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## ARTICLES – ARTÍCULOS

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# Measuring China's performance in the world economy. A benchmark comparison between the economies of China and the UK in the early twentieth century

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## Introduction

The late nineteenth to early twentieth century, known for drastic social and economic changes in China's economic history, has been viewed as a century-long pursuit of modernisation and industrialisation and also as a process of catching up with more advanced economies. Economic historians have been trying to explore the very beginning of modern China's ongoing industrialisation and the 1920s–1930s is commonly believed to be the most important period for China's industrial development before WWII, even though researchers have long been interested in the pre-war development of China's industry from the late nineteenth century (Brandt, Ma and Rawski 2017; Xu and van Leeuwen 2016; Yuan, Fukao and Wu 2010).<sup>1</sup> Pointing to an earlier year (period) in the history of China's pre-war industries, our study contributes to the literature by providing a new benchmark estimation of China's industrial performance for the 1910s. The year 1912 was the first year of the re-

1. Some studies declare that China's post-1949 state-led industrialisation can be traced back along a development path that began in the late nineteenth century (Wu 2011; Wong 2014). Historical studies on China's early industries refer to the influence of the Self-Strengthening Movement of 1861–1895 (for instance, Wu and Xu 2003). It is still difficult to say exactly when China started to industrialise; for some industries, records show new factories established in Shanghai before 1860 (Zhang 1989).

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publican era after the fall of the Qing Empire and, in particular, the first year with industrial data collected systematically and published as official year-books. Measuring the level of industrial development in this particular year evaluates the previous efforts toward industrialisation over the late Qing period (1840–1911). It provides a starting point for looking at the subsequent development until the outbreak of the war with Japan in the 1930s.

Measuring China's industrial performance in the 1910s improves our understanding of China's industrial development before WWII. Our new estimation provides a new benchmark to position pre-war China's industrial productivity level relative to contemporaneous economies in both Europe and Asia. Together with the 1930s benchmark estimated previously, this study, for the first time, presents the catch-up process in the industrial sector between China and more developed economies from the 1910s to the 1930s – when the industrial sector expanded rapidly in China.<sup>2</sup> Secondly, extrapolating backwards from the new 1910s benchmark, this study traces the relative development of China's early industries back to the late nineteenth century, with the estimates indicating the process of industrialisation during the years ruled by the Qing Empire.<sup>3</sup>

Specifically, this study compares the level of China's early industrialisation in the 1910s relative to that of the highly developed economy of the UK by estimating manufacturing purchasing power parities (PPPs) and calculating relative levels of manufacturing labour productivity between the two economies. Additionally, we compare the early industrial development between China and Japan, taking UK manufacturing as the reference. Moreover, this study continues by measuring industrial performance in various regions or provinces within China. With more regions and provinces included, the study reveals regional patterns of industrial performance, contributing to the discussion on the leading regions in China's industrialisation before WWII.<sup>4</sup>

2. In the 1910s–1930s, the growth of China's new industrial output exceeded that of Japan, India and Russia, according to Brandt, Ma and Rawski (2017). Yuan, Fukao and Wu (2010) constructed production-side PPPs for manufacturing industries and measured comparative output and labour productivity for three Asian economies of the 1930s, i.e., China, Japan and Korea, setting the US as the reference country. Their estimation for China indicates a level of labour productivity considerably lower than that of other Asian economies in their comparison.

3. To understand industrial development in the late nineteenth century, this study refers to the Ma and de Jong (2019) estimation for the period 1880s–1920s and compares China's industrial performance with that of Japan in the 1890s – the earliest estimates available for the quantitative comparison between China and Japan.

4. The literature on the regional distribution of China's early industries often refers to the total output in a region from the manufacturing sector or from a representative industry. Shanghai and its surrounding area are commonly described as the center for industrial production at a very early stage of China's industrialisation.

Discussions on a new estimation of China's historical GDP, recently published by Broadberry, Guan and Li (2018), have renewed attention to the "great divergence" in per capita incomes between Europe and China and their relative stage of economic development in general (Pomeranz 2000; Broadberry, Guan and Li 2021; Solar 2021). Understanding China's industrialisation and its position in the world economy contributes to "the great divergence" debate by pointing to the connection between industrialisation and economic growth, which has broad implications for future research. As the world's largest economy – at least until the early nineteenth century – and the second-largest today (or even the largest), China's economy has the power to affect the rest of the world and also has long been influenced by global developments.<sup>5</sup> Understanding China's early industrialisation and economic development in general contributes to our understanding of the history of the world economy since industrialisation.

This article proceeds as follows. Section 2 provides general information on the Chinese economy before the 1930s, relative to the UK economy, in terms of output, employment and trade. Section 3 presents a benchmark estimate of labour productivity in manufacturing between China and the UK, applying a so-called industry-of-origin approach using purchasing power parities (PPP) to compare values of production in various industries in both countries. Industrial data and sources are provided in Section 4, in which we introduce the Chinese official yearbook of 1912 in detail. In Section 5, we report the estimated manufacturing PPPs and the comparative levels of China/UK manufacturing labour productivity and then discuss the application and interpretation of the new indicator. Section 6 contains concluding remarks.

## **The Chinese economy in the early twentieth century**

Our comparison between China and the UK is based on the first Chinese industrial census of 1912 and the first UK industrial census of 1907.<sup>6</sup> The UK economy of 1907, the Chinese economy of 1912 and the 1930s represent dif-

5. According to Maddison's estimation, per capita income in China was higher than that of Europe from the tenth to the early fifteenth century and, in terms of total output, China was the world's biggest economy for several centuries before the economic decline of the nineteenth century (Maddison 2007, p. 11). According to World Bank data, China has been the second-largest economy since 2010, measured by GDP in current US dollars. According to GDP data published by the IMF, China became the second-largest economy in around 2000 and the largest in 2014, based on PPP measures.

6. To deal with the mismatch of census years, we will first calculate manufacturing PPPs between 1912 China and 1907 UK and then through extrapolation derive the manufacturing PPPs and comparative labour productivity for the 1910s. See Table 3 for the result.

ferent stages of economic development and industrialisation. Here we look at the economic structure, the structure of manufacturing, and trade patterns of the two economies in the early twentieth century. Appendix 2 gives more data and references discussed in this section.

### *GDP per capita and economic structure*

Around the 1910s, the UK economy left the Chinese economy far behind in levels of per capita GDP, although the two economies were comparable in total GDP levels. Adjusted by market exchange rates, China's GDP per capita level was around 7–10 per cent of the UK level in 1907 and 1911. Using market exchange rates may underestimate the level of per capita GDP for China relative to the UK level because they may not reflect the true domestic purchasing power of the currencies involved. It is more appropriate to use a PPP-based comparison; according to the new PPP estimated by Ma and de Jong (2019), China's GDP per capita level was 13.3 per cent of the UK level in 1911. The ratio is 12.2 per cent for 1907 and 11.7 per cent for 1912 based on the new GDP estimates for China in Ma and de Jong (2019) and Maddison's estimation of UK GDP. The above comparisons indicate roughly similar levels of economic development for China between 1907 and 1912 as a percentage of the UK level, which makes the comparison between 1912 China and 1907 UK feasible.

In both 1912 and 1935, agriculture in China had a share of more than 60 per cent in total GDP. By contrast, over 90 per cent of the UK GDP in 1911 was produced in the industrial and services sectors. The agricultural share in total GDP in China decreased in the period 1907–1935 by around ten percentage points. Nevertheless, the size of China's industrial sector in the total economy was small compared with the UK in 1911. Yuan, Fukao and Wu (2010) also stressed China's relative inferior position in industrialisation in 1935, as indicated by a low share of utilities and transportation in total GDP.

### *Manufacturing structure*

In both 1912 and 1935, China remained in the early stage of industrialisation, compared with UK manufacturing in 1907. Chinese manufacturing in this period concentrated mainly on food processing and textiles; the two manufacturing branches took up around 80 per cent of gross output and absorbed more than 70 per cent of total manufacturing employment. In UK manufacturing, around 50 per cent of gross output and employment was created by mechanical engineering and the production of mineral-based intermediate materials, including chemicals, building materials, metal and machinery. The share of metal and machinery industries in China was 12.6 per cent in 1935.

In the same year it was already 37.9 per cent in Japan, to put it in an Asian perspective (Yuan, Fukao and Wu 2010, Table 2, p. 328).

In 1912, China's food-processing industry produced more than 60 per cent of gross output with around 40 per cent of manufacturing employment; in 1935 the share became even larger. The textile industry created around 10 per cent of gross manufacturing output but being a very labour intensive sector it employed more than 30 per cent of the manufacturing labour force. Textiles expanded further to a level of around 20 per cent of gross manufacturing output in 1935. The manufacturing sector had a relatively high share of chemical products in 1912, mainly because of an extremely high level of oil production (e.g., cottonseed oil); but the share declined significantly in 1935. Despite the intention of the state to promote capital-intensive production, food-processing and textile industries dominated the manufacturing sector during the period 1912–1935.

The above comparisons are based on the gross output value, including both new factories and traditional handicraft workshops which better represent the overall situation of China's industrialisation before WWII. Within the handicraft workshops, food processing became the leading activity.

Looking at the regional level, we find that there were large differences in volumes and productivity of food processing. We grouped Chinese provinces into nine “macroregions”, according to Skinner, Henderson and Berman (2013).<sup>7</sup> In the Lower Yangzi region, the output share of food processing was below 40 per cent, and the employment share was below 30 per cent. North-east and Northwest China seemed to have a higher level of productivity in food processing, with around 60 per cent of output produced by around 30 per cent of employment. The textiles and related clothing products took more than 30 per cent of the manufacturing output and employment in the Lower Yangzi region, similarly to the UK level of 1907.<sup>8</sup> The structural shift toward intermediate goods production, such as chemicals, metal and building materials, indicates the growth potential of China's industrial sector already before WWII, however, with regional differences.

7. Boundaries of macroregions, based on river systems and other geographical conditions, and the boundaries of provinces in early twentieth century China overlap not exactly. For instance, in Skinner, Henderson and Berman (2013) the macroregion “North China” includes the north part of Anhui and Jiangsu province, but we put the two provinces into the region “Lower Yangzi”. Therefore, our grouping at the provincial level can only approximately represent the physiographic macroregions in China. Appendix 3 shows the map of “macroregions” discussed in this study.

8. Following the comparison at regional levels of Pomeranz (2000), we compare manufacturing structures between a region in China and the UK in this section (see the appendix, Figure A 2.2). Considering the problem of scale in comparing China as a whole and the UK, in section 5.2 we continue to compare manufacturing productivity between regional China and the UK.

### *Trade pattern*

To show the trade patterns for China and the UK, we regrouped the trade-related industries into three categories, following Yuan, Fukao and Wu (2010, p. 329): “primary goods”, “(relatively) simple manufactured goods” and “sophisticated manufactured goods”.<sup>9</sup> The shares for the three categories of products indicate stages of industrial development. As a country concentrates more on industrial production, its exports will shift more towards manufactured goods and its imports towards primary goods. With a much higher level of industrialisation, the UK in 1907 exported mainly manufactured goods, such as textiles, metals, and machinery, and imported primary goods, such as food products and raw materials. The UK export share of manufactured goods was 81 per cent in 1907, while the import share of primary goods was 72 per cent. Both in 1912 and 1935, China presented an opposite position relative to the UK. Around 70–80 per cent of Chinese exports were primary goods, while the import share of manufactured goods was around 50–70 per cent. The contrasting structures between the Chinese and the UK trade may also imply different characteristics of production, such as the Chinese specialisation in primary goods production.

Compared with its trade shares in 1912, Chinese exports of primary goods in 1935 decreased by ten percentage points. Until 1935, China had nearly no exports of sophisticated manufactured goods. In the 1910s–1930s, the import of primary goods increased by around 20 percentage points together with an increase in the imports of sophisticated manufactured goods such as machinery products. This change may reveal an expansion of machinery-based production in China and an increase in the domestic output of simple manufactured goods. Compared with the trade shares in 1912, Chinese imports of textiles decreased significantly in 1935, while the imports of other manufactured goods increased, particularly machinery and transportation equipment.

### **Calculating Purchasing Power Parities**

This study follows the standard approach to constructing industry-of-origin PPPs developed by the International Comparison of Output and Productivity Program (ICOP) at the University of Groningen (van Ark and Mad-

9. (1) “primary goods” includes “foodstuffs and live animals” and “raw materials, minerals, fuels”; (2) “(relatively) simple manufactured goods” includes all manufactured goods except “machinery and transport equipment”, and (3) “sophisticated manufactured goods” includes “machinery and transport equipment”.

dison 1988; van Ark 1993). Recently, the ICOP approach has also been applied to the period before WWII (Fremdling, de Jong and Timmer 2007; de Jong and Woltjer 2011) and also to the period before WWI (Woltjer 2013; Veenstra 2014). These studies not only prove that it is feasible to apply modern techniques for historical periods, but they also stress the advantages of the price-based method over the quantity-based method in productivity comparisons.<sup>10</sup>

This study estimates new manufacturing PPPs for 1912 China with 1907 UK as a reference country, following the methods applied in three studies on estimating PPPs of the 1930s: Fremdling, de Jong and Timmer (2007) gave a Germany/UK comparison for 1935/1936; de Jong and Woltjer (2011) provided a US/UK comparison for 1935; Yuan, Fukao and Wu (2010) presented a China/US comparison also for 1935.<sup>11</sup> Three extensions are made based on the newly estimated manufacturing PPPs. Firstly, we will compare (gross) labour productivities between China and the UK for 1912/1907, by using a single deflation procedure. This implies that we measure and compare the prices of gross manufacturing output. Ideally, we should also adjust for comparative movements in the prices of intermediate inputs, so as to get a double deflated estimate for the value-added of the production process.

A later improvement for this study, therefore, is to use double deflation instead of single deflation, which is considered to be the preferred approach for productivity comparisons, especially for the early twentieth century (Fremdling, de Jong and Timmer 2007; de Jong and Woltjer 2011).<sup>12</sup> The double deflation approach helps to capture differences in the technical input-output coefficients for a given industry between two economies, which might be due to, for example, differences in production methods, the type of materials used, and the imported materials. All these differences are essential to understand the early stage of China's industrialisation in the 1910s. However, both quantity and price information for inputs is not widely available in China's industrial statistics of the early twentieth century, when the newly established government of the Republic of China started to organise the first nationwide census of economic activities. Another future improvement is to adjust for

10. The quantity-based method often uses physical output per worker as a measure of productivity performance, while the price-based method uses output value per worker. The latter guarantees a higher coverage of industries in comparing productivity. Moreover, the representation of matched output for non-matched output is higher for price than for quantity ratios (Fremdling, de Jong and Timmer 2007, p. 359).

11. With the intention to compare price-based productivity levels between the 1910s and the 1930s, this study follows the estimation procedures applied for the 1930s PPPs in estimating the 1910s PPPs to ensure the consistency in methods.

12. In constructing PPPs, single deflation refers to output price data only, while double deflation considers price data for both output and intermediate inputs (See also Fremdling, de Jong and Timmer 2007, pp. 359-360).