From “Made in China” to “Innovated in China”: Necessity, Prospect, and Challenges

Shang-Jin Wei, Zhuan Xie, and Xiaobo Zhang
China’s (past) growth has been spectacular

Real per capita GDP (2.3 times)

Average real per capita GDP growth, 1980-2015

- Equatorial Guinea: 10.2
- China: 8.7
- Bhutan: 5.7
- Korea: 5.6
- Vietnam: 5.0
- Maldives: 4.9
- Taiwan: 4.5
- India: 4.4
- Sudan: 4.2
- Sri Lanka: 4.2

Note: Figures in 2011 PPP.
Source: ADB calculations from WEO April 2016.
Real per capita GDP growth rate
Source: WEO

Chinese growth rate (%)
Source: WEO

Notes: Figures in 2011 PPP. Excluding outliers: Liberia and Equatorial Guinea
Some numbers to put things in perspective

• Average real per capita GDP growth of 8.7% during 1980–2015

• Real per capita GDP increased from $714 in 1980 to $13,277 in 2015

• Only Equatorial Guinea has exceeded China’s performance

• Real per capita GDP growth of more than 6% for 25 consecutive years from 1990 to 2015

Note: Figures in 2011 PPP.
Reasons for the growth success (1)

• Policy actions

• Economic fundamentals
Reasons for the growth success (2)

• **Policy actions**
  – Launching market oriented reforms
    • Agriculture - “household responsibility system”
    • Industry and service
      – “grasp the large and let go of the small”
      – Lower entry barriers
  – Embracing globalization
    • “Democratization” of trading rights
    • Openness to FDI
    • Accession to the WTO
  – Minimizing resistance
    • Dual track system
    • Special economic zones
    • Political centralization + economic decentralization
Reasons for the growth success (3)
Economic Fundamentals: low wage + favorable demographics

Rank of real per capita GDP among 138 non-OECD countries

Share of working age cohort (15-59) in population (%)

Note: Figures in 2011 PPP.
Source: ADB calculations from WEO April 2016.

Source: Haver Analytics.
Rio Olympics opening ceremony
Beijing Olympics opening ceremony
Rising Real Wages (Men)

Zhang, Yang, and Wang, CER 2011
Rising Real Wages (Women)

Daily wage (yuan)


Eastern
Central
Western
Chinese factories: Past and present
Growth is likely to moderate further

• Vested interest groups have formed and low-hanging fruits of institutional reforms have been picked.

• Due to cyclical (weak global economy) and structural factors (rising wages, shrinking workforce)

• Postponing retirement age, increasing female labor force participation, and relaxing family planning policy will not reverse the trend in the short-run
Options for Chinese firms

• **In**: move to inland provinces
• **Out**: outward direct investment
• **Down**: shut down
• **Up**: innovation and upgrading. Future growth must mainly come from labor productivity growth.
• Can the transition from “made in China” to “innovated in China” happen?

If you want to look reasons to say no, you can find them
If you wish to look for optimistic examples, you can find them too.

WeChat’s world

**Time travellers**

<table>
<thead>
<tr>
<th>Messaging apps, monthly average users</th>
<th>Q1 2016, m</th>
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</thead>
<tbody>
<tr>
<td>WhatsApp</td>
<td>Mobile revenue, $m</td>
</tr>
<tr>
<td>Facebook Messenger</td>
<td>1,800</td>
</tr>
<tr>
<td>WeChat</td>
<td>1,000</td>
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</tbody>
</table>

**Features offered**

- Advertising
- E-commerce
- Digital content
- Online-to-offline services
- Finance

**Sources:** BDA; Tencent; The Economist

*End-2015

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**WeChat timeline**

- **January 2011:** Launches mobile messaging app as “Weixin” in China
- **April 2012:** Adds English name WeChat for Weixin, suggesting global ambitions
- **Summer 2012:** Allows brand accounts on Weixin
- **August 2013:** Adds mobile payments: start of Weixin Wallet
- **January 2014:** Adds taxi booking with Didi, sign of platform emerging
- **February 2014:** Starts ‘red packets’ at Chinese New Year
- **September 2014:** Launches in-store cashless payments
- **January 2015:** Monetisation gathers pace: ads appear in Moments feed and games take off
WeChat Wallet

- Quick Pay
- Balance: ¥2730.12
- Cards

- Transfer
- Mobile Top Up
- Wealth

- Loans
- QQ Coins
- Utilities

- Public Services
- Card Repay
- Red Packet

- Tencent Charity

Powered by Tencent
Uber gave up

The days of free-riding
China, ride-hailing

Market share %

Q4 2015

Uber

Didi

Others

Fares $n

Q1 2015

Q2 2015

Q3 2015

Q4 2015

Source: Analysys

*Includes chauffeur-driven cars but not taxis

†Shared by drivers and ride-hailing firm

Economist.com
What do the systematic data say?

• What is the actual growth of innovation of China’s firms?

• What accounts for the relatively fast pace of innovation (as measured by patent applications and approvals) by Chinese firms?

• Is there possible resource misallocation in the innovation space?
Note: data for China are from 1995 to 2014, and data for all other countries are for 2014 or the latest year available. Source: OECD database and World Bank.
Number of Chinese patents has exploded

Chinese patent applications

<table>
<thead>
<tr>
<th>Year</th>
<th>Invention (%)</th>
<th>Utility model (%)</th>
<th>Design (%)</th>
<th>Total domestic applications (RHS)</th>
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<tbody>
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</table>
What explains China’s innovation growth

– Easy approval?
– Government subsidies?

– Taking advantage of expanding market opportunities
– Spurred by rising wages?
Patent approval rate is not unusually high

Patent Approval Rate in BRIC Countries, the Republic of Korea, and the U.S.
Invention patents in the US show a rising trend.
Growing patent citations indicate quality improvements

Citations on Invention Patents Granted by USPTO: Cross-country Comparison

Graph showing the relationship between GDP per capita and the coefficient of country-year dummy for various countries.
Chinese product quality has steadily improved
• What drives the rising pace of innovation?

• Statistical analysis
Quantifying the drivers of innovation

• Regress patents on:
  – Wages
  – R&D subsidy rate
  – Tariff rate of trade partners
  – Market competition
  – Other firm characteristics (e.g., sales, tax rate, interest rate on liabilities, exporter or not)
Export firms are more innovative

Patent Intensity by Firm Export Status

- The graph shows the trend of patent intensity by firm export status from 1998 to 2009.
- Exporters (solid red line) exhibit a consistently higher patent intensity compared to non-exporters (dashed blue line).
- The patent intensity for exporters shows a steady increase over the years, while non-exporters have a more volatile trend with some peaks and troughs.
Labor-intensive firms innovated more
Key results

• Firm size is (+) associated with # of patents
• Export firms are more innovative
• Lower (foreign) tariffs are good for innovation
• Invention patents respond (+) to subsidies
• High tax rate discourages innovation
• Higher cost of capital discourages innovation
• Robust (+) relationship between wages and innovation
SOEs granted more subsidies...

Ratio of Subsidies to Sales by Firm Ownership and Size

Source: China annual above-scale industrial firm surveys.
...but lag behind private firms in patent generation
SOE R&D resources not efficiently spent

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total</th>
<th>Invention</th>
<th>Utility model</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D (log)*FIE</td>
<td>-0.006*</td>
<td>-0.006</td>
<td>0.002</td>
<td>-0.016**</td>
</tr>
<tr>
<td>R&amp;D (log)*SOE</td>
<td>-0.011**</td>
<td>-0.020***</td>
<td>-0.004</td>
<td>-0.016</td>
</tr>
<tr>
<td>R&amp;D (log)</td>
<td>0.015***</td>
<td>0.017***</td>
<td>0.013***</td>
<td>0.012***</td>
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<td>Sales (log)</td>
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<td>785,235</td>
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<td>YES</td>
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<tr>
<td>Year FE</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>AIC</td>
<td>300800</td>
<td>93583</td>
<td>192008</td>
<td>136310</td>
</tr>
</tbody>
</table>

Note: China annual above-scale industrial firm surveys. R&D data are available only during 2005-2007.
Summary

• The Chinese economy fortune is at crossroads

• Can Chinese firms really innovate?
  – Patent application
  – Patent citations

• Drivers of firm innovation:
  – (i) world market opportunities; (ii) rising labor costs

• Possible misallocation
  – Subsidy allocation biased in favor of SOEs, but private firms innovate more
  – Structural reforms that level the playing field can accelerate innovations
China Regional Innovation Index (1990-2015) was released in December 2016; 
*China Regional Innovation Report* was published by Peking University Press in 2016.
Major features

- Market-based and output-based
- Universe firm database
- Multiple dimensions (technology, talent, and investment)
The new innovation index combines the following data sources:

- Firm registry database, covering the number of startups and new investment
- National patent database
- National trademark database
- Venture capital investment
The major sub indicators

- Innovation index
- Patents
- Trademark
- External investment
- New firms
- Venture investment
- Homegrown entrepreneurs
**Methods:**

（1）Transform 10 variables into z-scores

（2）Calculate weighted z-scores

<table>
<thead>
<tr>
<th>维度名称（权重）</th>
<th>分项指标</th>
<th>在子维度中所占权重</th>
<th>在指数中所占权重</th>
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<tbody>
<tr>
<td>新建企业(1/10)</td>
<td>新增企业注册数量</td>
<td>1</td>
<td>1/10</td>
</tr>
<tr>
<td>吸引外来投资(3/20)</td>
<td>新增外来法人投资的笔数</td>
<td>1/2</td>
<td>3/40</td>
</tr>
<tr>
<td></td>
<td>新增外来自然人投资的笔数</td>
<td>1/2</td>
<td>3/40</td>
</tr>
<tr>
<td>吸引风险投资(1/4)</td>
<td>新增风险投资的企业数量</td>
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<td>1/8</td>
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<td>新增风险投资的金额</td>
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<td>1/8</td>
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<td>诞生创业者数量(1/10)</td>
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<td>专利授权数量（1/4）</td>
<td>新增发明专利授权数量</td>
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<td>1/8</td>
</tr>
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<td></td>
<td>新增实用新型专利公开数量</td>
<td>3/10</td>
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<td>新增外观设计专利公开数量</td>
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<td>商标注册数量(3/20)</td>
<td>新增商标注册数量</td>
<td>1</td>
<td>3/20</td>
</tr>
</tbody>
</table>
Innovation index

- **Time period:** 1990-2005
- **Regional coverage:**
  1. Ranking by province
  2. Ranking by city
  3. Ranking by county
  4. Ranking by urban district
- **Industry:** up to SIC4 level.
Trend of innovation

No. of startup

No. of VC investment

Newly granted patents
Spatial Distribution of Innovations
<table>
<thead>
<tr>
<th>Rank</th>
<th>Province</th>
<th>Total score</th>
<th>Ranking based on per capita</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Guangdong</td>
<td>95.50</td>
<td>5</td>
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<tr>
<td>2</td>
<td>Jiangsu</td>
<td>93.24</td>
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<tr>
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<td>Zhejiang</td>
<td>90.36</td>
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<td>Shanghai</td>
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<td>Beijing</td>
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<tr>
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<td>山东</td>
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<td>湖北</td>
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<td>安徽</td>
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<td>20</td>
<td>重庆</td>
<td>37.45</td>
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</table>
### City Ranking (top 50) in 2015

<table>
<thead>
<tr>
<th>城市名</th>
<th>总量指数得分</th>
<th>面积排名</th>
<th>Per capita ranking</th>
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<tbody>
<tr>
<td>上海</td>
<td>99.96</td>
<td>3</td>
<td>2</td>
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<tr>
<td>北京</td>
<td>99.96</td>
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<td>4</td>
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<tr>
<td>深圳市</td>
<td>99.85</td>
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<tr>
<td>苏州市</td>
<td>99.35</td>
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<td>杭州市</td>
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<td>成都市</td>
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<td>重庆市</td>
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<td>厦门市</td>
<td>96.14</td>
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</table>
The most innovative provinces include:

- Beijing
- Guangdong
- Shanghai
- Zhejiang

Rankings by province over time (1990-2015)

The lower the better
• Northeast region has declined.

• Liaoning’s ranking drops from 5th in 1990 to 19th in 2015.

Rankings by province over time (1990-2015)

The lower the better
Ongoing work

• Peking University is going to set up a data center to focus on information at the firm level (企业大数据研究中心).

• We will conduct Enterprise Survey for Innovation and Entrepreneurship in China (ESIEC) this summer. It will cover more than 100 counties nationwide, more than 10,000 firms.

• We will combine survey and administrative data (such as value added tax, social security, and utility bills) to keep track of both extensive and intensive firm growth. We plan to release quarterly indexes on firm performance and business environment.