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CHINESE REGIONS IN THE GREAT DIVERGENCE: PROVINCIAL GROSS DOMESTIC PRODUCT PER CAPITA, 1873–1918

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We construct 1912/18 Chinese provincial gross domestic product per capita from primary sources and project cross-sections for 1873 and 1893. The results fit the historical record. We hypothesise that regionally specific conflicts have a role to play in explaining differential growth rates, and that geography, governance, and sectoral structures explain relative income-level rankings. China's richest provinces matched Europe's poorest. A divergence did indeed occur, but our estimates show that at a broader economic level, it was perhaps not as dramatic as some of the literature implies.

JEL categories: N15, N95, R11, O53

Keywords: China, Great Divergence, provincial income

INTRODUCTION

This article looks past aggregate national measures of economic performance, or specific city ones, to assess whether certain parts of China were on equal footing to parts of Europe even as the 'great divergence' was, in aggregate, plain to see.

Historians have raised this question for earlier periods. Pomeranz argued that some areas of Asia were on the same level of development as European regions in the late-eighteenth century while Allen *et al.*'s work showed that unskilled labourers in eighteenth-century London enjoyed a standard of living some four-times higher than their counterparts in Beijing, Canton, and Shanghai.¹ London,

* This article is part of a project on the relationship between sub-national income and market potential around the nineteenth century world, coordinated by Nicholas Crafts (Warwick), Max-Stephan Schulze and Paul Caruana-Galizia (LSE).

1 Pomeranz, *The Great Divergence*; Allen *et al.*, Wages, prices, and living standards.

however, sets the bar high. As Broadberry and Hindle note, Beijing's living standards were comparable with those in Leipzig and Milan, so Pomeranz 'is therefore clearly right to point to variation in the level of development *within* both Europe and Asia.'² Still, the authors write, we should not overstate these similarities. Allen *et al.* found that no Asian region matched north-western European living standards by the eighteenth century, and that by the early to mid-nineteenth century, peripheral European regions also pulled away.³ With data on heights, the timing changes, but the story remains the same. Baten *et al.* show that heights in south China were persistently lower than those in the Netherlands, but the gap grew wider in the mid-nineteenth century.⁴ South Chinese heights were on the same level as Italian heights until this point, but then fell behind.

In summary, existing data indicate early and sustained divergence between Europe and China, but some similarities between China's richest regions and Europe's poorest. That some Chinese regions were at poor-European levels raises questions. First, it shows there are problems with using nations as units of analysis since they obscure too much, and with using cities in that they are usually exceptionally developed areas. Second, uncovering the variation within these two units of comparison casts doubt on broad cultural and national-level institutional explanations of relative economic performance.

We contribute to the debate by estimating China's provincial gross domestic product (GDP) per capita levels during the late-nineteenth century, and then comparing them with similar estimates for Europe from Caruana-Galizia and Marti-Henneberg.⁵ If certain regional differences in economic performance were not dramatic by the late-nineteenth century, it is easy to picture them being not so dramatic in earlier periods. However, if differences between *all* regions were dramatic, then Pomeranz's call for finer geographical units would not change the picture at all.⁶

CONSTRUCTING THE 1912/18 PROVINCIAL GDP CROSS-SECTION

We first construct a cross-section of provincial GDP for 1912/18, using data on agricultural, industrial, and services output from primary and secondary sources. We scale these sectoral cross-sections to Ma's estimates of sectoral GDP to produce a total GDP cross-section.⁷ Due to a lack of further data, we modelled this cross-section as a function of demographic and agricultural variables, using the estimated coefficients to project regional GDP cross-sections for 1873 and 1893.

2 Broadberry and Hindle, Editors' introduction, p. 2.

3 Allen *et al.*, Wages, prices, and living standards, p. 27.

4 Baten *et al.*, Evolution of living standards, p. 352.

5 Caruana-Galizia and Marti-Henneberg, European regional railways.

6 Pomeranz, *The Great Divergence*.

7 Ma, Economic growth.

Agricultural GDP

The main source for agricultural data was Perkins.⁸ This standard reference features tables of yields and acreage by crop and by province for 1914/18.⁹ It also provides prices for each crop in 1933 Yuan.¹⁰ For each province, we multiplied crop yields (in catties per mou) by crop acreage (in mou) to obtain total crop output figures by province. When Perkins provides tables of provincial crop output data, we use those. This is the case for silk cocoon production, tea production, and rice production.¹¹ While the 1914/18 data coverage for provincial crop acreage is complete, coverage for *provincial* crop yields for this benchmark year is sparse.¹² Perkins provides national level output for all crops in 1914/18, and we divide these figures by the respective national crop acreage to derive a national yield figure, when provincial yields for 1931/37 (the next benchmark year in his study) are unavailable. This is the case for kaoliang, millet, barley, miscellaneous grains, fibre, and tobacco.¹³ It is of course better to use provincial yields, but using national levels is unlikely to produce a systematic bias. Provincial variation in agricultural output stems from variation in acreage, on which there are more than enough data, more than on yields. For example, the coefficient of variation of soybean yields is 0.22 and for soybean acreage, 1.19; for cotton yields it is 0.12 and 1.23 for acreage; for peanuts it is 0.10 versus 0.90; and for corn it is 0.22 and 1.14.

Does using 1931/37 provincial yields for wheat, potato, corn, soybean, peanut, sesame and rapeseed, cotton, and sugarcane produce biases in the agricultural output table?¹⁴ While not ideal, this procedure does not change cross-sectional differentials: yields for a particular crop are either 1914/18 or 1931/37 for all provinces. Further, we ultimately scale the agricultural output cross-section to a national agricultural output figure from Ma, so cross-sectional differences are preserved and sum to a known national figure.¹⁵ It is also worth pointing out that yields did not change in any meaningful way over such a short period. Perkins' tables for national yields show that between 1914/18 and 1957 yields were flat for tobacco, fibre, cotton, barley, millet, kaoliang, and wheat.¹⁶

Multiplying provincial crop output figures by their 1933-Yuan prices from Perkins, we arrive at agricultural output for each province in 1914/18.¹⁷ Before scaling, the ratio of our agricultural output figure to Perkins' was 91 per cent. The missing 9 per cent is accounted for by livestock, for which we have no provincial data. Perkins does provide a national output figure for livestock and it is, in

8 Perkins, *Agricultural Development*.

9 Perkins, *Agricultural Development*, Appendices C and D.

10 Perkins, *Agricultural Development*, p. 288.

11 Perkins, *Agricultural Development*, pp. 276, 285, 286.

12 Perkins, *Agricultural Development*, pp. 249–65.

13 Perkins, *Agricultural Development*, pp. 278, 279, 284.

14 Perkins, *Agricultural Development*, pp. 270, 277, 278, 280, 282, 283, 284.

15 Ma, *Economic growth*.

16 Perkins, *Agricultural Development*, pp. 276–84.

17 Perkins, *Agricultural Development*, p. 288.

Table 1. Summary of agricultural GDP randomisation test

Variable	Obs.	Mean	Std. dev.	Min.	Max.	Insig. Proportion
Correlation coefficient	50	0.999	0.000	0.998	1	0%

Correlation coefficient is the Spearman rank correlation coefficient between the agricultural GDP cross-section and the latter plus the randomised livestock residual. 'Insig. Proportion' refers to the proportion of all 50 correlations of coefficients that are above the 10 per cent level of statistical significance.

1933-Yuan, 1,141,400,000. Indeed, adding this figure to our national total, we arrive at the precise national agricultural output figure in Perkins. How should this 'livestock' residual be distributed among the provinces?

We do not have any data to inform this, so we conducted a robustness test as follows. We generated 50 provincial cross-sections of uniformly distributed random continuous numbers, scaling each one so that it sums to unity. We then multiplied these weights by the 'livestock residual', adding each one of the randomised livestock residual cross-sections to the agricultural GDP cross-section. We then examined the Spearman rank correlations between the initial agricultural GDP cross-section and each one of agricultural GDP cross-sections plus randomised livestock residual ones. If the correlations are insignificant, then the distribution of the livestock residual presents a concern. Significant correlations, on the other hand, tell us that even after 50 random distributions, the residual does not change the picture. Table 1 summarises the coefficients. The mean size is 0.99, and of all 50 coefficients, all are statistically significant (below the 10 per cent level). The smallest coefficient is 0.998.

Finally, we scale our cross-section to the total including livestock, and then to Ma's agricultural GDP figure, which represents the latest work in the field.¹⁸ The final product is a provincial cross-section of agricultural GDP in 1930 Yuan. The agricultural sector made up 70 per cent of China's output in 1914.¹⁹

Industrial GDP

Following Broadberry *et al.*, our industrial output consists of metals and mining, manufacturing, food processing, and construction.²⁰ For metals and mining, we took data from the *Official Statistical Yearbook* for 1912 and 1916 on provincial coal output (average of 1912 and 1916; only two years available) and of refined metal²¹ output as well as metal ores (1916 cross-sections only, as 1912 is unavailable) in

18 Ma, *Economic growth*, p. 367.

19 Ma, *Economic growth*.

20 Broadberry *et al.*, *British economic growth*.

21 Here, the category 'refined metal' includes gold, silver, copper, iron, coal, petroleum, etc.

Yuan.²² The books recorded all modern manufacturing firms as well as family workshops of at least seven workers. The historiography tells us that these were, for a very long time, the most important subsectors of China's heavy industry.²³ According to Ma, for the 1930s, 'metal products' and 'coal products' alone accounted for 4.45 per cent of *all* China's handicraft gross output (what corresponds to the industrial sector).²⁴ We do not see an issue in taking averages across sub-sectoral output cross-sections, as we are after measuring relative levels of output for an imprecise cross-section of total GDP: 1912–18. If the national-level output numbers are anything to go by, they indicate very little growth in output over the late-nineteenth and early-twentieth centuries.²⁵ We deflated all Yuan figures to 1840 Yuan before aggregating them, using the rates implicit in Ma and De Jong and Maddison.²⁶

For food processing, we took data from the *Official Statistical Yearbook* for 1912 and 1916 on provincial output in Yuan of sugar, alcohol, and what translates into 'starch powder'.²⁷ The latter category refers to milling, and the flour produced from beans, lotus roots, sweet potatoes, kudzu, and, in 1916, wheat. All three groups represent what were staple commodities. Ma shows that in the 1930s, sugar gross output alone accounted for 4.4 per cent of all Chinese handicraft gross output, while 'flour milling' and 'rice milling' accounted for 53 per cent.²⁸ Ma does not provide numbers for alcohol output. The numbers for Kwangtung, Yunnan, and Szechwan refer only to 1912, due to data unavailability.

For manufacturing, we took data from the *Official Statistical Yearbooks* on provincial output in Yuan of silk and cotton as representative manufacturing industries.²⁹ According to Ma's numbers, 'cotton spinning', 'cotton weaving', 'silk-reeling', and 'silk-weaving' accounted for 26 per cent of all Chinese handicraft net output in the 1930s.³⁰ Again, the numbers for Kwangtung, Yunnan, and Szechwan refer only to 1912.

For the construction sector, we took data from the *Official Statistical Yearbooks* on provincial output in Yuan of bricks and tiles.³¹ Was brick the main building material? Bray writes that in late-imperial China, 'the usual building materials . . . were wood and earth . . .'.³² However, she also writes that 'rich houses' were partly made of 'fired brick' and 'poor houses' of 'cob or unbaked brick'. Thomson writes

22 Agriculture and Industry Department, *1912 Statistical Yearbook*, pp. 320–400; *1916 Statistical Yearbook*, pp. 542–5, 535–8.

23 Tawney, *Land and Labour in China*; Hartwell, A revolution in the Chinese iron and coal.

24 Ma, *Economic growth*, p. 382.

25 Ma and De Jong, China's per capita GDP.

26 Ma and de Jong, China's per capita GDP; Maddison, *Chinese Economic Performance*.

27 Agriculture and Industry Department, *1912 Statistical Yearbook*, pp. 43, 39, 55; Agriculture and Industry Department, *1916 Statistical Yearbook*, pp. 285, 281, 294.

28 Ma, *Economic growth*, p. 382.

29 Agriculture and Industry Department, *1912 Statistical Yearbook*, pp. 65, 71; Agriculture and Industry Department, *1916 Statistical Yearbook*, pp. 303, 308.

30 Ma, *Economic growth*, p. 382.

31 Agriculture and Industry Department, *1912 Statistical Yearbook*, p. 116; Agriculture and Industry Department, *1916 Statistical Yearbook*, p. 339.

32 Bray, *Technology and Gender*, p. 73.

Table 2. Summary of industrial GDP randomisation test

Variable	Obs.	Mean	Std. dev.	Min.	Max.	Insig. Proportion
Correlation coefficient	50	0.857	0.054	0.660	0.940	0%

Correlation coefficient is the Spearman rank correlation coefficient between the industrial GDP cross-section and the latter plus the randomised 'excess-Ma' residual. 'Insig. Proportion' refers to the proportion of all 50 correlations of coefficients that are above the 10 per cent level of statistical significance.

that brick-making was one of the industries that placed high demand on China's coal production.³³ It is difficult to paint a more complete picture of the relevance of brick-making (Ma does not provide any figures for it), but these strands of evidence tell us that there existed residential demand, and that the industry itself was significant enough to drive coal production. Indeed, the correlation between our brick output series in 1916 and total factory employment in 1912 (no other employment data exist) is a significant 0.49. Its correlation with Perkins' urban population numbers for circa 1900–10 is a significant 0.56.³⁴

Summing all these numbers, we arrive at a cross-section of industrial GDP. Its correlation with Feuerwerker's provincial table of the number and initial capital of Chinese-owned manufacturing and mining enterprises inaugurated between 1895 and 1913 is a significant 0.91.³⁵ Its correlation with the factory employment series mentioned above is a significant 0.62. The sum of all provincial estimates – or our national industrial GDP number in 1930 Yuan – is 48 per cent *greater* than Ma's number. This difference is much larger than the standard 10 per cent margin of error for historical national accounts. There are two reasons that account for this. First, the industrial output figures for the pre-1930s cited in Ma do not include the sugar, alcohol, and starch powder output figures.³⁶ Put together, these subsectors account for 63 per cent of the total difference, leaving a total difference of 29 per cent between our and Ma's industrial output.³⁷ Second, strictly speaking, our data refer to a broader cross-section year (1912/18) than Ma's numbers for 1914/18.³⁸ Say we subtract 10 per cent as a standard error margin in this type of work, we are left with a total difference of 19 per cent. This latter figure, we argue, can be taken as the size of the cross-sectional 'mismatch' (1912/18 vs 1914/18) between the figures.

We can assess how much this 19 per cent margin of error matters by conducting the same randomisation exercise as we did with the agricultural GDP cross-section, this time distributing the 'excess-Ma residual' among provinces. Table 2 summarises the correlation coefficients. The mean size is 0.86; all 50 coefficients

33 Thomson, *The Chinese Coal Industry*, p. 25.

34 Perkins, *Agricultural Development*, p. 292.

35 Feuerwerker, *Economic trends*, p. 36.

36 Ma, *Economic growth*.

37 Ma, *Economic growth*.

38 Ma, *Economic growth*.

are statistically significant at least at the 10 per cent level. The smallest coefficient is 0.66 and the highest 0.94, with a standard deviation of 0.05.

Finally, we scale our cross-section to Ma's industrial GDP figure, to ensure consistency throughout our scaling.³⁹ The final product is a provincial cross-section of industrial GDP in 1930 Yuan. Together, the agricultural and industrial sectors account for 78 per cent of China's 1914/18 national GDP.

Services GDP

Broadberry *et al.* divide the services sector into finance, housing and domestic services, and international trade and transport.⁴⁰ For the finance time series, they construct a measure of monetary velocity. For housing and domestic services, they follow Deane and Cole who assumed the subsector grew in line with population, except Broadberry *et al.* use an unexplained 'an allowance for urbanization'.⁴¹ For international trade and transport, they looked at exports, shipping tonnage, and urban population shares for domestic trade.

Starting with finance, the *Official Yearbooks* provide us with data on total capital – deposits, convertible notes, and retained earnings – in the financial sector. We try to include both the 'modern' and 'traditional' banking system in our financial GDP estimation. In our estimation, modern-style commercial banks and insurance companies are the representatives of the modern banking system. *Dangpu*, *Qianzhuang*, and *Piaohao* are the main elements of the traditional banking system in pre-modern China. Chang includes only these three types of financial institutions in his GDP estimation for the 1880s Qing China, because modern commercial banks emerged mainly after the 1890s.⁴² For the 1930s GDP estimation, Wu Baosan sums up six types of financial institutions, including *Qianzhuang* (or *yinhao*), *Dangpu*, modern-style commercial banks, trust companies, insurance companies, and savings banks.⁴³ Although it was one of the most influential financial institutions in Qing China before the 1890s, *Piaohao* gradually lost its status in the late nineteenth century. In the 1912 *Official Yearbook*, we still can find the record of *Piaohao*; however, we cannot find the same explicit record in the 1916 *Official Yearbook*. The period we focus on, including the four types of financial institutions into our estimation, should cover most of the financial sector and may also catch the shift in the financial industry.

We translate *Dangpu* into pawnshops. However, it is difficult to find general and agreeable translations for *Qianzhuang* (or *yinhao*) and *Piaohao*. In the Chinese literature we have covered until now, Chinese researchers choose a variety of translation. *Qianzhuang* (or *yinhao*) can be translated into banking houses, private banks,

39 Ma, *Economic growth*, p. 367.

40 Broadberry *et al.* *British economic growth*.

41 Deane and Cole, *British Economic Growth*; Broadberry *et al.* *British economic growth*, p. 16.

42 Chang, *Income of Chinese Gentry*, pp. 314–5.

43 Wu, *China's National Income*.

private money houses, and old-style Chinese banks. *Piaohao* can be translated into exchange banks, exchange shops, and draft banks. Ma translates *Qianzhuang* into 'Native Banks' in his estimation of NDP (Net Domestic Product) for the Low Yangzi region in the 1930s.⁴⁴ Edkins describes *Piaohao* as the bankers who promise to convey money from one region to another by a certain date, without providing a specific translation.⁴⁵ He referred *Qianzhuang* as 'cash shop bankers'.⁴⁶ Wagel mentioned *Piaohao* as 'the Shansi banks' because most of the owners of *Piaohao* were from Shansi (Shanxi) province.⁴⁷ He translated *Qianzhuang* into 'Native Banks'.⁴⁸ Another problem of these translations is that they mainly indicate the financial services provided by *Qianzhuang* (or *yinhao*) and *Piaohao* at their early stage. In the end of the nineteenth century, the two types of financial institutions offered a similar range of banking services, which were comparable with modern commercial banks; in the 1912 *Official Yearbook*, they were classified into one category.

To keep things simple, we use *Piaohao* to refer to both *Qianzhuang* and *Piaohao*. It is helpful to briefly introduce the two financial institutions, *Qianzhuang* and *Piaohao*. The latter started by providing payment and settlement procedures for long-distance trade and also inter-regional and international money transfer. As stated in Wagel, *Piaohao* established the system of drafts and discounts which helped to 'dispatch money from one part of the country to another . . . without actual dispatch of specie' and the system of cheques which 'dispensed with the need of a traveller carrying silver with him'.⁴⁹ It was what can be called a 'quasi-government institution': 'the Chinese treasurer in any province when sending money to Peking entrusts it to "Piaohao"'.⁵⁰ *Piaohao* expanded its business after the 1840s, taking advantage of the increase of international trade, reaching its peak in the middle of the 1890s, and finally declining when the fiscal problems of the Qing government intensified.⁵¹ *Qianzhuang* started by providing exchange services between silver taels and copper coins and between silver taels and foreign currencies, which originated from the multi-currency system in Qing China. Different from *Piaohao*, *Qianzhuang* focused on local business and short-term credit. It developed further after the 1890s when modern-style commercial banks expanded their business and when *Piaohao* started to decline, and finally declined itself with the establishment of the central bank in 1928 and the abolishment of silver taels in 1933.⁵²

In Wu Baosan's estimation for the 1930s Chinese GDP, the financial sector includes *Qianzhuang*, *Dangpu* (pawnshops), modern-style commercial banks, trust

44 Ma, *Economic growth*, p. 384.

45 Edkins, *Banking and Prices*, p. 1.

46 Edkins, *Banking and Prices*, p. 2.

47 Wagel, *Chinese Currency*, p. 154.

48 Wagel, *Chinese Currency*, p. 156.

49 Wagel, *Chinese Currency*, p. 155.

50 Edkins, *Banking and Prices*, p. 1; Wagel, *Chinese Currency*, p. 155.

51 Xu and Wu, *Zhongguo Zibenzhuayi*, pp. 681–5.

52 Xu and Wu, *Zhongguo Zibenzhuayi*, pp. 695–712.

companies, insurance companies, and savings banks.⁵³ For modern-style commercial banks, he estimated their net revenue, which equals the sum of interest revenue and other charges deducting the depreciations of physical capital such as buildings and equipment. For *Qianzhuang* (or *yinhao*), he combined the net revenue-to-capital ratio for modern-style commercial banks and the estimated total capital of *Qianzhuang* (or *yinhao*). For pawnshops, he first estimated their net revenue-to-capital ratio and total capital. In general, the equation used by Wu Baosan is: *interest revenue + other charges – depreciations – other costs = owners' profits (shareholders) + salary payments for managers and employees + interest payments for depositors (debtors)*. In Chang's GDP estimation for the 1880s Qing economy, the financial sector includes three subsectors: pawnshops, *Qianzhuang*, and *Piaohao*.⁵⁴ He estimated the value added from the income side, including owners' profits, interest payments, and salary payments. Salary payments are estimated from the number of financial institutions, the average employment per institutions, and the average salary per worker. However, he did not give details on the estimated owners' profits and interest payments. In Broadberry *et al.* and Guan and Li, the financial sector in the early stage of the Qing dynasty includes also pawnshops, *Qianzhuang*, and *Piaohao*.⁵⁵ Lacking data for *Qianzhuang*, and *Piaohao*, their estimation starts from pawnshops, employing data on the numbers of pawnshops, the total capital, and interest rates. Based on Chang's 1880 estimation, they assume that 'the ratio of the GDP of *Qianzhuang* and *Piaohao* to the GDP of pawnshops throughout the Qing dynasty is the same as during the 1880s'.⁵⁶ For Ming dynasty, no financial data are available; the ratio of financial sector GDP to total GDP during the Qing dynasty is assumed to hold for the Ming dynasty.⁵⁷ Ma estimates net domestic product by sector for Jiang-zhe provinces in 1933 from the national level, using the Jiang-zhe share. The Jiang-zhe share he used is assumed to be regional capital to the total capital for the whole country.⁵⁸ Here, total capital includes deposits, convertible notes, and retained earnings.

While it would be ideal to have instead of total capital data on provincial net revenue-to-capital ratios, they simply are not available. Using provincial interest rates or capital returns would be one possible proxy for the ratio, but here, too, data are unavailable. For pawnshops, we have only five provincial interest rates for the 1880s–90s.⁵⁹ Liu also mentioned a census for pawnshops in 1931 which covered 16 provinces, but did not give the data source.⁶⁰ For insurance companies, it is possible to calculate net revenue-to-capital ratios in 1912 for six provinces following Wu's method; however, we cannot use them as indicators for the

53 Wu, *China's National Income*, pp. 109–13.

54 Chang, *Income of Chinese Gentry*, pp. 314–5.

55 Broadberry *et al.*, China, Europe and the great divergence; Guan and Li, China's GDP.

56 Broadberry *et al.*, China, Europe and the great divergence, p. 45.

57 Broadberry *et al.*, China, Europe and the great divergence, p. 16.

58 Ma, Economic growth, pp. 364, 384;.

59 Liu, *Zhongguo Diandang*, pp. 233–5.

60 Liu, *Zhongguo Diandang*, p. 234.

other financial institutions.⁶¹ For *Qianzhuang* and *Piaohao*, we do not have any provincial interest rates, but inter-bank market integration may be a safe assumption. As described by Xu and Wu, the inter-bank market in Shanghai in the late-nineteenth century was powerful enough to influence interest rates in other regions.⁶²

What we do is use total capital, like Ma. More specifically, we sum total capital values in Yuan across all types of institutions by province in 1912 and 1916. The average of these two cross-sections provides us with provincial values on the size of the financial sector. Given all the previously discussed constraints, this is the best possible option.

For trade, we use Luo Yudong's figures of *likin* tax rates and income.⁶³ The *likin* tax was levied on an *ad valorem* basis on inter-provincial trade of goods, and was started as a way of raising funds to fight off the Taiping Rebellion. It survived well past the Taiping Rebellion, ending in 1931. We took the average *likin* income estimates covering 1883 to 1903 as representative of a province's general level of domestic trade.⁶⁴ We then applied the *likin* rates for the 'late-Qing' period to these averages, to arrive at *quantity* numbers of domestic trade by province, converting taels into Yuan at a rate of 0.72.⁶⁵ Some historians assume that the *likin* rate was flat, or at least very similar across provinces, but the numbers in Luo Yudong show us that the coefficient of variation on the rates is 0.75.⁶⁶ It is therefore important to not rely on revenues alone, as in Perkins. In contrast, when it comes to international trade, there was a national tax of 5 per cent, which was decided in the British–Chinese trade negotiations of 1842.⁶⁷ Yang and Hou provide a dataset of total tax revenue by ports, which we organised into provinces based on the location of the ports.⁶⁸ When data on tax revenues are missing in Yang and Hou, we used the export and import values data in Yao Xianhao, applying the 5 per cent tax rate to arrive at revenue figures.⁶⁹ We took the average tax revenue between 1912 and 1918 by province as our measure of provincial foreign trade. Before converting into Yuan, all figures were in H.K. taels, which was a special monetary unit, used in custom and trade records. We used the annual exchange rate time-series in Kong and Peng to do this.⁷⁰

For public services, we follow Broadberry *et al.* in measuring 'government and defence' with public expenditure.⁷¹ To smooth out the volatility in this, we use three cross-sections: Zhou Yumin's numbers for 1908; Zhou Zhichu's numbers

61 Wu, *China's National Income*, pp. 270–1.

62 Xu and Wu, *Zhongguo Zibenzhuyi*, p. 708.

63 Luo, *Zhongguo*.

64 Luo, *Zhongguo*, pp. 173, 185.

65 Luo, *Zhongguo*, p. 62.

66 Gernet, *A History of Chinese Civilisation*; Luo, *Zhongguo*.

67 Gernet, *A History of Chinese Civilisation*, p. 583.

68 Yang and Hou, *Statistics*, pp. 124–31.

69 Yao, *Zhongguo*, pp. 1610–7.

70 Kong and Peng, *Nankai*, pp. 475–8.

71 Broadberry *et al.*, British economic growth.

for 1909; and Deng Shaohui's numbers for 1911.⁷² The cross-sections are highly correlated with one another, with coefficients ranging from 0.84 to 0.93. The numbers are in taels, and we again convert using the standard 0.72 rate. Another element of public service expenditure in this period was the 'allowance' paid by the government to civil officials, military officers, and to *linsheng*, or civil servants in training. Chang provides these data, and informs us that for those in employment, income was the sum of a regular wage along with other expenses and the 'allowance', which was designed to prevent public officials from accepting bribes.⁷³ We take the total 'allowance' value paid in each province for what Chang refers to as the late-nineteenth century. Again, the goal here is to proxy the relative cross-sectional influence of the government in each province. Arriving at a precise number for any part of the service sector output is for the time being not possible.

Adding all these subsectoral output figures together, we arrive at a figure equal to 26 per cent of Ma's services GDP for 1914/18.⁷⁴ There is a lot of unaccounted for output from the transport, housing, and domestic services sector. One thing these subsectors have in common is that they are highly correlated with urbanisation. They do not rely on physical inputs, and so do not have to locate near physical resources (as manufacturing or even trade, having to be near ports, for example), and the transactions in these sectors happen in person, making it important for the subsectors to be close to their customers, as shown in Kolko.⁷⁵ Given this, we distribute the remaining 74 per cent of the services GDP number according to Perkins' 1900–12 urban population numbers.⁷⁶ This is the best we can do at the moment, but there is both conceptual and empirical support for it.⁷⁷ The correlation between the urban population numbers and the '26 per cent' services GDP cross-section is already high and significant at 0.90, indicating that there exists a strong correlation between urbanisation and services in this case. Another thing we know about the services sector from Daly is that female employment tends to be much higher in the services sector.⁷⁸ The correlation with *female only* factory employment, as used earlier, and the '26 per cent' cross-section is a significant 0.71.

Before distributing the residual 74 per cent among our constructed cross-section, we ran another randomisation test. Using the same method, we generated 50 cross-sections of uniformly distributed random numbers and scaled them to the '26 per cent' cross-section. We then added the '74 per cent' cross-section to each one of these 50 ones. The Spearman rank correlations between the standalone '79 per cent' cross-section and all the others are summarized in Table 3. The mean

72 Zhou, *Wanqing*, p. 385; Zhou, *Wanqing*, p. 163; Deng, *Wanqing*, p. 277.

73 Chang, *The Income*, pp. 36, 104.

74 Ma, Economic growth.

75 Kolko, Urbanization.

76 Perkins, *Agricultural Development*, p. 292.

77 Kolko, Urbanization.

78 Daly, A fine balance, p. 481.

Table 3. Summary of services GDP randomisation test

Variable	Obs.	Mean	Std. dev.	Min.	Max.	Insig. Proportion
Correlation Coefficient	50	0.816	0.062	0.603	0.926	0%

Correlation coefficient is the Spearman rank correlation coefficient between the services GDP '79 per cent' cross-section and the latter plus the randomised '21 per cent' cross-section. 'Insig. Proportion' refers to the proportion of all 50 correlations of coefficients that are above the 10 per cent level of statistical significance.

size is 0.816, and of all 50 coefficients, all are statistically significant (below the 10 per cent level). The smallest coefficient is 0.603, and standard deviation is 0.062.

Finally, we scale our cross-section to Ma's services GDP figure, to ensure consistency throughout our scaling.⁷⁹ The final product is a provincial cross-section of services GDP in 1930 Yuan.

ESTIMATIONS FOR 1873 AND 1893

Bringing all the sectoral GDP figures together, we produce a total provincial GDP cross-section in 1930 Yuan. We converted the cross-section into 1990 Geary-Khamis dollars using the converters implicit in Ma and de Jong to allow comparisons with the literature.⁸⁰ Here we leverage the constructed cross-section of GDP to project two more cross-sections: one for 1873 and another for 1893. Data are limited for this period, but we have the most important indicators for the Qing economy. Wang described it as follows:

In the past few centuries increased production in China has resulted mainly from population growth and expansion of acreage. Capital inputs played only a marginal role, and technological change was the least important.⁸¹

Similarly, describing the 1820 to 1949 period as one of economic decline, Maddison writes that:

[Chinese authorities] had little interest in foreign trade ... There was almost no knowledge of Western geography and technology, even less knowledge of Western languages, and education system that concentrated its full attention on the Chinese classics and a power elite of gentry-bureaucrats who had no notion changing the system of governance.⁸²

⁷⁹ Ma, *Economic growth*, p. 367.

⁸⁰ Ma and de Jong, *China's per capita GDP*.

⁸¹ Wang, *Land Taxation*.

⁸² Maddison, *Chinese Economic Performance*, p. 41.

Deng writes that in this period ‘the Chinese state was premodern if not primitive’.⁸³ By 1890, modern manufacturing and transport accounted for only 0.5 per cent of national GDP; Chinese exports accounted for 0.6 per cent of GDP, and there were ‘virtually no imports of machinery or other modern inputs’.⁸⁴ The country had virtually no railways, and a telegraphy network was started late: in the 1880s. The treaty ports, forced upon China in the mid-nineteenth century, were ‘islands of modernity’.⁸⁵ This picture receives support in the latest historical national real GDP per capita time series we have for China, produced by Ma and de Jong.⁸⁶ Their numbers show that between 1870 and 1912, GDP per capita actually *declined* at the compound annual rate of 0.21 per cent. If we consider only the 1890 to 1912 period, our last two benchmark years, the rate is –0.01 per cent. It is only in the 1920s and 1930s that the structure of the economy began to change: by 1933, the industrial sector accounted for, according to Maddison, 5.3 per cent of GDP or, according to Ma, 10 per cent of GDP.⁸⁷ Urbanisation, which is a standard proxy for productivity growth, grew slowly in China’s long-run history.⁸⁸ Figures reported in Maddison show that the proportion of urban population to total population went from 4.7 per cent in 762, to 5.2 per cent in 1120, 6.5 per cent in 1506, 6.8 per cent in 1650, and down to 5.9 per cent in circa 1820.⁸⁹ Then as now, China’s labour market was inefficiently segmented into rural and urban through the ancient *hukou* system, which restricted the emigration of rural labourers to urban areas.

In an extensive growth agricultural economy, the two variables Wang highlights – population and acreage – are what matter.⁹⁰ With the attention given to urbanisation in studies of historical economic development, we include it in this analysis to control for the potential of intensive economic growth. For acreage, we use Perkins’ provincial cultivated acreage data for 1873, 1893, and 1913.⁹¹ This is total acreage and not specific to any particular crop. Perkins remains the standard reference for these data. He also provides provincial total population data for these same years.⁹² There has been much more recent work on population estimation for the provinces, but for slightly different years: 1851, 1880, and 1910.⁹³ As the Perkins population data coincide with his acreage data, it is preferable to use both. How different are his population data from those in Cao Shuji? The Spearman correlation coefficient between Perkins’ 1913 and Cao Shuji’s 1910 numbers is 0.98. The correlation between the 1893 and 1880 numbers is 0.97. Between the 1873 and 1851 numbers, the correlation is 0.89. All

83 Deng, *A critical survey*, p. 22.

84 Maddison, *Chinese Economic Performance*, p. 47.

85 Maddison, *Chinese Economic Performance*, p. 47.

86 Ma and de Jong, *China’s per capita GDP*.

87 Maddison, *Chinese Economic Performance*, p. 47; Ma, *Economic growth*, p. 367.

88 Bairoch, *Cities and Economic Development*; Barro, *Determinants*; Acemoglu *et al.* *The rise of Europe*.

89 Maddison, *Chinese Economic Performance*, p. 35.

90 Wang, *Land Taxation*.

91 Perkins, *Agricultural Development*, p. 236.

92 Perkins, *Agricultural Development*, p. 212.

93 Cao, *Zhongguo*, pp. 703–4.

of these correlations are significant at a 1 per cent level. We use Perkins' population numbers because they are not different from Cao Shuji's and they coincide with the acreage data. For urbanisation data, we use Perkins' figures for circa 1900–10 to represent the 1912/18 cross-section of urban population, expressing it as a ratio to total provincial populations.⁹⁴ For the remaining two benchmark years, for which no provincial urban population exists, we maintain the same provincial ratios of urban-to-total populations, multiplying them by total provincial populations in 1873 and 1893. Figures in Maddison show very stable urban population-to-total population ratios from the premodern to modern periods.⁹⁵

More specifically, we implement the following OLS model

$$\ln(GDP_i) = \alpha + \beta_1 \ln(CA_i) + \beta_2 \ln(URB_i) + \beta_3 \ln(POP_i) + \varepsilon_i \quad (1)$$

where i indexes provinces; the dependent variable is the GDP of province i in 1990 Geary–Khamis dollars; CA is cultivated acreage in million shi mou; URB is the ratio urban population to total population; and POP is the total provincial population. Cultivated acreage captures variation in agricultural activity, which accounted for most of China's output during the period. By including urbanisation, we are going beyond Wang's argument that only *total* population growth mattered.⁹⁶ This is to account for the more recent empirical literature showing us that urbanisation is a better measure of economic activity.⁹⁷ The idea is that 'during pre-industrial periods only relatively prosperous areas could support dense populations'.⁹⁸ Crucially, however, we are using *urbanisation* not simply population density as in this newer literature, which uses population density to *de facto* measure urbanisation. In provinces as large as those in China, simple population density can be misleading. Indeed, a simple linear regression of our measure of log urbanisation on log population density across all province-years ($n = 72$) yields an R^2 of 0.563: an expectedly high, but imperfect correlation.

This approach has advantages. First, it fits the historical record well. As Wang, Maddison, and Ma and de Jong show, the Qing economy was agricultural and growth was extensive.⁹⁹ Output only increased as population and acreage did. Second, our projections are based on more historical data. Perkins' population (cross-checked with Cao Shuji) and cultivated acreage data are among the more reliable data we have on the late-Qing economy. Lastly, using different variables to the ones with which we constructed using the 1912/18 cross-section eliminates the risk of circularity. It also makes for a test on the validity of the 1912/18 cross-section. If the variables of population and acreage that historians have put

94 Perkins, *Agricultural Development*, p. 292.

95 Maddison, *Chinese Economic Performance*, p. 35.

96 Wang, *Land Taxation*.

97 Bairoch, *Cities and Economic Development*; Barro, *Determinants*; Acemoglu *et al.*, *The rise of Europe*.

98 Acemoglu *et al.*, *Reversal of fortune*, p. 1232.

99 Wang, *Land Taxation*; Maddison, *Chinese Economic Performance*; Ma and de Jong, *China's per capita GDP*.

Table 4. Regression results

	ln(GDP)
ln(CA)	0.224
SE	[0.103]**
RSE	[0.105]**
Boot.	[0.113]**
ln(URB)	0.0241
SE	[0.058]***
RSE	[0.051]***
Boot.	[0.064]***
ln(POP)	0.621
SE	[0.108]***
RSE	[0.088]***
Boot.	[0.002]**
Constant	8.610
SE	[1.243]***
RSE	[1.202]***
Boot.	[1.109]***
R^2	0.944
F-Stat. (OLS)	130.72
F-Stat. (RSE)	72.74
Wald- χ^2 (Boot.)	253.39
n	24

Notes: Estimated using OLS. n = number of provinces, 24. Dependent variable is log GDP in 1990 Geary–Khamis dollars in 1912/18. CA is cultivated acreage in millions of shi mou; URB is ratio of urban population to total population; and POP is total population. ‘SE’ refers to standard errors; ‘RSE’ refers to robust standard errors; and ‘Boot.’ refers to bootstrapped errors where the number of replications = 50. ‘F-Stat. (OLS)’ refers to the F-statistic of the OLS estimation with standard errors; ‘F-Stat. (RSE)’ refers to the F-statistic of the robust standard error estimation; and ‘Wald- χ^2 (Boot.)’ is for the bootstrapped estimation. *** denotes statistical significance at the 1 per cent level, and ** at the 5 per cent level. Breusch–Pagan/Cook–Weisberg test for heteroscedasticity accepts null of constant variance with a χ^2 of 2.13, and P -value of 0.144.

forward as fundamental to growth during this period were not able to explain the GDP cross-section, then it would cast doubt on the cross-section’s validity.

The results of model (1) are displayed in Table 4. The model explains 94 per cent of the variation in provincial GDP. Given its parsimony and limited number of observations, this is encouraging and adds weight to the historical descriptions of an agricultural, extensive-growth economy. The estimated coefficients fit the historical description. When standardized, population has a 0.59 standard deviation effect on GDP. Cultivated acreage has a 0.19 standard deviation effect, and urbanisation has a 0.24 standard deviation effect on GDP. All the coefficients are highly significant, even with robust standard errors and bootstrapped standard errors, indicating that the small sample may not be such an issue. Further, a Breusch–Pagan/Cook–Weisberg test for heteroscedasticity accepts the null of constant variance with a χ^2 of 2.13, and P -value of 0.144. These statistical results

support the validity of the constructed cross-section: it is explained by the arguments put forward in the historiography and by the broader historical context

As an additional robustness test, we can examine the time series reliability of the estimated coefficients. We check whether the 1873 and 1893 cross-sections are in the right 'window', by summing them and comparing to national GDP estimates from the literature. Converting Ma and De Jong's GDP per capita estimates into total GDP ones, using the population data in Maddison, our 1893 total GDP (sum of all provinces) figure is just 8 per cent larger; our 1873 number is 5 per cent smaller.¹⁰⁰ Maddison does not provide GDP estimates for our exact years, but if we compare his number for 1870 (instead of 1873) and 1890 (instead of 1893), the differences are 4 per cent larger and 5 per cent larger, respectively, meaning they are within a tolerable margin of error.

We do not see the margin of error to be a product of our specification. To show this, we linearly interpolated Maddison's GDP series and used his population series to calculate urbanisation, using the average ratio of urban to total population for 1912/18: 3.2 per cent.¹⁰¹ We also linearly interpolated Perkins' national acreage series from 1820 to 1913.¹⁰² Transforming all these interpolated series into logs, we applied the coefficients, including the constant term, in Table 4 to replicate a national GDP series. The results of this check can be seen in Figure 1. The interpolated and replicated series follow the same trends, being correlated at 0.96. The level difference between them is never greater than 9 per cent; the average is 4 per cent. The specification in model (1) and its resulting coefficients in Table 4 are reliable, according to these results, in both the cross-section and time series.

RESULTS

The results in Table 5 show that Chinese income inequality was stable. The coefficient of variation grew at a compound annual rate of 0.37 per cent, reaching 0.28 by the terminal benchmark year. Most studies of provincial inequality are confined to the post-1952 period. It is interesting to see that 0.30 to 0.35 was the level of inequality between 1952 and 1985, with an upward movement to 0.40 during the 'Great Leap Forward'.¹⁰³ The twentieth century rise in provincial inequality, Great Leap aside, is a puzzling fact of China's economic history, especially in light of the lower levels in the late-nineteenth century. Indeed, this level of inequality was not high by Asian or European standards. The coefficient of variation on Indian provincial GDP per capita went from 0.39 in 1875 to 0.31

100 Maddison, *The World Economy*.

101 Maddison, *The World Economy*.

102 Maddison, *The World Economy*, provides GDP numbers for 1913, 1900, 1890, 1870, 1850, and 1820. Perkins, *Agricultural Development*, provides acreage numbers for 1913, 1893, and 1873.

103 Demurger *et al.*, *Geography, economic policy*, p. 149.

Figure 1. National GDP time series cross-check.

Notes: Maddison (2007) uses the available data points on Chinese GDP between 1820 and 1913, interpolating the rest. The ‘Replicated’ series is the product of applying the coefficients derived from model (1) in Table 4 to a national population urbanisation time series (population from Maddison 2007, using urbanisation ratio for 1912/18), and an interpolated cultivated acreage time series. See text for further details.

in 1911.¹⁰⁴ In France, the coefficient went from 0.30 to 0.34 between 1872 and 1911.¹⁰⁵ Schulze’s figures for Austria-Hungary show a coefficient that went from 0.35 in 1870 to 0.31 in 1911, without ever dropping below 0.31.¹⁰⁶

It is possible that our provincial aggregations, by for example lumping Shanghai with the rest of Kiangsu, level off starker differentials. The data for this period do not allow for finer disaggregation, but it is unclear whether disaggregating in this way would change the picture. For example, re-calculating the coefficient of variation for France without the Paris-Seine region, we get the same levels of inequality: 0.30 in 1872 and 0.34 in 1911.¹⁰⁷ Second, as countries develop, their within-country inequality grows, and China’s stable inequality may reflect the stagnant state of the Chinese economy.¹⁰⁸ Demurger *et al.* showed that China’s most rapid increase in provincial inequality coincided with its post-1978 period of

¹⁰⁴ Caruana-Galizia, Indian regional inequality.

¹⁰⁵ Caruana-Galizia, Estimating French regional income.

¹⁰⁶ Schulze, Regional income dispersion.

¹⁰⁷ Caruana-Galizia, Estimating French regional income.

¹⁰⁸ Williamson, Regional inequality; Combes *et al.* The rise and fall.

Table 5. Chinese provincial GDP per capita in 1990 dollars

	1873	1893	1912/18	CAGR (%)
Anhwei	482	423	606	0.51
Chekiang	687	617	797	0.33
Fukien	610	528	457	-0.64
Heilungkiang	870	716	777	-0.25
Honan	416	368	362	-0.31
Hopei	810	692	506	-1.04
Hunan	579	483	509	-0.28
Hupei	684	601	745	0.19
Inner Mongolia	692	588	512	-0.67
Kansu	524	467	489	-0.16
Kiangsi	564	494	543	-0.08
Kiangsu	768	667	853	0.23
Kirin	802	670	550	-0.83
Kwangsi	493	427	497	0.02
Kwangtung	667	572	633	-0.12
Kweichow	430	403	396	-0.18
Liaoning	821	694	695	-0.37
Shansi	558	502	635	0.29
Shantung	508	438	359	-0.77
Shensi	717	625	608	-0.37
Sinkiang	575	504	824	0.80
Szechwan	634	533	559	-0.28
Tsinghai	489	468	337	-0.82
Yunnan	276	270	279	0.02
China (Mean)	677	512	586	-0.18
C.V.	0.24	0.21	0.28	0.37

Notes: All figures are in 1990 Geary–Khamis dollars. ‘CAGR’ stands for compound annual growth rate in per cent from 1873 to 1918; ‘C.V.’ stands for coefficient of variation. ‘China’ is mean of provincial GDP per capita estimates. Cross-sections for 1873 and 1893 have been scaled to Ma and De Jong (2011), using Maddison’s (2007) population numbers. The cross-section for 1912/18 has been scaled to Ma’s (2008) number for 1914.

rapid growth.¹⁰⁹ Stable inequality levels allow us to categorise provinces into three income groups based on their median income levels across the period.

In the first group, there are the high-income (\$777 to \$670) provinces of Manchuria (Heilungkiang, Liaoning, and Kirin), Kiangsu, Hopei, Chekiang, and Hupei. These provinces fall within one standard deviation (\$124) from the top performer: Heilungkiang. Apart from the latter, these provinces are all in the north east and are on the coast, which historians have long-argued gave provinces an economic advantage.¹¹⁰ Manchuria’s provinces enjoyed per capita income levels, some 30 per cent above the national average. This matches the history of

¹⁰⁹ Demurger *et al.*, Geography, economic policy.

¹¹⁰ Murphey, *Shanghai*.

Manchuria's economic success described by Eckstein *et al.*¹¹¹ Demurger *et al.* label the provinces Liaoning, Heilungkiang, and Kirin (collectively, Manchuria) 'the industrial heartland of China in 1949 (because of Japanese control of the economy that started in 1905)'.¹¹² Our results show that Manchuria, Liaoning, and Heilungkiang at least, already had an advantage by 1873, so it is difficult to attribute its success to Japanese control alone. Its 'colonisation' is more likely to have been an endogenous outcome of its historical economic advantage, which, in turn, is usually explained by its rich mineral and coal reserves, and hence early industrialisation.¹¹³ Our numbers show that Liaoning's exports grew at an annual compound rate of 20 per cent from 1873 to 1918. Kiangsu and Hopei also maintained high per capita incomes throughout. The first is home to Shanghai and the second to Beijing. By 1910, their urban populations were 2.2 and 1.6 million, respectively – the highest and second highest urban populations in China.¹¹⁴ This correlation adds weight to the arguments on the importance of considering urbanisation in the economic development highlighted earlier, and implemented in our empirical model. Chekiang's position in this group can be explained by its long history of openness to trade and commerce. Ningbo was one of the first five treaty ports opened in 1843, followed by Wenzhou in 1876. Our estimate of Chekiang's service sector GDP in 1912/18 ranks it fifth of all 24 provinces, behind Kiangsu, Hopei, Kwangtung, and Szechwan. Finally, Hupei makes it into this group on account of its industrial production. In 1912/18, Hupei alone produced 33 per cent of China's cotton. During this period, it was also the fourth largest producer of bricks. The literature often attributes this industrial success to Hupei having an unusual institutional setup. It had its own Viceroy, the most famous being the late-nineteenth century Zhang Zhidong, who modernised the province, especially Wuhan, turning it into a centre of commerce and industry.¹¹⁵

In the second group, we have the middle-income (\$633 to \$509) provinces: Kwangtung, Shensi, Inner Mongolia, Sinkiang, Szechwan, Shansi, Kiangsi, Fukien, and Hunan. These provinces all fall within one standard deviation of the top performer: Kwangtung. The latter's inclusion in this group rather than the top group may surprise: it was, after all, the centre of the opium trade – growing its exports at an annual rate of 4.3 per cent between 1873 and 1918 – and was home to Hong Kong and Macau. It was also a major producer of silk, sugar, and alcohol, contributing to its status as the third largest provincial economy (total GDP) in 1912/18. However, its large population – around 31 million by 1913 – means that in per capita terms, it falls \$20 shy of 'first group status'. Shensi had in its favour China's most productive starch powder industry, producing 54 per cent of the country's total output in 1912/18. In other industries, it accounted for very

111 Eckstein *et al.*, The economic development.

112 Demurger *et al.*, Geography, economic policy, p. 155.

113 Tawney, *Land and Labour*; Eckstein *et al.*, The economic development

114 Perkins, *Agricultural Development*, p. 292.

115 Hsu, Late Ch'ing foreign relations.

little of the country's output. The province was never home to a treaty port, and so closed to foreign trade, diminishing its service sector output. Still, its population – at 10 million in 1913 – along with its specialised starch powder output, meant that it was able to maintain a middle level of per capita income. The same story holds for peripheral Inner Mongolia and Sinkiang, the next two in the hierarchy. Inner Mongolia had no real industrial or service sector output to speak of, but it was an important agricultural producer, attracting thousands of Han Chinese migrants to farm there towards the end of the nineteenth century. In total output terms, Inner Mongolia's agricultural GDP was \$2.95 billion in 1912/18; this ranks it in twentieth place (of 24 provinces). In per capita terms, the figure is \$434; this ranks it in eighth place. The mountainous Sinkiang, the western-most province of China, made for poor agricultural land. It was also cut off from most trade networks. It did, however, produce 54 per cent of China's coal in 1912/16. Similarly, Szechwan was also kept afloat by one major industry: agriculture. It produced 12 per cent of China's total agricultural output in 1912/18; its agricultural output was almost double that of the second largest producer, Kiangsu. Apart from its public sector, the second largest in 1912/18, there was not much more activity in this province. The next two provinces – Shansi and Kiangsi – were not specialised in any particular subsector, and had middle levels of output across the board. Fukien, like Chekiang, had one of the first five treaty ports, and so has a long history of trade and commerce. Unlike Chekiang, however, Fukien did not get a railway until 1957. Its network of paved roads was also dire. Indeed, our export numbers show that Fukien's exports declined by –2.1 per cent annually between 1873 and 1918. Hunan marks the end of this group. It had China's second-most productive coal and metal industries in 1912/18, and as we would expect given this industry, the second largest volume of capital in the financial sector. With these concentrations aside, however, there was little else to support its population of 23.2 million.

Finally, in the third group we have low-income provinces (\$493 to \$276): Kwangsi, Kansu, Anhwei, Tsinghai, Shantung, Kweichow, Honan, and Yunnan. The southern provinces of Kwangsi, Kweichow, and Yunnan all had agricultural output below the national average. Yunnan's 1912/18 agricultural GDP was the twenty-second lowest; Kweichow's was the eighteenth lowest; and Kwangsi was the twelfth lowest. As Demurger *et al.* write, the natural conditions for agriculture in these provinces was favourable, but 'farming was undeveloped because malaria and other subtropical diseases checked population growth, and the high temperatures sapped human energy faster, resulting in lower labor productivity'.¹¹⁶ These provinces did not fare any better in terms of industrial or service sector output. While Yunnan and Kwangsi produced a lot of refined metal and metal ore, there was little other industry to speak of. As for services, the only subsector in which any of these provinces rank in the top 10 in 1912/18 are in the subsidies or 'allowances' paid to military officers, with Yunnan at sixth place and Kweichow

116 Demurger *et al.*, *Geography, economic policy*, p. 154.

at ninth place. Given that these allowances were paid to stop military officers from taking bribes, it does not speak to an open and efficient institutional set up. A similar story can be found in arid and mountainous Kansu. The province's output most crops and all industrial and service subsectors were below average in 1912/18, except for the same military officer allowance, where it ranked in second place. This may indicate a heavy presence of military officers, given that Kansu was the origin of the Dungan Revolts (1862 to 1877, and 1895 to 1896), which devastated the province itself and spread across China, resulting in the deaths of 12 million Chinese Muslims.¹¹⁷ Tsinghai, located on the extreme western periphery of China bordering Tibet, has rainfall and temperature conditions that are good for crop cultivation, but its terrain is rugged. The average elevation of this region is 1,428 m, with an average slope of 5.2 degrees, and 14 per cent of the land has a slope of greater than 10 degrees. The proportion of arable land of 10 per cent is barely above that you find in the arid northwest.¹¹⁸ According to our numbers, Tsinghai accounted for 21 per cent of China's land area, but in 1912/18 produced only 0.16 per cent of its agricultural output, the lowest of all provinces. Shantung is a northern coastal province and by 1898 was home to the treaty ports of Qingdao and Weihai. Our export figures show annual export growth of 12.3 per cent from 1873 to 1918. It was also, however, one of the original provinces and centres of the Boxer Rebellion (1899 to 1901), the death toll of which was not high compared with the Taiping or Dunang Rebellions, but it was still disruptive to the provincial economy. The total amount of capital in Shantung's financial sector was 36 per cent below the national average in 1912/18, which is especially low considering it was home to two treaty ports. The economies of Anhwei and Honan were also hit by internal conflict. Anhwei finds itself in the alluvial plain that runs from the north of the Yellow River to the south of the Yangtze River. Accounting for just 1.30 per cent of China's land area, in 1912/18 it produced 6.27 per cent of China's agricultural output. Anhwei was the centre of China's most devastating internal war, the Taiping Rebellion (1851 to 1863). As Gernet writes, the mass destruction of productive land and human capital meant that resources were diverted into restoring the agricultural economy at the expense of economic reform. The total amount of capital in Anhwei's financial sector was 82 per cent below the national average in 1912/18, inhibiting the development of a service and industrial sector, as well as the recovery of the agricultural sector. Lastly, Honan was affected by the North Chinese Famine (1876 to 1879), the Taiping Rebellion, and was where the 1887 Yellow River Flood started.

How do these per capita income levels compare with Europe's? In 1873, Heilungkiang was China's richest province with a GDP per capita of \$870. In 1870 Europe, there were eight regions out of a sample of 200 that had per capita incomes between \$800 and \$950.¹¹⁹ Of these eight, five were in Austria-Hungary, one in France (Haut-Garonne), one in Germany (East Prussia), and one in Spain

117 Gernet, *A History of Chinese Civilisation*.

118 Demurger *et al.*, *Geography, economic policy*.

119 Caruana-Galizia and Marti-Hennberg, *European regional railways*

(Extremadura). These comparisons add weight to the argument in Pomeranz (2000) that some European areas were at similar levels of development to Asian ones. The fact remains, however, that China's *richest* province – some 43 per cent above the Chinese average in 1873 – was only as rich as Europe's *poorest* regions. We must also remember that Chinese provinces were large: Heilungkiang was larger than modern-day Germany or Italy. Comparing subnational units is a step forward, but future research would do well to further disaggregate Chinese provinces into smaller units. In 1893, Heilungkiang remained China's richest province, but its income had declined to \$716, reflecting the nationwide economic decline of China during the late-nineteenth century. The number of European regions of a comparable income level (\$650 to \$850) in this period (1900 is the next available year for European data) is lower: one region, Dalmatia in Austria-Hungary (\$771). By the close of the period, Kiangsu surpassed Heilungkiang as the richest Chinese province with an income of \$853. The only comparable European region is Dalmatia (\$874).

On a macro level, the results in Table 5 corroborate histories of national economic decline and stagnation.¹²⁰ China's mean provincial per capita income compound annual growth rate over the period was –0.20 per cent. The internal disorder and continuous shocks to the economy in the forms of rebellions, foreign wars, and natural disasters meant that most Chinese were better off at the end of the nineteenth century than they were at the start of the twentieth. Ma and de Jong's numbers show that Chinese real GDP per capita dropped by 10 per cent from 1873 to 1912.¹²¹ Looking to Europe for comparisons, we see that Italian regions enjoyed an annual growth in per capita income of some 1.2 per cent, similar to that in France.¹²² These figures fit with Gernet's claim that China's 'tragic period' coincided with Europe's 'acceleration.'¹²³

When it comes to per capita income growth rates, rather than income levels, we need a more dynamic explanation. While a full empirical explanation is beyond our scope, we would argue that different growth rates were a result of regionally specific rebellions and revolts, rather than the more national ones like the Taiping Rebellion, which plagued China in the immediate run-up to and during this period. To get a handle on this, we grouped the provinces into ones that were affected by rebellions (*A*) and ones that were not (*B*). Group *A* contains those provinces affected by the 1899 to 1901 Boxer Rebellion (Liaoning, Hopei, Kirin, and Shantung), the 1862 to 1877 Dungan Revolt (Shensi, Shansi, and Kansu), the 1853 to 1868 Nien Rebellion (Hunan), and the 1856 to 1872 Du Wenxiu Rebellion (Yunnan). We then conducted a simple two-group mean-comparison *t*-test. The results in Table 6 show that the mean growth rate for group *A* is –0.39 per cent, against –0.09 per cent for group *B*. This yields a difference in means of 0.31 per cent, with a standard error of 0.186, and resulting *t*-statistic of 1.64. The latter

120 Maddison, *Chinese Economic Performance*; Ma and de Jong, China's per capita GDP.

121 Ma and de Jong, China's per capita GDP.

122 Felice, Estimating regional GDP; Caruana-Galizia, Estimating French regional income.

123 Gernet, *A History of Chinese Civilisation*, p. 589.

Table 6. Mean comparison of growth rates for provinces (un)affected by regionally conflict

	N	Mean	Std. Error.	Std. dev.
A	9	-0.39	0.142	0.427
B	15	-0.085	0.116	0.448
Combined	24	-0.199	0.093	0.456
Difference		0.305	0.186	
Difference = mean(B) – mean(A)				
t-stat	1.644			
P(T > t)	0.057			

Notes: All figures are in 1990 Geary–Khamis dollars and are expressed as compound annual growth rates in per cent from 1873 to 1918. Group A contains those provinces affected by the 1899 to 1901 Boxer Rebellion (Liaoning, Hopei, Kirin, and Shantung), the 1862 to 1877 Dungan Revolt (Shensi, Shansi, and Kansu), the 1853 to 1868 Nien Rebellion (Hunan), and the 1856 to 1872 Du Wenxiu Rebellion (Yunnan).

is significant at the 10 per cent level: provinces affected by regionally specific conflict grew at slower rates. We are not claiming that this evidence is conclusive, but merely putting it forward as potential explanation for provincial differences in growth rates.

By the start of the twentieth century, Europe was clearly pulling further away from China, but the provincial results show us that we need to compare sub-national units. Differences in GDP per capita between China's richest provinces and some of Europe's poorest were not as dramatic as some of the literature implies.¹²⁴ Further, the divergence in GDP per capita among regions accelerated late in the period: we found eight comparable European regional income levels in 1873, but only one by circa 1910. This is not just a matter of timing or degree, but has implications for how we explain divergent paths of development. Currently, dominant institutional explanations need to account for the similarities in income between Heilungkiang and, say, Extremadura in Spain or Haut-Garonne in France – *up until 1870*.¹²⁵

CONCLUSION

There are two avenues open for future research. First, a quantitative examination of the *drivers* of provincial income inequality would improve our interpretation of China in this period. We have sketched out some preliminary hypotheses – that rebellion explains different growth rates and geography explains stasis in income levels, for example. Testing them would allow for some clarity in the numerous

¹²⁴ Allen *et al.*, Wages, prices, and living standards; Baten *et al.*, Evolution of living standards.

¹²⁵ Rosenthal and Wong, *Before and Beyond Divergence*; Ma, Economic growth.

competing explanations of China's internal development. There is no shortage of provincial variation to exploit in an empirical study, now that the income data exist. Second, in drawing comparisons with Europe or other parts of Asia, it would be beneficial to experiment with different aggregations of regional production. Enlarging European regions so that they match Chinese provinces, or vice versa, would bring us closer to a fairer comparison of these two very different parts of the world.

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