Reconstructing China's Historical GDP 1840–1912: An International Comparison based on the Maddison Historical Data Project

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Beijing ICP conference
BNU, October 2018
Outline

• Introduction
  – Motivation
  – Focus of the study
  – Result

• Method and procedure

• Conclusion
  – Discussion and extension
Motivation

- Great Divergence and Asia’s small divergence, GDP per capita

## Motivation

- GDP per capita estimates, 1840s-1930s

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1840s</td>
<td>318 (10.8 taels)</td>
<td>594 (12.95 taels)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1850s</td>
<td>600</td>
<td>594</td>
<td>538</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1860s</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1870s</td>
<td>530</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1880s</td>
<td></td>
<td>572</td>
<td>7.4 taels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1890s</td>
<td>540</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1900s</td>
<td>545</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1910s</td>
<td>552</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1920s</td>
<td>562</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1930s</td>
<td>570</td>
<td>579</td>
<td>46</td>
<td>619</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Constructed by the authors.
Focus of the study

• We try to
  – Position China’s economic development in the late Qing period, 1840-1910
    • From an international comparative perspective
  – Demonstrate quantitatively the stagnation of China’s economy in history
    • Trends and fluctuations of the economy
Results

- Historical Chinese GDP per capita in 1990 international dollars

Sources: Constructed by the authors.
Results

- Annual growth rates, constant prices, 1840-1910 (%)

<table>
<thead>
<tr>
<th>Periods</th>
<th>Italy</th>
<th>Holland/ Netherlands</th>
<th>England/ GB</th>
<th>India</th>
<th>Indonesia (Java before 1880)</th>
<th>Japan</th>
<th>Qing China</th>
<th>Qing China (Total GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1840-1860</td>
<td>-0.24</td>
<td>0.17</td>
<td>0.70</td>
<td></td>
<td>-0.28</td>
<td>0.41</td>
<td>0.17</td>
<td>-0.27</td>
</tr>
<tr>
<td>1860-1880</td>
<td>0.45</td>
<td>1.06</td>
<td>1.01</td>
<td>0.31</td>
<td>0.99</td>
<td>1.31</td>
<td>0.36</td>
<td>0.24</td>
</tr>
<tr>
<td>1880-1900</td>
<td>0.74</td>
<td>0.82</td>
<td>1.32</td>
<td>0.40</td>
<td>0.63</td>
<td>1.68</td>
<td>-0.16</td>
<td>0.25</td>
</tr>
<tr>
<td>1900-1910</td>
<td>1.67</td>
<td>1.06</td>
<td>0.24</td>
<td>1.56</td>
<td>1.06</td>
<td>1.16</td>
<td>0.51</td>
<td>1.07</td>
</tr>
</tbody>
</table>

Sources: Calculated by the authors. Per capita GDP for other countries and regions is from the Maddison Project (Bolt and van Zanden, 2014). The Chinese population is also from the Maddison Project.
Methods

• Procedures of estimation
  – Rates of growth in real terms, real GDP per capita, 1840-1912
    • Nominal terms to real terms
    • General price levels: a new GDP deflator
  – An international comparison
    • Value conversion: a new benchmark PPP estimation for 1912 (with UK and with US)
  – Backward projection from the 1912 benchmark along the real growth rates
Methods: General price levels

• We included in the new GDP deflator:
  – A basket of products: rice, wheat, raw cotton, raw silk, tea, coal, and gold
  – Weights: based on volumes

• Procedures:
Methods: General price levels

• Two different economic trends
  – The new deflator using the new approach
  – An alternative deflator
    • Based on a short-cut assumption of a product basket
      – Rice and gold: fixed weights across time, 70%, 30%
Methods: General price levels

- Two different real economic trends, real GDP per capita, using two different deflators, 1912=1

Sources: Constructed by the authors.
Result 1: Real growth rates

- The new estimation of Chinese GDP and GDP per capita, 1840-1912, in constant prices, 1912=1

Sources: Constructed by the authors.
Methods: A new benchmark PPP, ca. 1910

• A new benchmark China/UK PPP ca. 1910 (Chinese Yuan/£)
  • Exchange rate, Chinese Yuan/ £, 1 Pound= 9.99 Yuan

<table>
<thead>
<tr>
<th></th>
<th>Chinese Yuan Prices/Ton</th>
<th>UK £ Prices/Ton</th>
<th>PPP Yuan per £</th>
<th>Chinese weights</th>
<th>British weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
<td>9.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>101.85</td>
<td>10.10</td>
<td>10.08</td>
<td>0.89</td>
<td>0.00</td>
</tr>
<tr>
<td>Wheat</td>
<td>71.40</td>
<td>8.14</td>
<td>8.77</td>
<td>0.10</td>
<td>0.80</td>
</tr>
<tr>
<td>Maize</td>
<td>46.49</td>
<td>6.88</td>
<td>6.76</td>
<td>0.01</td>
<td>0.20</td>
</tr>
</tbody>
</table>

|                  |                         |                 |                |                |                |
| Agriculture      |                         |                 |                |                |                |
| Industry         |                         |                 | 6.61           | 0.02           | 0.441          |
| Service          |                         |                 | 7.85           | 0.14           | 0.441          |
| **The economy as a whole** | **9.10** | **6.61** | **8.12** | **0.84** | **0.118** |

Source: constructed by the authors.
Methods: A new benchmark PPP, ca. 1910

- A new benchmark **China/US** PPP ca. 1910 (Chinese Yuan/$)
  - Exchange rate, Chinese Yuan/ $, 1 Dollar= 2.03 Yuan

<table>
<thead>
<tr>
<th>PPP between countries</th>
<th>Recent estimations</th>
</tr>
</thead>
<tbody>
<tr>
<td>China/UK PPP from our estimation</td>
<td>PPP yuan/£ = 8.12</td>
</tr>
<tr>
<td>US/UK PPP from Woltjer (2013)</td>
<td>PPP $/£ = 6.1</td>
</tr>
<tr>
<td>China/US PPP</td>
<td>PPP yuan/$ = 1.33 (64.6%)</td>
</tr>
</tbody>
</table>

Source: constructed by the authors.
Results: A new benchmark GDP of 1912

- A benchmark estimate of GDP per capita in 1912 in 1990 international dollars

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita (Yuan)</td>
<td>48.36</td>
<td>359.60</td>
</tr>
</tbody>
</table>

Exchange rates in 1912

- exchange rate (Yuan/$) 2.06
- PPP (Yuan/$) 1.33 (64.6%)

Comparative China/US GDP per capita

- At the exchange rate 0.068
- At PPP 0.105

GDP in 1990 international dollars

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5017</td>
<td>507</td>
</tr>
<tr>
<td>Maddison’s estimation</td>
<td>552</td>
<td></td>
</tr>
</tbody>
</table>

Sources: Constructed by the authors.
**Methods: A new benchmark PPP, ca. 1910**

- PPPs in manufacturing industry, China/UK ca. 1910
  - Matches and coverage of industries

<table>
<thead>
<tr>
<th>Matched industries</th>
<th>Coverage ratios (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In gross output value</td>
</tr>
<tr>
<td></td>
<td>China, 1912</td>
</tr>
<tr>
<td></td>
<td>China, 1912</td>
</tr>
<tr>
<td>Total manufacturing</td>
<td>30</td>
</tr>
<tr>
<td>Iron, steel, engineering, and shipbuilding</td>
<td>0</td>
</tr>
<tr>
<td>Metal industries</td>
<td>0</td>
</tr>
<tr>
<td>Textile industries</td>
<td>7</td>
</tr>
<tr>
<td>Clothing industries</td>
<td>4</td>
</tr>
<tr>
<td>Food, drink and tobacco</td>
<td>7</td>
</tr>
<tr>
<td>Chemicals</td>
<td>8</td>
</tr>
<tr>
<td>Paper and printing</td>
<td>2</td>
</tr>
<tr>
<td>Leather and leather products</td>
<td>1</td>
</tr>
<tr>
<td>Lumber and wood products</td>
<td>0</td>
</tr>
<tr>
<td>Stone, clay, and glass product</td>
<td>1</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0</td>
</tr>
</tbody>
</table>

Sources: Constructed by the authors.
Methods: A new benchmark PPP, ca. 1910

- PPPs in manufacturing industry, China/UK ca. 1910

<table>
<thead>
<tr>
<th></th>
<th>1910s</th>
<th>1930s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross output PPP (Yuan/Pounds)</td>
<td>Relative to exchange rates b</td>
</tr>
<tr>
<td>Fisher a</td>
<td>1 Pound= 9.99 Yuan</td>
<td>1 Pound= 14.86 Yuan</td>
</tr>
<tr>
<td>Total manufacturing</td>
<td>6.61</td>
<td>0.66</td>
</tr>
<tr>
<td>1 Food, drink, and tobacco</td>
<td>8.29</td>
<td>0.83</td>
</tr>
<tr>
<td>2 Textiles</td>
<td>6.47</td>
<td>0.65</td>
</tr>
<tr>
<td>3 Leather</td>
<td>11.98</td>
<td>1.20</td>
</tr>
<tr>
<td>4 Clothing</td>
<td>5.00</td>
<td>0.50</td>
</tr>
<tr>
<td>5 Chemicals</td>
<td>16.12</td>
<td>1.61</td>
</tr>
<tr>
<td>6 Clay, stone, glass products</td>
<td>7.75</td>
<td>0.78</td>
</tr>
<tr>
<td>7 Paper</td>
<td>9.38</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Sources: Estimated by the authors.

- Fisher PPP is a geometric mean of Laspeyres and Paasche PPPs for manufacturing PPPs and for branch PPPs.

- Relative to exchange rates: Fisher gross output PPP/ the exchange rate.
Conclusions

• “Stagnation” in an international comparative perspective
  – Rate of growth
  – the potential path of sustained economic growth after the 1900s
  – Compared to other Asian countries, no sign of persistent and sustained economic growth in the late 19th century Qing Empire
Discussion and extension Labour productivity

- Relative labour productivity in late Qing China, three sectors, 1850s/1910s (%)

<table>
<thead>
<tr>
<th>Employment shares</th>
<th>Agriculture</th>
<th>Industry</th>
<th>Services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850</td>
<td>91.3</td>
<td>3.5</td>
<td>5.2</td>
<td>100</td>
</tr>
<tr>
<td>ca. 1915</td>
<td>82.5</td>
<td>7.7</td>
<td>9.8</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value-added shares in GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850s</td>
</tr>
<tr>
<td>1910-1912</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative labour productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 1850</td>
</tr>
<tr>
<td>ca. 1910</td>
</tr>
</tbody>
</table>

Sources: Employment shares of 1850 and 1915 are from Shi et al (2014) and Wu (2016).
Discussion and extension Labour productivity

- Comparative labour productivity in manufacturing, China/UK ca. 1910/1935

<table>
<thead>
<tr>
<th>Industry</th>
<th>Comp. LP 1912/1907</th>
<th>Comp. LP ca. 1935</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total manufacturing</td>
<td>0.0905</td>
<td>0.1568</td>
</tr>
<tr>
<td>Food, drink, and tobacco</td>
<td>0.0533</td>
<td>0.1520</td>
</tr>
<tr>
<td>Textiles</td>
<td>0.0283</td>
<td>0.1152</td>
</tr>
<tr>
<td>Leather</td>
<td>0.0487</td>
<td>0.1256</td>
</tr>
<tr>
<td>Clothing</td>
<td>0.1531</td>
<td>0.1896</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0.0240</td>
<td>0.2630</td>
</tr>
<tr>
<td>Clay, stone, glass products</td>
<td>0.0734</td>
<td>0.3819</td>
</tr>
<tr>
<td>Paper</td>
<td>0.0606</td>
<td>0.2780</td>
</tr>
</tbody>
</table>

Sources: from Ma, de Jong, and Xu (2016).

Employment is defined as numbers employed rather than hours worked.

For the comparative China/UK labor productivities in 1935, we combine two estimates, the comp. LP US/UK ca. 1935 calculated by de Jong and Woltjer (2009) and the comp. LP China/Us ca. 1935 calculated by Yuan, Fukao, and Wu (2010).
Discussion and extension Labour productivity

• Comparative labour productivity in manufacturing, ca. 1910/1935 (UK=100)

<table>
<thead>
<tr>
<th>Year</th>
<th>US</th>
<th>Germany</th>
<th>Sweden</th>
<th>Italy</th>
<th>Japan</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1907</td>
<td>190</td>
<td>106.4</td>
<td></td>
<td></td>
<td>20.8</td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>58.5</td>
<td></td>
</tr>
<tr>
<td>1912</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.97</td>
</tr>
<tr>
<td>1913</td>
<td>212.9</td>
<td>119</td>
<td>101.6</td>
<td></td>
<td>24.4</td>
<td></td>
</tr>
<tr>
<td>1935</td>
<td>207.8</td>
<td>102</td>
<td>97</td>
<td>51.4</td>
<td>38.8</td>
<td>15.7</td>
</tr>
</tbody>
</table>

Sources: Broadberry, 1997, Chapter 4 and 5. For China, the estimation of comparative labour productivity is from Ma, de Jong, and Xu (2016).
Thank you!