – the ‘export bundle’ getting closer to that of OECD countries.
  - But, the lower unit-value (eg, the mass-market products assembled with relatively low labour costs)
  - Driven by offshoring – international fragmentation of production
- In the innovation literature, an entry of firms with the world technology frontier impacting on innovations of incumbent firms (Aghion et al, 2005, Amiti and Khandelwal, 2013)
  - stimulating the ‘pro-competitive’ motivation of innovation to escape from the competition.
  - Does it happen in Japan?

# Increasing share of 'high-tech' products China's manufacturing exports (%)?



## ***What we do in this paper....***

- Examine the innovative response of Japanese firms to Chinese import competition
- Using two measures of innovation – R&D expenditures (research inputs) and patenting (invention outcomes)
  - These two capturing the different stages of innovation
- Creating new firm-level dataset
- Estimating two technology equations – *R&D and patenting*
  - Deal with the problem arising from the simultaneous decision between importing and innovation
- The heterogeneous response by firms (depending on the status of importing and exporting)
- Control for the quality of innovation by attaching **citation information**

# What we found.....

- Correlation was detected between innovation and imports from China
- The quality of innovation matters – the quality of patents has been deteriorated by the increase competition from China
  - The patenting strategy is quite similar to **the defensive patents** to protect the core technology (eg, ICT industry)
  - Patenting only incremental inventions
  - Japanese firms respond by patenting more but not necessarily in high quality!

## **Question and Motivations**

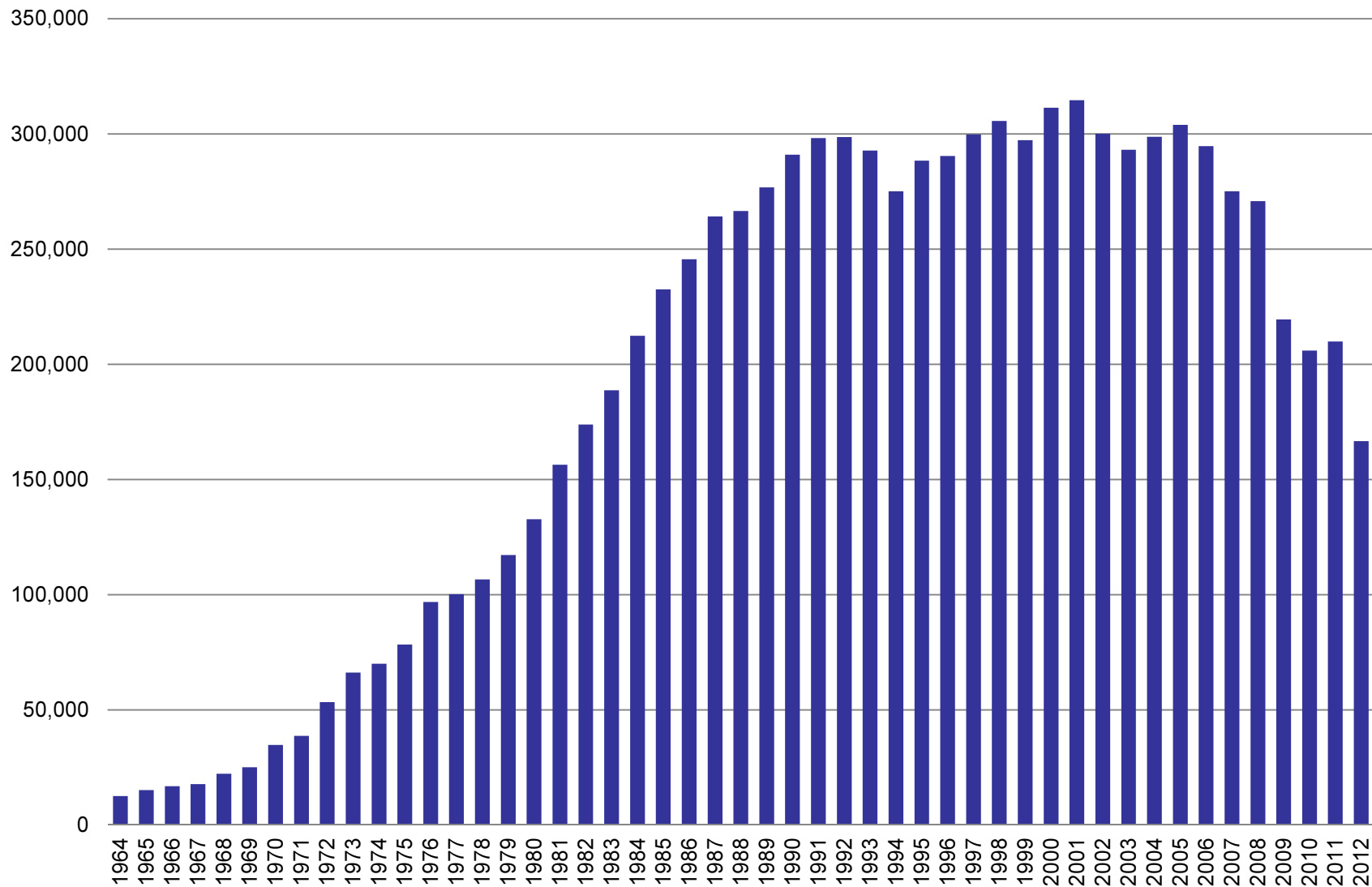


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# Patenting in Japan



# Innovation and import penetration

year	Patent	Emp.	China	US	NIEs	Dev. Asia	Hincome
1994	29.2	631.2	0.8	1.8	1.0	0.9	3.5
1995	29.4	601.7	1.0	2.0	1.3	1.0	3.9
1996	29.6	594.7	1.3	2.4	1.4	1.2	4.6
1997	30.2	576.9	1.5	2.5	1.3	1.3	4.7
1998	30.2	557.6	1.6	2.7	1.3	1.3	4.8
1999	29.7	552.7	1.7	2.4	1.4	1.4	4.5
2000	31.1	542.4	2.1	2.4	1.6	1.6	4.6
2001	30.9	517.7	2.6	2.5	1.6	1.8	4.9
2002	30.1	504.3	3.2	2.5	1.7	1.9	5.0
2003	30.3	518.4	3.4	2.2	1.5	1.7	4.9
2004	30.6	515.0	4.0	2.1	1.6	1.8	5.0
2005	30.4	515.6	4.6	2.1	1.7	1.9	4.9
2006	30.2	535.1	5.2	2.3	1.9	2.0	5.1
2007	27.9	539.5	5.9	2.3	2.1	2.3	5.2
2008	27.2	541.2	5.9	2.1	1.9	2.2	4.8
2009	22.2	537.6	5.8	1.9	1.8	2.1	4.4

## Share of patenting and Chinese import penetration at 2-digit industry in 1994, 2000 and 2009

Industry	Patent (% share in total manufacturing)			Chinese import competition		
	1994	2000	2009	1994	2000	2009
	%	%	%	%	%	%
<b>ELECTRONIC AND ELECTRIC EQUIPMENT</b>	19.5	20.3	20.0	0.6	2.5	11.2
<b>TRANSPORTATION EQUIPMENT</b>	9.8	11.6	14.2	0.0	0.2	0.9
<b>INSTRUMENTS</b>	4.6	5.4	13.8	1.2	3.6	6.7
<b>TEXTILE PRODUCTS</b>	3.8	4.4	1.3	8.1	20.5	40.1
<b>LEATHER PRODUCTS</b>	0.4	0.2	0.1	7.2	16.5	33.6
	(100)	(100)	(100)			



**Question and Motivations**

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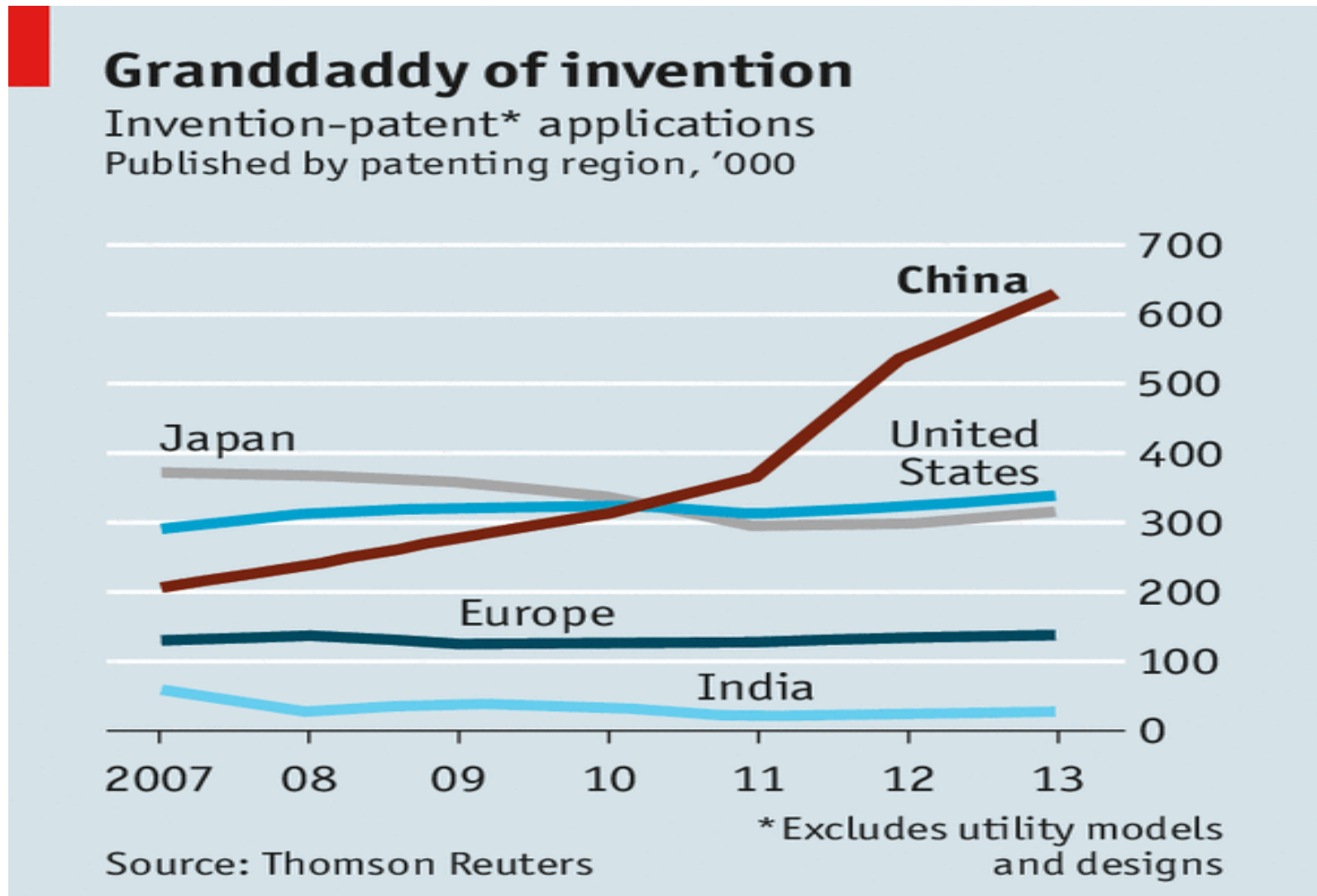
**Empirical approach**

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## ‘Take-away’ can be summarised...

- While increased imports from China have induced Japanese firms to take out more patents but they mostly were in lower quality.
- **the defensive nature of patents** in order to protect their core inventions.
- This is similar to a strategy taken up by firms in ‘continuous’ technology-intensive industries in ICT to build up the patent fence to deter new entrance in the technology field.

# China's innovation has (not yet) taken off



# Policy implications

- No compelling evidence to suggest that China's trade shocks have stimulated innovation in Japan
- **Welfare reducing patenting** (*patent thickets*) – patent with incremental inventions to raise the entry and transaction costs for those new competitors
- Perhaps, partly explained by firms' efforts to combat the possible imitation from China?

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# Japanese firm-level data

- firm-level data (drawn from the METI surveys)
- Firms >50 employees and >US\$300k capital
- Use the annual survey on Japanese firms for the period of 1997-2009 (about 8,000 firms annually in Table 2)
- It is a panel dataset (firm fixed-effects)
- Basic firm accounting information
- Merge it with the Japan Patent Database (**nobody has done this before**)
- Merge with Japan Industrial Productivity (JIP) data of the RIETI (to measure the exposure of Chinese competition)

## Innovation Equation (baseline specification)

$$\ln(Pat)_{it} = \alpha_i + \alpha_j + \alpha_t + \beta_1 \ln(IM^{China})_{jt-1} + \varphi' X_{it-1} + \varepsilon_{it}$$

 **# of patents  
for firm i at  
time t**

 **Firm, sector  
and year  
Fixed Effects**

 **Chinese import  
competition at  
industry j at t-1**

 **Other firm-level  
controls**

# Firm-level exposure to Chinese competition

- Trade data at industry-level (merging trade data into industry-level)
- Our main measure is

$$IM^{China}_{it-1} = \frac{M^{China}_{j,t-1}}{(Q_{j,t-1} + M^{Total}_{j,t-1}) - X_{j,t-1}}$$

- Alternatively, (Chinese imports/total imports) at industry  $j$



# ***Dealing with a simultaneity problem between innovation and import***

$$IM_{jt}^{China} = \alpha_j + \alpha_t + \beta(IM_{US,j,t=1991}^{China} * IM_{World,t}^{China}) + \varphi' X_{it} \varepsilon_{jt}$$

- i. Control for firm-level unobserved characteristics by fixed effect
- ii. The split-sample approach
  - “Pure domestic firms” and “Global firms”
- iii. Implement an instrumental approach.