

The Truth about Chinese Innovation

Markus Eberhardt

School of Economics, University of Nottingham

<https://sites.google.com/site/medevecon/>



Leverhulme Centre
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1 Economics at Nottingham

2 Innovation

3 Truth

4 China

5 The Truth about Chinese Innovation

6 Conclusion



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- It looks like the Trent Building here in Nottingham...
- ...but is actually a building on the **University of Nottingham Ningbo Campus** in China.
- Come and study Economics in Nottingham and go to Ningbo for a term during your second year!

Overview

- **Innovation** — a little bit about growth theory and how we try to measure innovation effort and the results from innovation.
- **Truth** — some general thoughts on how economists try to test their theories.
- **China** — an informal illustration of China's growth and the varying theories ('hypotheses') on what will happen next.
- **The Truth about Chinese Innovation** — my own attempt at testing these theories.

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Some Preliminary Considerations

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- To **innovate** means to generate and apply **new knowledge/new technology** to solve practical problems; 'carrying out new combinations'.
- **Is invention an economic phenomenon?**
 - Typically not, especially radical inventions.
 - But making an invention into a successful innovation requires money and a market!

Some Growth Theory ('The Model')

- 1950s: **The Solow Model**. All you need to do is save, invest, 'accumulate your capital stock' (buy machines). Growth in the Solow model comes from technical progress, which 'just happens'. Technical progress is like the biblical 'manna from heaven'.

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- So the Solow model just shrugged its shoulders at the question 'Why do countries grow?'
- Early 1990s: **The 'Endogenous Growth' Revolution**. Models try to explain why countries grow: because firms make investment in human capital (workers), innovation (ideas, R&D), product development/variety.

Market Failures

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- **Creative Ideas**

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⇒ **scope for government intervention**: incentive to innovate vs. failure to reap all benefits (externalities); public interest in fast diffusion of knowledge;

⇒ **Endogenous growth models** explain mechanism but not necessarily safeguard for firms' investments.

Measures of Innovation and Performance

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 - **Unobservable output:** keep innovation a secret. Nothing to measure for the empirical economist :- (

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- **Innovation as an engine for growth.**
- **Economic Theory Model** enables us to create this link in a 'formal' (mathematical equation) model.
- **Market Failure** may be preventing firms from making sufficient investment into innovation.
- **Measures of Innovation:** inputs, output.

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Watson: “This is indeed a mystery,” I remarked. “What do you imagine that it means?”

Holmes: “I have no data yet. It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts. . . .”

Sir Arthur Conan Doyle (1891) *A Scandal in Bohemia*

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⇒ **Counterfactual.** What would have happened to Patient A if they had not received the drug?

Recap: What have we learned?

- When investigating an economic question empirically we need to worry about **whether the data we have** (e.g. 1,000 firms in China) **is a good representation** of the population (e.g. 2m firms in China). This is easiest to achieve using a 'random sample' or if available (like in our China study) census data which covers virtually all firms in the country.

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- When we're investigating certain economic questions (e.g. wages of workers) we need to **make sure that we have not unwittingly excluded some subjects from our empirical study** (e.g. the unemployed) by construction.
- If we want to measure the impact of an intervention (e.g. a drug treatment or a new government policy) we must try to establish the **appropriate counterfactual**.

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Short Task

Turn to your neighbour and over the next 2 minutes come up with **5 products** (maybe manufactured goods rather than commodities such as rice or soybeans) that you think are produced in present-day China.

Some Examples



lenovo

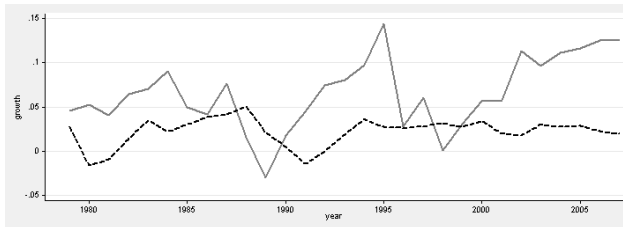


Two illustrations of China's recent growth

How far you needed to go to get a decent cup of coffee...



... changed from 15km in 1996 to about 200m in 2003.



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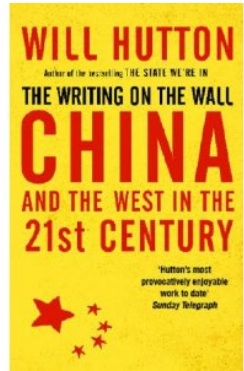
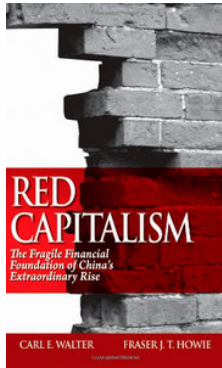
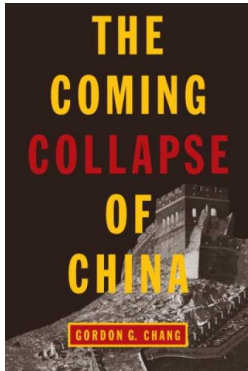
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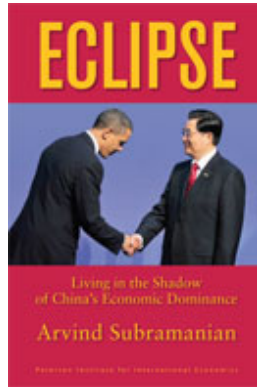
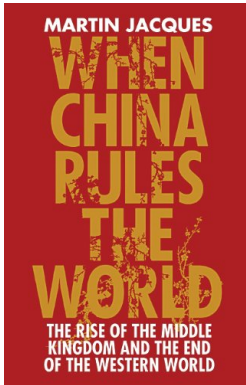
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 - regional and **global stability** (economic, political),
 - direct (trade, investment) and indirect ('Chinese growth model') effects on **developing economies**.

Economic Collapse



Some cheerleaders for the 'collapse' argument (more or less)

World Dominance



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- 5 **'Red Queen Run'** argument: China does not need to become an innovator, can continue its role as best manufacturer in the world (fastest turnaround, assured quality, worldclass logistics).

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 - **Characteristics of firms who chose to file/file lots with US patent office** (rather than only in China).

USPTO: Top 10 firms (1985-2006)

Rank	Company	Share
1	Hongfujin Precision Industry (Foxconn)	26.42%
2	Huawei Technology	20.55%
3	Fuzhun Precision Industry (Foxconn)	11.07%
4	China Petroleum Chemical (Sinopec)	8.29%
5	Semiconductor Manufacturing Intern.	6.49%
6	Futaihong Precision Industry (Foxconn)	5.15%
7	ZTE	3.14%
8	Lenovo	1.96%
9	BYD	1.70%
10	China International Marine Containers	0.93%
	Other	14.32%
	Total	100.00%

SIPO: Top 10 firms (1985-2006)

Rank	Company	Share
1	Huawei Technology	34.09%
2	ZTE	10.04%
3	LG Electronics Appliances Tianjin	9.27%
4	Hongfujin Precision Industry (Foxconn)	8.11%
5	China Petroleum Chemical (Sinopec)	4.32%
6	Lenovo	2.48%
7	BYD	1.82%
8	LG Electronics Shanghai	1.69%
9	Baoshan Iron & Steel	1.65%
10	Inventec Shanghai	1.55%
	Other	24.96%
	Total	100.00%

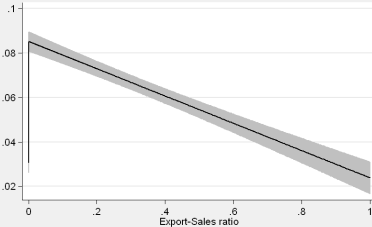
Product vs. Process Innovation (1985-2006)

Innovation Type	USPTO		SIPO	
	Share	#Patents	Share	#Patents
Product	46.8%	895	29.9%	293
Process	20.3%	389	36.9%	362
Product & Process	32.8%	628	33.2%	325
Total	100.00%	1,912	100.00%	980

Notes: Figures are based on manual investigation of claims of all USPTO patents and a random sample of SIPO patents.

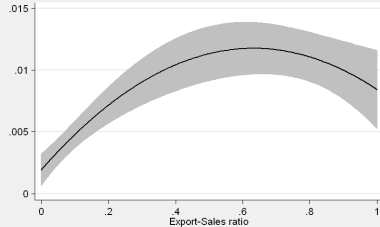
Patenting in China and the US

Exports and Patenting Behaviour
Predicted probability of Chinese but no US patent



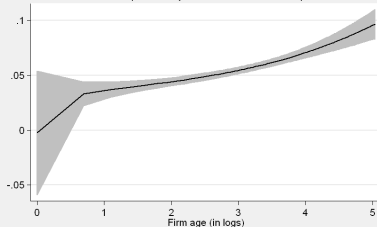
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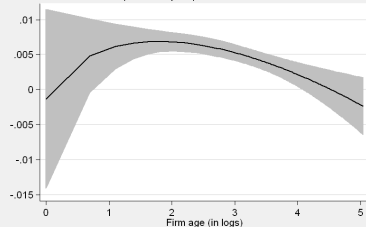
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- **Patenting decision and patent productivity: younger, more export-oriented firms** chose to file (lots) with both agencies, rather than just in China.

How can we interpret these results?

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- ② **‘Is there evidence for wider technological take-off?’**
⇒ Based on our analysis: No.
- ③ **‘Is China falling into the Middle-Income Trap?’,**
‘Is there evidence for a pure Red Queen Run?’
⇒ There are some (albeit few) very innovative, global players based in China.

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- ① **‘What is behind the Chinese patent explosion?’**
⇒ A handful of firms.
- ② **‘Is there evidence for wider technological take-off?’**
⇒ Based on our analysis: No.
- ③ **‘Is China falling into the Middle-Income Trap?’**,
‘Is there evidence for a pure Red Queen Run?’
⇒ There are some (albeit few) very innovative, global players based in China.
- ④ **‘Which firms file patents in the US as well as China?’**
⇒ Younger, more export-oriented ones.

- 1 Economics at Nottingham
- 2 Innovation
- 3 Truth
- 4 China
- 5 The Truth about Chinese Innovation
- 6 Conclusion**

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- ③ What to take into account when we carry out **empirical analysis** (representativeness, counterfactual).
- ④ Why **innovation in China** is interesting at all.
- ⑤ **What did we find in our research project?** The 'Chinese dragon' is still learning to fly: only a very small number of firms dominate Chinese patenting. Limited evidence for China moving from imitator to innovator.

Thank you.

Markus EBERHARDT

University of Nottingham and CSAE

Christian HELMERS

Universidad Carlos III de Madrid and CSAE

and

Zhihong YU

University of Nottingham



The University of
Nottingham

UNITED KINGDOM · CHINA · MALAYSIA



Illustration: Community Innovation Survey

Return

5. For each of the main innovation related activities in question 4, please ESTIMATE the amount of expenditure for the year 2008

a. Internal R&D	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1410
b. Acquisition of external R&D	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1420
c. Acquisition of machinery, equipment and software	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1430
d. Acquisition of external knowledge	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1440
e. Training for innovative activities	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1450
f. All forms of design	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1460
g. Market introduction of innovations	<input type="text"/>	,	<input type="text"/>	,	<input type="text"/>	<input type="text"/>	<input type="text"/>	1470

During the 3 year period 1 January 2006 - 31 December 2008

7. did this business introduce:

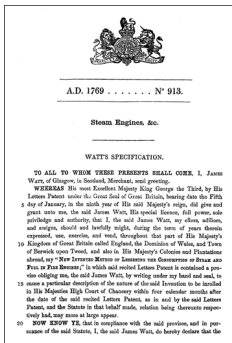
For each category please yes or no

	Yes	No	
a. new or significantly improved goods? Exclude the simple resale of goods purchased from other businesses and changes of a solely aesthetic nature	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0510
b. new or significantly improved services?	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0520

Notes: The UK Innovation Survey 2009, the sixth Europe-wide CIS, was sent to 28,000 UK enterprises with 10 or more employees and achieved a 50 per cent response rate. It provides the UK data covering the three-year period from 2006 to 2008.

Illustration: Patents Return

In the ancient Greek city of Sybaris (destroyed 510 BC), leaders decreed: “If a cook invents a delicious new dish, no other cook is to be permitted to prepare that dish for one year. During this time, only the inventor shall reap the commercial profits from his dish. This will motivate others to work hard and compete in such inventions.”



The image shows a modern patent document from the European Patent Office (EPO). It features the EPO logo and the text "Europäisches Patentamt / European Patent Office / Office européen des brevets". A barcode is present with the publication number "0 201 184 B1". The title is "EUROPEAN PATENT SPECIFICATION". The document lists key dates: Date of publication of patent specification: 16.12.92; Application number: 86302299.2; Date of filing: 27.03.86. It also mentions a divisional application 92201226.5 filed on 27/03/86. The process is for "amplifying nucleic acid sequences". Priority is claimed from US 716975 (25.10.85) and US 791368. The date of publication of the application is 17.12.86 Bulletin 86/46. The proprietor is F. Hoffmann-La Roche AG, Postfach 3255, CH-4002 Basel(CH). The inventor is Mullis, Kary Banks, 447 Beloit Avenue, Kensington California 94706(US). The date of publication of the grant of the patent is 16.12.92 Bulletin 92/51.

Notes: left – GB patent No. 1769-913, James Watt’s improved steam engine; right – a modern patent with the EPO.