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Kyoji Fukao, Harry X. Wu and Tangjun Yuan

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Institute of Economic Research
Hitotsubashi University
2-1 Naka, Kunitachi, Tokyo, 186-8603 JAPAN
Tel: +81-42-580-8405
Fax: +81-42-580-8333

Comparative Output and Labour Productivity in Manufacturing for China, Japan, Korea and the United States in circa 1935 by A Production PPP Approach[*]

Kyoji Fukao
Hitotsubashi University

Harry X. Wu[**]
The Hong Kong Polytechnic University

Tangjun Yuan
Hitotsubashi University

Abstract

Following the standard methodology for measuring industry-of-origin or production-side PPPs, this study compares the unit values of manufacturing products in China, Japan, Korea and the US to calculate unit value ratios (UVRs) and hence estimates PPPs for individual manufacturing industries using the US as the base country in *circa* 1935. Based on the products that could be matched between these countries, the estimated manufacturing production PPPs for China, Japan and Korea are only from half to two thirds of the prevailing market exchange rates, suggesting much lower cost of production in manufacturing in these countries than in the US. The estimated PPPs are used to calculate industry-level output and labour productivity in China, Japan and Korea relative to those of the US in *circa* 1935. The results show that the size of factory manufacturing in Japan was 12 percent of the US level whereas in China it was only one percent and even lower in Korea. In terms of comparative labour productivity, measured as PPP$ per hour worked with the US as the reference, Japanese and Korean manufacturing was 24 and 23 percent of the US level, whereas Chinese manufacturing was only 7 percent of the US level.

Key Words: Production (industry-of-origin) purchasing power parity (PPP), unit value ratio, comparative output and labour productivity, comparative advantage, economic development

***JEL* References**: L60, O47, P52

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[**] Send all correspondence to Harry X. Wu at afhxwu@inet.polyu.edu.hk.

1. INTRODUCTION

The Post-World War II rapid economic growth of the East Asian economies cannot be well understood without a proper measure of the pre-WWII economic conditions in an internationally comparative framework. What is missing in the conditional convergence literature is a measure on real production costs at industry level especially for producer goods manufacturing that plays a key role in the modern economic development.

Level of a country's real per capita GDP measured by expenditure-side purchasing power parities (PPPs) is by nature a measure of a nation's welfare level relative to that of the benchmark country. While it may suggest the country's relative stage of economic development but does not *directly* measure the level of its industrialization and (industry-specific) labour productivity compared with those of the benchmark country.[1] It has been widely accepted that "industry-of-origin" or production-side PPP approach is a more appropriate direct method for measuring such conditions between countries (see Rostas, 1948; Paige and Bombach, 1959; Maddison, 1970 and 1983).[2] This is because by comparing industry-specific producer prices between countries we can measure the relative real factor costs of production at industry level by taking into account the prices of both tradables and (implicitly) non-tradables, which will shed important light on a country's comparative advantage and international competitiveness.

The current study attempts to fill this gap in literature to measure the pre-WWII East Asia comparative output and labour productivity by constructing production-side PPPs in manufacturing for three major East Asian economies, China, Japan and Korea, with the US as the reference country in *circa* 1935 – the best pre-war period. This is particularly important for the understanding of the pre-WWII economic conditions in China. Compared with Japan and Korea,[3] historical macroeconomic statistics for

[1] The expenditure PPP approach was pioneered by Gilbert and Kravis (1954) and developed by Kravis, Heston and Summers in the International Comparison Program (ICP) since the 1960s and resulted in the Penn World Tables (see Kravis, Heston and Summers, 1982; Summers and Heston, 1991).

[2] See Maddison and van Ark (2002) for a comprehensive review of the industry-of-origin PPP approach developed in the International Comparison of Output and Productivity (ICOP) program led by Maddison at University of Groningen.

[3] Among the East Asian economies, the most consistent and reliable long-term GDP series going back to the late-19th century are available only for Japan, partly thanks to the efforts of the Long-Term Economic Statistics (LTES) project under the leadership of Kazushi Ohkawa at the Institute of Economic Research of Hitotsubashi University in Japan, leading to a publication of 14 volumes for Japan (an abridged English version by Ohkawa and Shinohara, 1979). The Hitotsubashi group extended

China are sketchy. Solid economic statistics for standard national accounts are only available for the mid 1930s, thanks to the pioneering work on constructing China's GDP for the period 1931-36 by Ou (1947), Liu (1947), Liu and Yeh (1965) and Yeh (1977). We argue that by benchmarking China with the leading regional (Japan) and international (the US) economies where better and longer time series data are available, together with other social and economic information, we may find a sensible way to quantitatively position China. Of course, focusing on one benchmark (currently 1935) is insufficient to anchor the long historical course of China's industrialization that began in the late period of the Qing Empire following the First Opium War, but it is an important starting point.[4]

Like many production-side PPP studies, the current study concentrates on the manufacturing sector. Although there are generally more data available for manufacturing than for other industries, it is the importance of manufacturing in modern economic development rather than the data availability that is the major motivation behind most studies. Among all industries, manufacturing plays the most important role especially at the early stage of industrialisation. It is the most dynamic sector because manufactured goods have relatively high income elasticity of demand; they are highly tradable and have greater potential to gain from specialisation and economies of scale through trade. Manufacturing growth is also the most important factor behind innovation and hence technological progress. Therefore, as found in many studies, the substantially rising share of manufacturing is almost a universal feature of rapid structural transformation at the early stage of industrialisation (Kuznets, 1971; Chenery, Robinson and Syrquin, 1986).

In addition, a production-side PPP study plays a complementary role in checking any existing expenditure PPP study for the same countries during the same period. In particular, this study may help complement recent studies for Japan/China, Japan/US and China/US in *circa* 1935 using the expenditure PPP approach (see Fukao, Ma and Yuan, 2007, for example).[5] In theory, a country's PPP GDP estimated by expenditure

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this line of research to two former Japanese colonies, Taiwan and Korea, with the 1988 publication of a statistical volume compiled by Mizoguchi and Umemura. The volume provides annual estimates of GDP and its various components for these two economies during the period of Japanese occupation based on the detailed economic statistics of the colonial administrations.

[4] Such a historical benchmark study is also significant for checking PPP estimates for the modern time Chinese economy. See studies on China/US production PPPs for manufacturing industries by Szirmai and Ren (2000) and Wu (2001).

[5] The recent study by Fukao, Ma and Yuan (2007) for the first time constructs expenditure PPPs for Japan/China, Japan/US and China/US for circa 1935. Together with other studies (Fukao, Ma and

and production approach respectively should be the same or at least well reconciled. A production-side PPP study on manufacturing is one important step towards that goal.

This paper proceeds as follows. In Section 2 we provide a general picture of the economies of China, Japan, Korea and the US in terms of output and employment structures as well as foreign trade by major commodity groups, which serves as a useful background for the whole study. Section 3 presents the standard industry-of-origin PPP approach and discusses the key measurement issues concerned. In Section 4, data sources are provided and problems are discussed for individual countries. In Section 5, we report the estimated PPPs and discuss the results against the background of cost conditions in individual industries between countries in comparison. In Section 6, we apply the estimated PPPs to the cross country output and labour productivity comparisons. Finally, in Section 7 we conclude this study with a discussion of the important implications of our findings.

2. THE CHINESE, JAPANESE, KOREAN AND THE US ECONOMIES IN THE MID 1930S

The selected countries in the current study are fairly representative for different stages of modern economic development. By the mid 1930s, while the US was the world's leading industrial power, just recovered from the Great Depression in 1929-33, the Japanese economy had already undergone a rapid catch up with the West in industrialisation that began during the Meiji period (1868-1912).[6] China's modern industrial development was motivated by its consecutive failures in wars with the Western powers since the First Opium War (1840), as well as increasing domestic rebellions,[7] but it had been slow and largely defence-oriented. Japan's rising as the major regional military power in response to China's military build up in the 1860s-1880s and success in defeating the Qing Imperial Navy in 1894 forced China to speed up its industrialization. However, political and social chaos in the early period of the republican China (from 1911 to the mid 1920s) significantly impeded the course of China's industrial development. By the mid-1930s, which is our benchmark period,

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Yuan, 2006; Yuan and Fukao, 2002), this study also extends the expenditure PPP-based international comparison to Taiwan and Korea for the same period.

[6] The Meiji Restoration (1868) was the catalyst toward industrialization in Japan that led to the rise of the island nation as a major military power by 1905, under the slogan of "Enrich the country, strengthen the military" (fukoku kyōhei). See Ohkawa and Shinohara (1989), Beasley (1995), and Fukao and Saito (2006).

[7] Taiping Rebellion (1851-1864) was certainly the most destructive and costly rebellion to the regime. Lesser rebellions at that time include Miao Rebellion (1860-72) and Nien Rebellion (1851-68).

China had just enjoyed its ever first "golden decade" of industrialization, but it was still well below the level of Japan can be seen clearly in Table 1.

The Korean economy in our comparison serves as a different reference. Korea underwent its modern industrial development when it was held as the Japanese colony in 1910-1945. However, the Korean development was typically a colonial type concentrating on agricultural and primary resource-based or labour intensive manufacturing that complemented the resource-hungry Japanese economy (see for example, Fukao, Ma and Yuan, 2007; Kim, 2007; Mitsuhiko Kimura, 2008; Mizoguchi and Umemura, 1988,). The integration of the Japanese and Korean economies through colonialism might be one of the main reasons for Korea to grow more rapidly than China (Table 1).

Income Level and Economic Structure

Both the level and the structure of GDP in Table 1 suggest different stages of economic development in the countries in our comparison. The US was the largest economy in total and per capita GDP and left all other economies far behind. In *circa* 1935, in terms of total GDP measured by market exchange rate, China was 15 percent of the US level, followed by Japan (7 percent) and Korea (1 percent). If measured by per capita GDP (still at market exchange rate), it will more appropriately reflect the stage of development because of the removal of the population effect. As shown in the table, the per capita GDP was $450 for the US, $64 for Japan, $28 for Korea and $18 for China.

TABLE 1
BASIC NATIONAL ACCOUNTS INDICATORS FOR COUNTRIES IN COMPARISON IN CIRCA 1935

<table>
<tr><th></th><th>USA</th><th>China[6]</th><th>Japan</th><th>Korea</th></tr>
<tr><td>Total GDP (in mil US$)[1]</td><td>65,400</td><td>9,522</td><td>4,445</td><td>651</td></tr>
<tr><td>Population (thousand persons)</td><td>127,250</td><td>528,000</td><td>69,254</td><td>22,899</td></tr>
<tr><td>GDP per Capita (in US$)</td><td>514</td><td>18</td><td>64</td><td>28</td></tr>
<tr><td>GDP per Capita (Expenditure PPP$)[2]</td><td>514</td><td>45</td><td>143</td><td>66</td></tr>
<tr><td>Maddison GDP per Capita (Expenditure PPP G-K$)[3]</td><td>514</td><td>53</td><td>199</td><td>126</td></tr>
<tr><td>Structure of GDP: (%)[4]</td><td>100.0</td><td>100.0</td><td>100.0</td><td>100.0</td></tr>
<tr><td>Agriculture, Fishery, Forestry</td><td>11.7</td><td>62.5</td><td>18.1</td><td>49.0</td></tr>
<tr><td>Mining</td><td>2.1</td><td>0.9</td><td rowspan="2">30.3</td><td>2.1</td></tr>
<tr><td>Manufacturing[5]</td><td>23.4</td><td>10.1</td><td>10.2</td></tr>
<tr><td>Construction</td><td>2.3</td><td>1.7</td><td>6.3</td><td>3.3</td></tr>
<tr><td>Utilities</td><td>3.8</td><td>0.7</td><td rowspan="2">10.2</td><td>2.5</td></tr>
<tr><td>Transportation</td><td>6.5</td><td>5.7</td><td>6.7</td></tr>
<tr><td>Other Services</td><td>50.2</td><td>18.4</td><td>35.1</td><td>26.2</td></tr>
</table>

Sources: For total GDP, industrial composition of GDP and population, Chinese data are from, Yeh (1977, p.97, Table.1) and Luo (2000, p.27, Table 2), Korea data are from Kim (2008, pp.392-393, Table I-1 and I-2), Japanese data are form Ohkawa, Shinohara and Umemura (1974, p. 202), and the US data are from U.S. Department of Commerce Bureau of the Census (1976, Part I, p.224.). The population estimate for China in the mid 1930s is controversial. Many researchers (see Ma, 2008, pp. 359-69) adopt the figure as 500 millions from Liu and Yeh (1965). We adopt the estimates by Luo (2000) whose work attempts to adjust the pre-war official estimates to fill gaps in infant and woman statistics, to re-estimate population statistics by the Princeton life-table approach using the 1929-31 survey data and vital statistics, and to include population for Tibet. Inner Mongolia and Manchuria.

Notes:

1) All figures measured in US$ in this table are simply converted by the prevailing market exchange rate. In 1935, 1 US$ was equal to 3.43 Japanese Yen and 3.01 Chinese Yuan. Korean Yen = Japanese Yen.
2) Based on Fukao, Ma and Yuan for the average of 1934-36 (2007, Table 8), suggesting a PPP converter as 3.21, 2.23 and 2.36 for China, Japan and Korea, or 31, 45 and 42 percent of the US price level, respectively.
3) Derived from Maddison (2003, pp. 88 and 182), assuming that his estimate of $5,467 for US in constant 1990 GK$ is equivalent to $514 at 1935 prices, and his estimates for other countries relative to the US level are held (i.e. deflated by the same price index). This approach is different from Fukao, Ma and Yuan (2007, see Figure 1 for the same comparisons in 1990 PPP$).
4) Industry compositions of GDP are calculated in nominal terms of national currencies. Industry composition data for Japan is based on net domestic product.
5) See Table 2 for the structure of manufacturing by factory production.
6) Yeh (1977, p.97, Table.1) estimated China's 1935 GDP at 1933 prices. We use weighted agricultural and industrial price indices for 1933-35 to adjust the estimate to 1935 prices.

It is however more sensible to convert these per capita figures into PPPs. By applying the only available bilateral expenditure PPP estimates in Fukao, Ma and Yuan (2007) to the above figures, we can come out with per capita PPP estimates as $143 for Japan, $66 for Korea and $45 for China. It shows that while Japan had already reached to nearly one third of the US level of per capita PPP GDP, China only achieved one tenth of the US level, which was even 30 percent below the Korean level. Here we also compare Fukao-Ma-Yuan estimates with those of Maddison (2003) to show the differences between the two studies.[8]

The GDP structure of these countries also reflects different stages of economic development. As shown in Table 1, in *circa* 1935 China had the largest share in agriculture (62.5 percent), followed by Korea (49.0), Japan (18.1) and the US (11.7). In the same period, one forth of the US GDP (25.5) was produced by the industrial sector (manufacturing and mining). By contrast, as the country that experienced the most rapid catch up with the US, 30.3 percent of Japanese GDP came from industry, compared with only 12.3 in Korea and 11.0 percent in China. Furthermore, China's relative inferior position in industrialization is also reflected by the development of the so-called facilitating industries such as utilities and transportation. In *circa* 1935, only 6.4 percent of the Chinese GDP was produced by the facilitating industries, whereas the share was over 10 percent in both the US and Japan and about 9 percent in Korea.

[8] See discussion in Fukao, Ma and Yuan (2007) about the differences in per capita PPP GDP estimates especially for Korea between Fukao, Ma and Yuan and Maddison (2003).

Manufacturing Structure

The structure of the manufacturing sector in these countries also indicates the different level of development. In Table 2, we first present the share of factory manufacturing in total manufacturing, which indicates to what extent the economy has transformed from traditional to modern manufacturing. We then examine the structure of factory manufacturing among these countries.

TABLE 2
TOTAL AND PER EMPLOYEE GROSS VALUE ADDED IN MANUFACTURING, AND MODERN MANUFACTURING STRUCTURE FOR COUNTRIES IN COMPARISON IN 1935

	USA	China	Japan	Korea
Total manufacturing GVA (in mil US$)[1]	19,496	1,059	1,575	68
Manufacturing GVA by factory[2] (in mil US$)	18,616	121	1,138	51
	(95.5)	(11.4)	(72.3)	(75.6)
GVA per factory employee (US$)[3]	2,246	154	482	307
Structure of factory manufacturing: (%)[4]	100.0	100.0	100.0	100.0
Food, beverage and tobacco	15.0	14.9	11.6	35.8
Textiles, wearing apparel, leather products	13.8	43.1	19.3	11.9
Wood and allied products	4.8	0.2	1.8	3.9
Paper, printing and publishing	6.9	8.1	2.9	4.6
Chemicals and allied products	19.0	13.4	18.6	29.2
Building materials	3.2	6.5	4.3	4.6
Basic and fabricated metals	13.3	4.8	15.9	4.2
Machinery and transportation equipment	19.4	7.8	22.0	2.6
Miscellaneous manufacturing	4.7	1.3	3.6	3.1

Sources: US data are from U.S. Department of Commerce (1936), Chinese data from Makino and Kubo (1997), Japanese data from The Ministry of Commerce and Manufacturing (Sho Ko-sho) (1935), Korean data from Kim (2008) and Chosen Government-General (1937).

Notes:
1) See Table 1 for market exchange rates used for conversion.
2) The share of the factory sector is given in the brackets. See Section 4 for the definition of the factory sector.
3) Since the employment here is based on numbers employed rather than hours worked, this estimation should not be taken as a strict measure of labour productivity. See Table 6 for the conversion of industry level numbers employed into hours worked.
4) Output shares are calculated in national currencies.

As Table 2 shows, the factory share of the US manufacturing was 95.5 percent (as shown in the figures in brackets under manufacturing GVA), compared with 72.3 percent in the case of Japan. Such a difference looks plausible given the stage of their development. Growth is inevitably unbalanced within the manufacturing sector during industrialisation. Empirical studies have found that typically, driven by the significant growth of intermediate demand in total production, investment goods industries are the fastest growing industries, followed by intermediate goods industries and then light industries that mainly produce consumer goods (Nishimizu and Robinson, 1984). Such observations should be confirmed by our country cases in the current study.

To help our examination we can roughly reclassify all manufacturing industries into two groups: one that is agricultural or primary resource-based manufactures that largely concentrated on the production of "consumer goods" (including food, textiles, wood and paper products, excluding miscellaneous) which tended to more labour-intensive and the other that is mineral-based intermediate materials production and machinery manufacturing that focused on the production of "producer goods" (i.e. including chemicals, building materials, metals and machinery) which tended to be more capital-intensive. The re-grouping shows that the share of "consumer goods" in China and Korea was indeed high, about 66 and 56 percent of the total manufacturing, respectively, whereas the same share in the US and Japan was much lower or 40 and 36, respectively. As for the share of "producer goods", it was low in China (34) and Korea (44), but high in the US (60) and Japan (64). Obviously, the structure of the Chinese and Korean manufacturing was much "lighter" or more labour-intensive than that of the US and Japan because they were still at the earlier stage of industrialization, by contrast, the US and Japanese manufacturing were much "heavier" or capital-intensive.

Furthermore, the structure of the Korean manufacturing does not suggest that Korea was more industrialized than China. Although Korea had smaller "consumer goods" manufacturing than China, 64 percent of the Korean "consumer goods" engaged in "food" whereas in China 65 percent of "consumer goods" were textiles (taking the group total as 100, Table 2). In the case of "producer goods", 37 percent of the Chinese heavy industries engaged in the production of "metals" and "machinery", whereas only 16 percent in the case of Korea. By contrast, 59 percent of the Japanese "producer goods" industries engaged in "metals" and "machinery", even higher than that of the US (55). However, considering the integration of the Japanese and Korean economies, we argue that the overly "heavy" Japanese manufacturing might be complemented by the excessively "light" Korean manufacturing.

Trade Patterns

The history of modern economic development has shown that countries tend to export primary goods to exchange for manufactured goods especially machinery at the early stage of development. Along with industrialization, their exports will become more concentrated on sophisticated manufactured goods and their imports will be mainly primary goods or (simple) manufactured goods that could be produced cheaply in low income countries. This is reflected by the structure of trade of the countries in our comparison for *circa* 1935. We can divide the commodities traded in Table 3 into three categories: 1) "primary goods" including "food stuff and live animals" and "crude materials, minerals, fuels", 2) "(relatively) simple manufactured goods" that includes all manufactured goods except "machinery and transport equipment", and 3) "sophisticated manufactured goods", that is, "machinery and transport equipment".

As Table 3 shows, with higher level of industrialization compared with China and Korea, the US and Japan exported more manufactured goods than primary goods. It should be noted here that resource endowment plays a role in determining trade patterns. Since the US is relatively resource rich and Japan is excessively resource scarce, the export of primary goods was extremely low in Japan (only 12 percent compared with 40 percent in the US). The case of China and Korea just shows the opposite: 67 percent of the Chinese exports and 76 percent of the Korean exports were primary goods. Again, the Korean case further supports our postulation about the "colonial integration" of the Korean and Japanese economies. It should be noted that China was also an important importer of primary goods (49 percent of total imports). Although China has a much larger territory than Japan, it is not rich in resource endowment on per capita basis; besides, China's poor infrastructure back to the 1930s prohibited lost-cost extraction of natural resources.

Table 3 also shows that 81 percent of the Japanese exports focused on simple or less sophisticated manufactured goods, which looked rather excessive compared with the US (37), China (33) and Korea (23). It is clear that in the mid 1930s, the US was the most important, if not the sole, player in the export of machinery and transport equipment, accounting for 23 percent of its total exports. The Japanese machinery export was about 7 percent of its total exports, whereas only one percent for Korea and nothing for China.

TABLE 3

EXPORT AND IMPORT VALUES FOR CHINA, JAPAN, KOREA AND THE US BY MAJOR COMMODITY GROUP IN *CIRCA* 1935

(In million US dollars; national currencies are converted at market exchange rate[5])

	USA		China		Japan		Korea	
	Export	Import	Export	Import	Export	Import	Export	Import
Total value	2243.1	2038.9	172.8	222.4	979.6	997.7	160.5	193.3
Food stuffs and live animals[1]	458.7	1074.4	37.1	59.5	97.2	583.9	94.4	32.3
Crude materials, minerals, fuels[2]	432.3	312.2	78.5	48.6	21.6	106.5	27.1	32.0
Chemicals	103.1	68.7	3.5	17.9	92.6	96.3	7.1	15.3
Textiles	456.2	306.9	29.1	18.3	474.7	19.0	17.2	54.2
Manufactured goods classified chiefly by material[3]	195.6	177.2	15.5	32.0	117.5	118.2	5.2	13.9
Machinery and transport equipment	520.9	14.5	0.7	17.9	70.8	46.7	1.5	18.4
Miscellaneous manufactured articles[4]	76.3	85.1	8.3	28.2	105.1	27.1	7.9	27.2
Of which:								
"Primary"[6]	0.40	0.68	0.67	0.49	0.12	0.69	0.76	0.33
"Simple manufactured goods"[6]	0.37	0.31	0.33	0.43	0.81	0.26	0.23	0.57
"Sophisticated manufactured goods"[6]	0.23	0.01	0.00	0.08	0.07	0.05	0.01	0.10
As percentage of Gross Value of Output (%)	3.9	3.6	2.5	3.2	22.0	22.4	24.7	29.7

Sources: The US data are for merchandise activities only, including re-export of foreign merchandise, from US Department of Commerce (1936, pp:.466-550, Table 523-524). Data for Japan and Korea are the average of 1934-36, from Yamazawa and Yamamoto (1979, pp. 178-183), IER (2000) and Kim (2008, p.111). Data for China are the average of 1933 and 1938 from IER (2000).

Notes:

1) Including beverages, tobacco, and animal and vegetable oils and fats.
2) Excluding edible materials; including lubricants and related materials.
3) Excluding textiles.
4) Including other commodities and transactions not classified according to kind.
5) See Table 1 for exchange rate in 1935.
6) "Primary" includes "food stuffs and live animals", "crude materials, minerals and fuels"; "simple manufactured goods" includes all manufactured except "machinery and transport equipment"; lastly, "sophisticated manufactured goods" = "machinery and transport equipment".

Our review so far has drawn a simple background picture about the economic conditions of the countries in comparison in *circa* 1935, including their levels of per capita income, patterns of economic structure, patterns of manufacturing structure, and structures of import and export trade. These patterns are in general logically coherent and suggest different comparative advantages of manufacturing industries in these countries, which will be checked later in our PPP exercise comparing the producer prices or factor costs of producing the same product in these countries.

3. METHODOLOGY

Methodologically, we follow the standard approach of constructing the industry-of-origin PPPs developed by the International Comparison of Output and Production Program (ICOP) at University of Groningen led by Angus Maddison (Maddison and van Ark, 1988; van Ark 1993) and its recent practices especially in pre-WWII comparisons including an UK/US comparison by de Jong and Woltjer (2007) and two UK/Germany comparisons by Broadberry and Burhop (2007) and by Fremdling, de Jong and Timmer (2007), all for 1935/36.[9]

The methodology and data used in sectoral comparisons differ significantly from the standard International Comparison Program (ICP) procedures. While price data for ICP are largely obtained from extensive price surveys conducted in the participating countries, the industry-of-origin approach relies on price data implicit in the censuses of manufacturing. Results of separate price surveys are not systematically used. The product lists and specifications are also drawn from the census data. The aggregation methodology used here is quite simple because there are only bilateral comparisons involving two countries at a time. Largely due to data constraints so that we cannot perform complicated multilateral methods to compute PPPs necessary to convert value aggregates. An important aspect of these production-side PPP comparisons is that along with price data, derived in the form of unit values,

[9] Besides, Choi (2006) and Kim, Duol and Park (2007) compared the labour productivity levels of the Japanese and the Korean manufacturing sector in the pre-war period. Their analysis is based on real gross output per worker estimation. Using the approach of Rostas (1948), Yukizawa (1977) compared the labour productivity levels of the Japanese and the U.S. manufacturing sector in the pre-war and the post-war period. Pilat (1994) compared labour productivity levels of the Japanese and the U.S. manufacturing sector for 1939 using his estimates of PPP.

we also have quantity data at the product level. Therefore there is no need to use the concept of basic headings[10] which is central to the ICP work.

Let us begin with some basic notations. Let q and p refer to quantity and price, respectively, and superscripts B and X represent the base country and the country to be compared, respectively. Subscript i refers to manufactured product, j refers to the type of industry, and k refers to the type of manufacturing branch, which is equivalent to the 2-digit level "manufacturing industry" used in ISIC.[11]

In the standard ICOP industry-of-origin studies, prices are in fact unit values (UVs) as they are derived from data on values (v) and quantities (q) for specific manufactured products or broad categories of products, thus, for product i, $UV_i = \frac{v_i}{q_i}$. We can obtain unit value ratios (UVRs) by a direct comparison of UVs between two countries, which can be used in deriving PPPs at the branch and sectoral levels. In the industry-of-origin approach, a distinction is made between UVRs and PPPs. UVRs refer to product level price information and PPPs refer to price levels at more aggregated levels, e.g. from manufacturing industries to branches and to the whole manufacturing sector.

The production PPPs are derived using a "pyramid" type approach which consists of three steps. The first step involves the derivation of industry-specific PPPs based on prices of manufactured products belonging to a particular industry and aggregated using output or sales quantities as weights. The second step uses these industry-specific PPPs and aggregated to yield branch level PPPs. Finally, the third step uses these branch-level PPPs and aggregated to derive a single PPP for the whole manufacturing sector.

Step I: Industry-specific PPPs

Let p_{ij} and q_{ij}, respectively, denote the price ($=UV_{ij}$) and quantity of manufactured product i belonging to industry j that is considered to have matching specifications and quality. For all "matched products" which are considered as typical of the industry to which they belong, the PPP for this industry using either country weights are derived as follows:

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[10] For the purpose of ICP, basic headings are defined as the lowest level of aggregation at which expenditure share weights are available for the purpose of aggregation.

[11] In this study's PPP exercise, due to data constraint, we reclassify the 2-digit industries into larger groups within the manufacturing sector.

(1) $$PPP_j^{XB(B)} = \frac{\sum_i^m p_{ij}^X q_{ij}^B}{\sum_i^m p_{ij}^B q_{ij}^B} \quad (i = 1, 2, \ldots, m)$$

for the Laspeyres Index using the base country quantity weights, and

(2) $$PPP_j^{XB(X)} = \frac{\sum_i^m p_{ij}^X q_{ij}^X}{\sum_i^m p_{ij}^B q_{ij}^X} \quad (i = 1, 2, \ldots, m)$$

for the Paasche Index using the quantity weights of the country to be compared, respectively.

The Fisher index formula is used to compute PPPs at the industry level. Taking the geometric average of the so-constructed Laspeyres and Paasche indices we can obtain PPP for industry *j* as a Fisher Index:

(3) $$PPP_j^{XB(\text{Fisher})} = \sqrt{PPP_j^{XB(B)} \times PPP_j^{XB(X)}}$$

The choice of the Fisher index is largely guided by the number of desirable statistical, axiomatic and economic–theoretic properties resulting in labels like the "ideal index" and the "superlative index" (Diewert, 1992).

Step II: Branch Level PPPs

At this stage, the so-constructed *j* industry level PPPs are aggregated to *k* branch level PPPs. It is obtained by the weighted average of sample industry PPPs using the gross value of output (GVO) of the sample industries as weights. The following formulas are developed especially to take into account the size effect of industries in aggregation (see van Ark, 1993).

The calculation in this step results in two *k* level PPPs, one at the quantity weights of the base country or the Laspeyres weights:

(4) $$PPP_k^{XB(B)} = \frac{\sum_j^n \left[GVO_j^B \times PPP_j^{XB(B)}\right]}{\sum_j^n GVO_j^B} \quad (j = 1, 2, \ldots, n)$$

and the other at the quantity weights of the country to be compared or the Paasche weights:

(5) $$PPP_k^{XB(X)} = \frac{\sum_j^n GVO_j^X}{\sum_j^n \left[GVO_j^X / PPP_j^{XB(X)} \right]} \quad (j = 1, 2, \ldots, n)$$

Using the same approach to Eq. (3), the Fisher PPP for *k* branch can be derived as follows:

(6) $$PPP_k^{XB(\text{Fisher})} = \sqrt{PPP_k^{XB(B)} \times PPP_k^{XB(X)}}$$

Step III: Deriving PPP for the Manufacturing as a Whole

The derivation of the PPP for total manufacturing follows a similar approach to Step II whereby PPPs are aggregated from the branch level to total manufacturing using the base country and alternative country branch level weights, respectively. The geometric mean of the so-constructed Laspeyres and Paasche indices finally gives the total manufacturing PPP.

These PPP estimation procedures require detailed product as well as industry-level data and involve intensive work in matching, weighting and aggregating at different levels. Product specification and quality are essential for unbiased estimation, but in most cases they could only be justified by limited information. Typical data problems are discussed in the nest section.

4. Data for Constructing PPPs

Three types of data are used in this study: 1) product data for constructing unit values (UVs) and hence deriving PPPs, 2) sub-industry and industry data for weighting and aggregating in PPP estimation, and 3) value added and employment data for industry-level productivity analysis. Ideally, at each level the data should be available for "modern" and "traditional" components. In reality, survey or census data only cover the modern sector. In this section, we concentrate mainly on the data that are used in constructing PPPs, including sources, coverage and definition, industrial and sectoral classification, problems and how we deal with the problems. Detailed notes on sources and data handling, often given in technical details, are provided in notes to the tables. Problems on various aggregate data for international comparison are already discussed in Section 2 and the data problems for productivity analysis are handled in Section 6.

Coverage

For the PPP-based direct comparison at industry level, we could only and sensibly cover the "modern" component of each industry in these countries. For the comparison of aggregate economy, wherever possible we cover both the "modern" and "traditional" components and sectors. First of all, we need to report how the "modern" and "traditional" sectors are defined in official statistics of each country, and if there is any problem in terms of compatibility and availability.

It is not surprised to see only the modern sector is recorded in historical statistics. Data on traditional economy are only estimates based on national censuses or limited scope surveys by researchers or authorities. Modern manufacturing in this study is conceptually defined as the production of products that is organized in factories where workers concentrate in a building or buildings to manufacture goods or supervise machines processing one product into another. However, as we can see below, the official criteria for "factory" vary greatly in the early 20th century because of the lack of international coordination in statistical standards.

In the US *Biennial Census of Manufactures 1935*, "factory" was defined as any enterprise that produced $5,000 or more output a year (U.S. Department of Commerce, 1938, pp. 4-6). By comparing the US census with other sources of official statistics, we have found that over 95 percent (Table 2) of US manufacturing were operated in factories. In the Japanese *Census of Factories 1935*, it was defined as any enterprise that hired five or more workers and used machine power (Statistical Division of the Ministry of Commerce and Manufacturing Minister's Office, 1937, "Preface", p. 1). In Korea, as explained in the *Statistics on Manufactured Products for 1935*, a factory was defined as any enterprise that hired at least 10 workers in production (Chosen Government-General, 1937, "Preface"). Despite strong Japanese influence the Korean manufacturing statistics somehow doubled the employment criterion for factories.

In the case of China, its first national industrial census under the leadership of D.K. Lieu (Liu Ta-chün) (NRC, 1937) conceptually followed the Chinese first *Factory Law*, passed in 1929[12] that defined a factory as an enterprise that hired at least 30 workers

[12] The author and publication date of the *Factory Law* are unclear. As cited in *Pacific Affairs* in February 1929 (Vol. 2, No.2, pp. 73-76, *Pacific Affairs*, University of British Columbia), according to a

and also employed machine power. Work on manufacturing by Liu and Yeh (1965) is largely based on Lieu's three-volume survey report. According to the report, the actual survey ended up including many factories that did not meet the *Factory Law* criteria. Volumes 2 and 3 also report data from those factories that did not meet the *Factory Law* criteria, but did not process such data seriously and compare them with those that met the criteria. In fact, Lieu's factory survey focused on large firms. The survey was conducted under the National Resource Committee (NRC) that belonged to the Military Committee of the Chinese Nationalist Government. The genuine purpose for the survey was a preparation for China's national defence rather than statistics because large factories could be used for military production. In the current study, our calculations are based on a study by Makino and Kubo (1997) who attempt to adjust Liu and Yeh's estimates using Lieu's survey data. However, Makino and Kubo mainly adjusted Liu and Yeh's estimates for data overlapping and inconsistencies in Lieu's three volumes of survey data but did not attempt to work out estimates taking into account the data from the factories that did not meet the *Factory Law* criteria.

To check the compatibility of factory criteria among the countries in our comparison we use our PPP estimates in Section 5 and estimates for hours worked and output per worker in Section 6 to calculate the gross value of output (GVO) in 1935 PPPs for an enterprise that meet the minimum criteria for "modern factory" in China, Japan and Korea, respectively. Compared with the $5,000 GVO criterion in the US statistics, the implicit GVO criterion was $6,431 for Japan, $19,389 for China, and $7,356 for Korea.[13] If the estimate for China is now assumed to be lowered by two thirds to include the factories below the *Factory Law* criteria,[14] which means 10 workers per factory on constant productivity, it will give an estimate of $6,463, almost the same as the above estimate for Japan. Since the minimum employment

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Kuo Min News dispatch from Nanking on December 3, 1928, China's first *Factory Law* had been drafted by the Ministry of Industry, Commerce and Labour and discussed by the Legal Commission of the Ministry. According to the citation in the *Cambridge History of China*, Vol. 12 (Part I) (Footnote 14, p. 42), the *Factory Law* was issued in 1929. However, the official record shows that the *Factory Law* was promulgated on December 30, 1932, and published by Commercial Press in *Comprehensive Collection of Laws and Regulations of the Republic of China*, Volume 3 (1935, pp. 3410-14).

[13] We first calculate output in PPPs based on estimates reported in Tables 4, 7 and 8, which give PPP$12,609 for Japan, PPP$30,296 for China and PPP$16,346 for Korea, and we then convert the results to the US dollars by market exchange rate/PPP exchange rate ratios that are also available in Table 4.

[14] This assumption is not too strong because only 20 percent of the factories in Lieu's survey could meet the *Factory Law* standard, i.e. 3,450 out of 18,000 (NRC, 1937).

criteria for a Japanese factory is 5 workers, it appears that to produce the same output as in Japan, a Chinese factory had to hire 10 workers whereas a Korean factory has to hire 8.5 workers (implied by 85 percent of minimum $7,356 GVO for Korea). These rough estimates suggest that the underlying minimum output requirement for factories might be quite similar among the three East Asian economies.[15] It should be noted that this exercise by no means suggests that factory data of individual countries used in this study can be converted to the same standards; rather it provides useful reference for understanding the estimates.

Industrial Classification

Statistical classification of industries only and inevitably covers factory-based data, excluding traditional activities in manufacturing. In the current study, we classify modern (factory) manufacturing into 9 industries as used firstly in Table 2 and then throughout the study. Our classification is based on the Japanese standard,[16] which is largely compatible with the two-digit or some combination of the two-digit industries as defined in ISIC (International Standard of Industrial Classification). As the Korean classification follows the Japanese standard, what we need to do is only to reconcile the Chinese and US data with the Japanese standard. For the US data, this is not a difficult task because they contain detailed data on sub-industries and hence easy for us to check compatibility and to re-classify them into broader industrial groups as used in this study.

There are two main sources for the Chinese data. The first one was China's first national income account constructed by Ou Pao-san during 1941-46, which resulted in a two-volume publication in Chinese in 1947 (Ou, 1947).[17] The work concentrated mainly on 1933, reflecting the detailed survey data for that year which had been previously compiled by D.K. Lieu in 1937 (see NRC, 1937). Since Ou's work

[15] It would be unrealistic to assume factories in any of these Asian economies were close to the US standard on average in 1935. In fact, the data on US total manufacturing output and employment implies that based on average productivity, a US firm only needed to hire one worker to be qualified as a "factory" in the official statistics, which suggests that the US traditional, non-factory manufacturing had largely disappeared by 1935.

[16] There are also some adjustments to the Japanese data. For example, paper industry is included in chemicals in the Japanese classification, which has to be re-classified into paper, printing and publishing industry.

[17] See an English-language summary of the work that is published in the *Journal of Political Economy* (Ou, 1946).

followed the western concepts of national income,[18] his industrial classification is acceptable. The second source was the work jointly made by two US-based economists Liu Ta-chung and Yeh Kung-chia (1965)[19], which subsequently revised Ou's work. Liu-Yeh's estimates raised China's GDP for 1933 by 37 percent, that is, from Ou's 21.77 billion yuan to 29.88 billion yuan at 1933 prices (p.66). The differences between Liu-Yeh and Ou appear to be mainly in agriculture, factory manufacturing and handicrafts. They are basically empirical rather than conceptual differences.

Commodity Data for Constructing PPPs

Following the standard production-side PPP approach, as explained in the methodology section, to derive the relative price of a product (or unit value ratio) between two countries at the same time we need to match the same product between the two countries in comparison and then derive unit value for the product in national currency for each country. This will be an impossible task without detailed census or survey data on manufacturing. Fortunately, by the mid-1930s advanced countries had conducted manufacturing census regularly and some countries at their earlier stages of industrialisation had began such census. For the US, Japanese and Korean data on value and quantity of manufactured products, we rely on the US *Bicentennial Census of Manufactures 1935* (US Department of Commerce, 1938), the Japanese *Census of Factories 1935* (Statistical Division of the Commerce and Manufacturing Minister's Office, 1937), and the Korean *Statistics on Manufactured Products 1935* (Chosen Government-General, 1937[20]). All of these sources refer to our benchmark 1935. We derive unit prices for matched products from these census data.

[18] Ou's short bibliography by Trescott (1996) explains how his work was likely highly influenced by the western concepts of national income: "Ou Pao-san went to Harvard for graduate study in 1936 and completed an MA concentrating on agricultural economics. He then spent a year studying in Berlin, visited Cambridge and became acquainted with Piero Sraffa. Returning to Harvard in 1939, he received a strong exposure to Keynes's ideas from Alvin Hansen and Seymour Harris. He perceived the potentialities for national-income estimation after reading Simon Kuznets's work, as well as pioneering studies of the national incomes of Sweden and Hungary. Ou returned to China in 1940 … [and helped by] five assistants from recent university graduates, [his] national-income project began in 194l and extended until 1946. … In 1947, support from the Rockefeller Foundation enabled Ou to return to Harvard to complete a PhD. John Black directed his dissertation, which dealt with capital formation and consumers' outlay in China, making use of the national income estimates."

[19] Estimates in Yeh (1977) are basically the same as those in Liu and Yeh (1965). However, Yeh provides a time series for 1931-36， of which the data for 1935 are used in this study.

[20] No official publication date is available. We put "1937" as a guessed publication date because the Japanese census for 1935 was published in 1937.

The Chinese data used in this study are, however, not straightforward and hence deserving more detailed explanations. We rely on three sources of data: 1) D.K. Lieu's *Report on a Survey of China's Industry*, Volume 2 (NRC, 1937); 2) *Archive Materials for Studies of Industrial and Agricultural Commodity Prices*, Shanghai Volume, compiled by Office for Industrial and Agricultural Price Survey (OIAPS, 1956-57); and 3) Zhen Chen's *Study Materials of Industrial History in Contemporary China*, Volume 4, Parts 1 and 2 (1961). To derive unit prices of matched products, we make the best use of Lieu's data as reported in Table 4 (Volume 2), referring to products produced by factories that hired at least 30 workers. Lieu's data cannot fully satisfy our needs. The gaps in products are filled or supplemented by the information available in Chen (1961) and in OIAPS (1956). However, both Lieu's and Chen's data are for 1933. To convert prices from 1933 to 1935, we calculate wholesale price indices for 1933-35 using product price data available in OIAPS.

We use gross value of output (GVO) weights to aggregate unit value ratios (UVRs) from product level to sub-industry and then to industry level to derive industry-level PPPs (see Appendix tables for the levels of aggregation). As already mentioned, we based on the Japanese classification to group all manufacturing activities into 9 industries. The US, Japanese and Korean GOV data at industry and sub-industry levels are available from these countries' census data. The Chinese industry and sub-industry level GVO data available in Lieu (NRC, 1937) are incomplete. In a study on China's industrial output in 1933, Makino and Kubo (1997) estimated factory output by industry, which conforms to the Japanese standard of industrial classification. Therefore, we use their GVO data as weights in aggregation, supplemented by data from Chen (1961).

5. Discussion of the Estimated PPPs

Following the standard methodology for constructing industry-of-origin PPPs, we first conducted three comparisons, namely, China/Japan and Korea/Japan with Japan as the reference country, and Japan/US with the US as the reference country. The details of these comparisons are reported in Appendix Tables A1, A2 and A3, respectively.[21] As expected, the coverage ratio between a less developed country and a more developed country can be very different. In the China/Japan comparison, about 72 percent of

[21] Table A1 is published in the Appendix as an example for our work in matching producer prices. Due to limited space, Tables A2 and A3 are available on request.

Chinese products and 30 percent of Japanese products are covered, and in the Japan/US comparison, the ratio is about 32 percent for Japan and 10 percent for the US. However, in the Korea/Japan comparison, the ratios are very close, 41 and 45 percent, respectively.

In Table 4, to make our PPP estimates easy to follow we use Japan as the bridge country to re-base China and Korea to the US, and report a summary of the US$-based PPP estimates and relative price level by industry.

TABLE 4
SUMMARY OF ESTIMATED PURCHASING POWER PARITIES BY MANUFACTURING INDUSTRY, CHINA/US, JAPAN/US AND KOREA/US, IN 1935

	China/US		Japan/US		Korea/US	
	PPP Yuan/$ (Fisher)[1]	Relative Price level (MER =3.01)	PPP Yen/$ (Fisher)[1]	Relative Price level (MER =3.42)	PPP Korean Yen/$ (Fisher)[1]	Relative Price level (MER =3.42)
Total manufacturing	1.91	0.64	1.75	0.51	1.54	0.45
Food, beverage & tobacco	1.95	0.65	2.80	0.82	2.35	0.69
Textiles, wearing apparel[3]	1.70	0.57	1.24	0.36	1.52	0.44
Wood & allied products	1.86	0.62	2.19	0.64	1.55	0.45
Paper, printing & publishing	1.56	0.52	1.38	0.40	1.75	0.51
Chemicals & allied products	1.57	0.52	1.36	0.40	0.97	0.28
Building materials	1.30	0.43	1.42	0.41	1.39	0.41
Basic & fabricated metals	2.43	0.81	2.35	0.69	1.82	0.53
Machinery[4]	2.39	0.80	2.02	0.59	1.07	0.31
Miscellaneous	0.89	0.29	0.63	0.18	0.95	0.28

Source: Authors' estimation. See Appendix Table A1-A3 for details.
Notes:
1) Fisher PPP is a geometric mean of Laspeyres and Paasche PPPs (see Eq. 3 for industry PPPs and Eq. 6 branch PPPs).
2) Including leather products.
3) Including transportation equipment.

The results in Table 4 show that the PPP for total manufacturing is the highest for China (1.91 yuan/$), followed by Korea (1.54 yen/$) and Japan (1.75 yen/$). Compared with the prevailing market exchange rate (MER), the PPP-implied relative price level for Chinese manufacturing (i.e. yuan PPP divided by yuan MER) is 0.64, suggesting that for the *matched* manufactured products the cost level (as reflected by producer prices in the comparison) of Chinese manufacturing was 36 percent lower than the US level as suggested by the market exchange rate. By the same calculation, the price level in Korean manufacturing (0.45) and Japanese manufacturing (0.51) was 55 and 49 percent lower than the US price level, respectively.

To assess the plausibility of the production PPP estimates, we compare them with the expenditure PPPs in Fukao, Ma and Yuan (2007, Table 4) for China, Japan and Korea in *circa* 1935 that also use the US as the reference country. It turns out that the production PPP-implied price levels for manufacturing are 100, 13 and 5 percent higher than the expenditure PPP-implied price levels for these countries. Despite such large cross country variations, it is generally in line with what can be predicted by the theory that the non-tradables (included in the expenditure PPPs) in less developed countries tend to be cheaper than the tradables. Fukao, Ma and Yuan (2007) also estimate the price level of the tradables in the final consumption of these countries. In the case of Japan and Korea our production PPP estimates are very close to their results, but this is not the case of China, which is 60 percent higher than the price level for tradables estimated using the expenditure approach.

Theoretically, the price differences between the US and these East Asian economies are just as explained by the Balassa-Samuelson theorem. Balassa (1964) and Samuelson (1964) argue that because the productivity growth in the non-tradable goods sector is generally and substantially lower than the productivity growth in the tradable goods sector during the development process, there is the secular trend of the prices of non-tradable goods rising relative to the prices of tradable goods. Since the US economy was much more developed and industrialized than other countries in the comparison, such a higher price level in US is expected due to higher cost of the non-tradables.

However, two questions have emerged from our production PPP estimates. The first one is why the gap between the PPP-implied price level and the market exchange rate appear to be too large to be in line with the empirical findings in general or what could be predicted by the production PPP theory. Manufactures are generally tradable goods and by nature their PPPs are close to the market exchange rates (see Rao and Timmer, 2003). If no serious sample bias towards low price products in our unit value matching exercise, our tentative conjecture is based on two likely factors: 1) a stronger demand for imports in these East Asian countries than the foreign demand for exports from these countries, hence driving up the exchange rate of foreign currencies (the US dollar) and 2) net capital outflows from these countries that also depreciated domestic currencies. Both deserve a separate research agenda.

Our second question is why China's price level appears to be much higher than the Japanese price level. Our assessment is from two sides. On the one hand, the initial cost of industrialization in China was very high because of the high learning cost – China was then unquestionably at the lower portion of the learning curve than Japan. More importantly, the Chinese market for the new manufactured goods was less competitive because of required high initial investment in both physical and human capital which were likely more expensive in China than in Japan.[22] On the other hand, the Japanese economy had by then more or less passed the initial stage of industrialization and enjoyed more efficient factor market. Japan's integration with the Korean economy through colonialism might also lower its cost of inputs. Here our focus will be on the recent studies on the comparison of real wages which seem to have lent some support to our conjecture on the low cost of Japanese manufacturing.

Studies by Bassino and Eng (2002) and Bassino (2005) find that daily nominal wages for unskilled workers and carpenters in Tokyo in 1935 were not much higher than those in Bangkok, Singapore, or Penang in British Malaya. As consumer price levels, particularly food prices, were much lower in those Southeast Asian cities, their studies suggest that real wages in Tokyo were lower than in those cities. Bassino's wage data show that the skill premium for carpenters vis-à-vis unskilled workers in Tokyo was smaller than in any of the Southeast Asian cities, indicating the existence of a large pool of skilled workers in Japan in comparison with Southeast Asia.[23] This appears to be supported by Godo and Hayami (2003) who reveal that in the 1930s, average years of schooling in Japan were already over 60% of the U.S. level despite the much greater lag in per capita income. Studies by Williamson have shown the cost position of Japan from a different perspective (1998, Table 1 and 2002, Table 3). His estimates suggest that although Japan's wage was higher than Korea and other Asian countries, there was a substantial drop in wage-rental ratio in Japan by 35 percent in 1935-38 from the level of 1930-34, which was not matched in Korea and other Asian countries during the same period.

It is interesting to examine our production PPP estimates for individual industries. It is not surprised to find that "metals" and "machinery" in China, "metals" in Japan, and "food" in Japan and Korea were most expensive to produce. For China, this seems to suggest high learning cost, whereas for Japan and Korea, suggest high cost

[22] For example, to make a pair of sport shoes it would cost a Chinese factory 12 yuan but only cost a Japanese factory 9.5 yuan in China (Chen, 1962, p. 700, Table 5).

[23] See more discussions on the wage gap between Japan and other countries with supporting data in Bassino and Ma (2005) and Allen et al. (2005).

of scarce resources. On the other hand, "textiles" in Japan and Korea, and "building materials" in all the three countries were cheapest compared with those of the US. The case of "textiles" may suggest higher productivity in both Japan and Korea. The case of "building materials" may suggest lower labour costs in all the three countries compared with that of the US. Besides, "building materials" are less affect by prices of international market because they are mainly traded in domestic market and used in construction which is largely non-tradable.

Since the level of economic development in China was closer to that of Japan than to that of the US, and historically, China and Japan were competitors, it would be very meaningful to examine the industry-level PPPs using Japan as the benchmark, which are in fact our primary results (Table A1). After re-basing the PPP results of individual countries to Japan we present the relative price level for each country in total manufacturing and individual industries in Table 5.

TABLE 5
RELATIVE PRICES OF CHINESE, KOREAN AND US MANUFACTURING BY INDUSTRY IN 1935
(Japan = 1)

	Chinese	Korea	USA
Total manufacturing	1.24	0.88	1.96
Food, beverage & tobacco	0.79	0.84	1.22
Textiles, wearing apparel	1.56	1.23	2.76
Wood & allied products	0.96	0.71	1.56
Paper, printing & publishing	1.28	1.26	2.47
Chemicals & allied products	1.31	0.71	2.52
Building materials	1.04	0.98	2.42
Basic & fabricated metals	1.17	0.77	1.45
Machinery	1.35	0.53	1.69
Miscellaneous manufacturing	1.61	1.51	5.46

Sources and *Notes*: See Table 4.

First of all, such a re-basing explicitly shows that for the *matched* products the US price level was higher than that of Japan in all industries. As already pointed out, this is expected because for what could be produced in low income countries the US began to lose comparative advantage, if its productivity level cannot offset its high cost which will be examined next, and move into other higher value added and newly invented more sophisticated manufactures (which of course have no counterparts in the low income economies).

Our focus here is, however, China. In the case of China, almost all industries, except for "food" and "wood", had higher factor costs (reflected by producer prices) than those of Japan. This is not observed in the case of Korea, thanks to its colonial integration with the Japanese economy, the cost of "machinery" in Korea was much lower than in Japan.[24] The results for China suggest that the high costs in Chinese modern manufacturing industries made it difficult to compete with foreign manufactured goods as well as with the domestic goods that could be produced with traditional technology. On the other hand, we may also expect that the implicit high profits as suggested by the high prices could be one of the major factors that attracted foreign traders and hence motivated them to lobby for government interventions, including using military power, for the opening up of the China market.

6. COMPARATIVE OUTPUT AND LABOUR PRODUCTIVITY

In this section, we apply the industry-specific PPPs in a cross country comparison of output and labour productivity. Output (in terms of gross value added) in PPPs provides an indicator for the size of an industry relative to the base country. Labour productivity measured as output per hour worked in PPPs reflects the level of capital deepening and the level of efficiency compared with the base country. Compared with the output conversion based on market exchange rate, the two indicators are more proper measures of the level of industrialization in an international comparison framework.

The data work required for deriving these indicators is by no means easier than that required for the price comparisons in constructing PPPs because available historical statistics were not compiled in the concept of value added and data required for estimating value added are insufficient. The data work and results reported below are preliminary and will be finalised when the further improvement is done.

Gross value added in PPPs

There are no gross value added data readily available for any country. Based on the available cost data recorded for factories, we define gross value added (GVA) as gross value of output (GVO) minus the cost of materials (*M*) and the cost of energy or electricity (*E*), that is,

$$GVA_i^F = GVO_i^F - M_i^F - E_i^F \,, \qquad (7)$$

[24] We find the data for Korea and Japan matching may have some problems. For example, there are huge price differences between the two countries in water tube boilers, steam engines, water turbines, winding machines and pumps blowers (Appendix Table A3 – available on request). However, after assuming their prices in the domestic market were the same as export prices, the Korean price level is about 80 percent of the Japanese level. Mismatching in quality and function of these machines could be a problem.

where subscript i indicates industry and superscript F stands for "factory", because only factory data can satisfy data requirement for the estimation. This approach is similar to what used in the Japanese Long-Term Economic Statistics (Ohkawa, Shinohara and Umemura, 1972). To be consistent, we apply the same approach to all countries.

Since it is impossible to have cost break down data for non-factory or handicraft manufactures, we apply value added ratio (VAR) derived from the factory sector to estimate GVA for handicraft manufactures, that is,

$$GVA_i^N = GVO_i^N \times VAR_i^F = GVO_i^N \times \frac{GVA_i^F}{GVO_i^F}. \quad (8)$$

where the superscript N stands for non-factory or handicraft manufacturing. However, since value added ratio in the handicraft sector may be different from that in the factory sector and the difference may vary across industries, such a treatment may distort the real GVA and labour productivity for some handicraft industries, hence industries as a whole (factory plus handicraft). This is certainly an area that deserves further research.[25]

For the factory sector, the Japanese manufacturing GVA by industry are estimated based on data from the *Census of Factories 1935* (Statistical Division of the Commerce and Manufacturing Minister's Office, 1937, pp. 20-40), the US manufacturing GVA by industry are estimated using data from the *Bicentennial Census of Manufactures 1935* (US Department of Commerce, 1938, pp. 22-38.), and the Korean manufacturing GVA by industry are based on data constructed by Kim for 1935 (2008, p. 111).

The case of China is a bit more complicated as explained in Section 4. The most important information is from China's first factory census conducted by Lieu (NRC, 1937). Lieu's census intended to cover all factories as defined by *Factory Law*, i.e. enterprises that hired 30 or more workers and used machine power. However, the census went beyond the original scope to include enterprises with less than 30 workers. This was because in most locations there were many enterprises that could

[25] Ideally, if we can find some cost information on handicraft industry i that allows the derivation of a parameter λ to adjust the existing value added ratio derived from the factory sector of the same industry, we can better estimate VAR for the handicraft industry, i.e. $VAR_i^N = \lambda_i \frac{GVA_i^F}{GVO_i^F}$. This λ may be applied to other handicraft industries that likely have similar value added ratios.

not satisfy the *Factory Law* criteria. The number of factories participated the census was eventually over 18,000, of which 3,450 met the *Factory Law* standard. The total number is not certain because there are some overlapping of the two categories as detected by Makino and Kubo (1997). In this study we directly use the revised data from Makino and Kubo.

Table 6 first presents the so-constructed GVA data in national currencies for individual manufacturing industries and then converts the data to PPPs reported in Table 4. To include the handicraft manufacturing, in the lower panel of Table 6 we report GVA for individual industries as a whole (factory plus handicraft). Besides, to compare with the US, in the last column of each country panel, a country/US index is provided for all industries.

It shows that for the factory sector, the size of Japanese manufacturing was 12 percent of the US level in PPP terms, whereas for China and Korea it was only 1 and 0.6 percent, respectively. However, given China's size and extremely uneven development across regions, it is useful to bear in mind that in the mid 1930s the so-call "lower Yangtze" (Shanghai, Nanjing, Jiangsu and Zhejiang) produced 66 percent of total factory output in China proper (excluding Manchuria) (see Ma, 2008, Appendix Table 2).

If putting factory and handicraft manufactures together, the size of Japanese manufacturing raised to 16.6 percent of the US level, whereas for China the ratio increased to 10.9 percent of the US level, for Korea it is basically unchanged. (The coverage of the available data for the Korean handicraft sector is apparently insufficient. Yet it is difficult to gauge with available information.)

It is also meaningful to examine the industries in each country that were distinctly larger than the relative size to the US for the manufacturing as a whole. If excluding "building materials" (highly non-tradable), they were "textiles" in China; "textiles" and "chemicals" in Japan; and "food" and "chemicals" in Korea. Note that fertilisers were one of the main "chemicals" products in Japan and Korea that were used for farm production (food and textiles), which explains why "chemicals" were relatively larger in size.

TABLE 6

GROSS VALUE ADDED IN NATIONAL CURRENCIES AND IN PPPS BY MANUFACTURING INDUSTRY, CHINA, JAPAN AND KOREA IN COMPARISON WITH THE US, IN 1935

	China			Japan			Korea			US
	GVA[2] (mil. Yuan)	GVA (mil. PPP$)	GVA (US=1)	GVA[2] (mil. Yen)	GVA (mil. PPP$)	GVA (US=1)	GVA[2,3] (mil. Yen)	GVA (mil. PPP$)	GVA (US=1)	GVA
Factories										
Total manufacturing[1]	364	190	0.010	3,893	2,230	0.120	176	114	0.006	18,616
Food, beverage & tobacco	54	28	0.010	453	162	0.058	63	27	0.010	2,789
Textiles, wearing apparel	157	92	0.036	750	605	0.236	21	14	0.005	2,563
Wood & allied products	1	0	0.0004	71	32	0.037	7	4	0.005	886
Paper, printing & publishing	29	19	0.015	111	80	0.063	8	5	0.004	1,286
Chemicals & allied products	49	31	0.009	725	534	0.151	51	53	0.015	3,534
Building materials	24	18	0.031	167	118	0.199	8	6	0.010	594
Basic & fabricated metals	17	7	0.003	617	262	0.106	7	4	0.002	2,469
Machinery	28	12	0.003	857	424	0.117	5	4	0.001	3,614
Miscellaneous manufacturing	5	5	0.006	140	224	0.254	5	6	0.007	882
Factory plus handicraft										
Total manufacturing[1]	3,881	2,030	0.109	5,387	3,087	0.166	233	120	0.006	18,616
Food, beverage & tobacco	2,707	1,389	0.498	955	341	0.122	109	46	0.017	2,789
Textiles, wearing apparel	746	438	0.171	974	786	0.307	34	23	0.009	2,563
Wood & allied products	71	38	0.043	117	53	0.060	5	3	0.003	886
Paper, printing & publishing	59	38	0.030	171	124	0.096	7	4	0.003	1,286
Chemicals & allied products	116	74	0.021	859	633	0.179	41	32	0.009	3,534
Building materials	46	36	0.060	231	163	0.274	8	5	0.009	594
Basic & fabricated metals	43	18	0.007	630	268	0.108	9	5	0.002	2,469
Machinery	66	28	0.008	1,434	709	0.196	6	6	0.002	3,614
Miscellaneous manufacturing	26	29	0.033	180	287	0.326	10	11	0.012	882

Source: Both factory and traditional GVA data are from the same sources as in Table 2. PPP converters are the estimates in Table 4.

Notes:

1) For more details of the classification see Table 2.
2) Chinese, Japanese and Korean GVA figures are estimated based on the GVA/GVO ratios of individual countries which are calculated by the authors using information from Statistical Division of the Ministry of Commerce and Manufacturing (1937), Kim (2008) and Ou (1946).
3) Korean Yen = Japanese Yen.

Hours worked

Numbers employed can be very different from hours worked. It is due to institutional and political factors such as laws and regulations and labour unions, labour market conditions that are related to demand and supply factors, nature of industry, i.e. level of safety or heath hazard, as well as culture or tradition that developed in history because of climate conditions and farming customs. Since these factors and conditions vary greatly among countries, it is important to convert numbers employed to hours worked in international comparison.

In the current study, data on working hours for Japan, Korea and the US are directly adopted either from government statistics or other studies. The Japanese working hours in manufacturing for 1935 are obtained from the government *Handbook of labour statistics* complied by the Statistical Division of Cabinet Office (1935, pp. 96-99). The Korean working hours in manufacturing for 1939 are obtained from Chosen Government-General, *Statistics on Manufactured Products* (1941, pp: 4-5). As for the US data on working hours, we use estimates by de Jong and Woltjer (2007, p. 23, Table 5).

The Chinese data on working hours are not straightforward. The 1935 issue of *China Economic Annals*, compiled by the Ministry of Industry (1935, pp. Q13-16), is perhaps the only official publication that colleted almost all then available surveys on working hours and working days in China in different industries and regions over the period 1932-34. Based on the data from these surveys, we estimate total and average annual working hours for individual industries for *circa* 1935.

The results are reported in Table 7. It indeed shows that annual hours worked per person were very different among these countries and across industries. On average, the Korean manufacturing workers worked 2,431 hours per year, compared with 2,807 hours in China and 3,132 hours in Japan, which were 34, 54 and 72 percent higher than the US of 1,817 hours, respectively. Intuitively, the working hours in Japan might be overestimated whereas in the US might be underestimated. Some studies have found that long working hours in Japan were indeed a long tradition and only changed very recently (ref, Japan Industrial Productivity Database-JIP2008). On the other hand, the estimation for the US by de Jong and Woltjer (2007) seems too low. If using the standard of eight hours per working day and six days per week, the average US manufacturing workers only worked for 38 weeks, by contrast the Japanese had to work for 65 weeks a year!

If taking a closer look at some industries in China and Korea, our findings suggest that the long working hours in Japanese manufacturing might not be impossible. In the case of “chemicals” in China the average annual working hours per worker were 3,167, even slightly more than the Japanese average. In the case of “wood” in Korea, it was 3,097, very close to the Japanese average, but in the case of Korean “paper” industry, it was as high as 3,690 or 18 percent more than the Japanese average working hours. Therefore, if the estimates for Japan, China and Korea are plausible for *circa* 1935, the estimates by de Jong and Woltjer (2007) for the US may be too low and hence may exaggerate the labour productivity in the US in 1935.

TABLE 7

NUMBERS EMPLOYED, HOURS WORKED AND ANNUAL HOURS WORKED PER PERSON BY MANUFACTURING INDUSTRY, CHINA, JAPAN, KOREA AND THE US, IN 1935 (FACTORY ONLY)

	China			Japan			Korea			US		
	Numbers employed (x1000)	Hours worked (x1000)	Hours per person	Numbers employed (x1000)	Hours worked (x1000)	Hours per person	Numbers employed (x1000)	Hours worked (x1000)	Hours per person	Numbers employed (x1000)	Hours worked (x1000)	Hours per person
Total manufacturing[1]	784	2,201	2,807	2,361	7,394	3,132	167	407	2,431	8,290	15,062	1,817
Food, beverage & tobacco	71	183	2,577	158	468	2,958	49	108	2,209	929	1,823	1,962
Textiles, wearing apparel	505	1,439	2,850	1,007	3,231	3,209	31	80	2,551	1,806	3,203	1,774
Wood & allied products	2	4	2,790	85	253	2,975	6	23	3,690	632	1,237	1,958
Paper, printing & publishing	44	129	2,914	61	197	3,256	7	22	3,097	475	901	1,896
Chemicals & allied products	63	201	3,167	229	716	3,133	43	83	1,930	1,218	2,304	1,892
Building materials	30	78	2,559	93	278	3,003	10	26	2,573	263	476	1,812
Basic & fabricated metals	23	66	2,895	218	671	3,081	7	19	2,696	1,121	2,032	1,813
Machinery	38	114	2,974	367	1,160	3,158	7	20	2,758	1,492	2,698	1,809
Miscellaneous manufacturing	8	20	2,535	144	443	3,075	6	14	2,380	355	596	1,682

Source and Notes*:* See discussion in the text.

Labour productivity in PPPs

Based on the estimates for gross value added in Table 6 and hours worked in Table 7, we can easily calculate labour productivity in PPPs in Table 8. Note that the estimates are only for the factory sector. To compare with the US labour productivity, we can also calculate relative labour productivity for China, Japan and Korea with the US as the reference (= 1). It shows that on average, the Japanese and Korean labour productivity in manufacturing in 1935 was very close, or PPP$0.30 and 0.28 per hour, respectively, whereas China was only 0.09 PPP$ per hour. In relative terms, in 1935 the labour productivity in Japanese and Korean manufacturing was about 23-24 percent of the US level (= $1.24 per hour), whereas the labour productivity in Chinese manufacturing was less than 7 percent of the US level. Clearly, even if there were underestimation of the hours worked in the US manufacturing, it may not change the pattern significantly. Given all other indicators for the level of economic development, especially per capita income, we feel that the Japanese labour productivity would not be more than one third of the US level in any case, which gives a useful reference for assessing the level of other economies.

At the industry level in individual countries, it shows that some industries enjoyed higher labour productivity than others as compared with the country average. Importantly, in Japan, we find almost all heavy or "producer goods" industries (i.e. "chemicals", "building materials", "metals" and "machinery") had higher labour productivity than light or "consumer goods" industries, suggesting heavy industries had already played a major role at that stage of Japan's industrialization. This was, however, neither in the case of China nor Korea. In China, only "wood" and "building materials" enjoyed better labour productivity than the manufacturing average, whereas in Korea only "food" and "chemicals" enjoyed better labour productivity than the manufacturing average. The findings reflect different stages of economic development in these countries and are in line with our findings on relative prices for individual industries.

TABLE 8

COMPARATIVE LABOUR (MANHOUR) PRODUCTIVITY IN PPPS BY MANUFACTURING INDUSTRY, CHINA, JAPAN AND KOREA IN COMPARISON WITH THE US, IN *CIRCA* 1935 (FACTORY ONLY)

	China[2]		Japan		Korea		US
	Labour productivity (in PPP$)	Labour productivity (US=1)	Labour productivity (in PPP$)	Labour productivity (US=1)	Labour productivity (in PPP$)	Labour productivity (US=1)	Labour productivity (in PPP$)
Total manufacturing[1]	0.09	0.07	0.30	0.24	0.28	0.23	1.24
Food, beverage & tobacco	0.15	0.10	0.35	0.23	0.25	0.16	1.53
Textiles, wearing apparel	0.06	0.08	0.19	0.23	0.17	0.22	0.80
Wood & allied products	0.09	0.12	0.13	0.18	0.19	0.27	0.72
Paper, printing & publishing	0.15	0.10	0.41	0.29	0.21	0.15	1.43
Chemicals & allied products	0.15	0.10	0.75	0.49	0.64	0.42	1.53
Building materials	0.23	0.19	0.42	0.34	0.23	0.18	1.25
Basic & fabricated metals	0.11	0.09	0.39	0.32	0.21	0.17	1.22
Machinery	0.10	0.08	0.37	0.27	0.21	0.16	1.34
Miscellaneous manufacturing	0.27	0.18	0.50	0.34	0.41	0.28	1.48

Source: See Tables 6 and 7.

Notes:

1) See Table 2 for more details of the classification of manufacturing industries.
2) For China, estimation is based on 1933 nominal GVA and 1933-35 price changes.

7. Concluding Remarks

Following the standard methodology for measuring industry-of-origin or production-side PPP, this study compares the unit values of manufacturing products in China, Japan, Korea and the United States, derives unit value ratios (UVRs) and hence estimates relative price levels for individual manufacturing industries in *circa* 1935 with the US as the reference country. Unlike the expenditure PPP approach, this production approach allows us to more rigorously examine the pre-WWII economic conditions in East Asia from the production side in terms of producer costs and labour productivity in manufacturing relative to those in the US.

Based on estimated production PPPs as well as estimated gross value added and hours worked for these countries, we find that in *circa* 1935 the producer price level in China, Japan and Korea was 64, 51 and 45 percent of the US level in manufacturing the same products as implied by the prevailing market exchange rates of these countries' currencies against the US dollar, but the labour productivity in these countries was only 7, 24 and 23 of the US level, respectively. Apparently, the higher price level in the US is justified by its much higher labour productivity implying more advanced technology. However, a comparison among the three East Asian countries reveals some inconsistencies. Japan and Korea had almost the same productivity and their producer price levels were close. By contrast, China's productivity was not much more than one third of the level of Japan and Korea but had a much higher price level than that of Japan and Korea. Such a striking finding for China raises two challenging questions: Did Chinese manufacturing produce in line with its comparative advantage? If not, what drove China's earlier industrialization?

Let us think about the first question. In order to understand price gaps and comparative advantage, we need to assume that Japan's exports and China's exports were not perfect substitutes. Even if China's prices were higher than Japan's, China could still export substantial amount of textiles if they were cheaper in comparison with the world average prices. To properly explain price level gaps, we need to take into account two factors, factor cost and the level of technology (as reflected by labour productivity, input/output ratio of intermediate inputs, and unit capital cost). China's factor costs might be much higher than those in Japan. Since China's per capita GDP was about one third of the Japanese level (Table 1), it is reasonable to assume that China's wage level might be one half of the Japanese level. If China's labour productivity in textiles was one third of the Japanese level (Table 8), then China's unit labour cost or wage-labour productivity ratio must be 50 percent higher than that of Japan. On the other hand, China's unit intermediate input cost could also be higher than that in Japan because of higher prices of cotton yarns and inefficient production process. Therefore, we can expect that China's price level of textiles would be higher than that in Japan.

The Heckscher-Ohlin theory usually assumes identical technology, but in the 1930s the technology level was very different as discovered in Table 8. If we consider the factor cost differences and technological differences simultaneously, we can expect that China's comparative advantage mainly existed in primary industries and labour-intensive products including some types of textiles and garments. Table 3 shows that China's net exports mainly concentrated in crude materials, minerals, fuels as well as textile products, which are very consistent with our conjecture.

Let us now turn to our second question what might drive China's earlier industrialization if it was indeed costly as suggested by our cost comparisons. Countries begin their modern economic development at different times, which means that late comers may face very different conditions from the pioneers which enjoy first-mover advantage even if the initial resource endowments are the same. When some countries have already industrialized or developed with modern technologies and industries, less developed countries tend to pursue a state-supported take-off or even some non-market approach for industrialization. This is because to many less developed countries comparative advantage is equivalent to cheap labour and land which, as some believe, would not easily lead to a fast catch up with developed countries. History has indeed shown us that large developing countries might use their comparative disadvantage to catch up though seldom efficient and successful.

Small countries in modernization seek to maximize their benefits by using their comparative advantage (niche services or unique natural resources) to pay for manufactured goods made in advanced countries because developing capital goods industries is inefficient due to diseconomies of scale. Small countries may also seek political-military allies so that they do not have to develop their own defence-oriented heavy industries. Large countries are different. Their potentially huge domestic markets attract those domestic investors who could afford for the high initial costs of learning and imitating, though they usually require state support. Politicians in such countries tend to have strong incentives to lend support or to pursue a state-involved industrialization because of political returns and national defence pressures. Some countries may rely on political support or state power to develop capital goods manufacturing and R&D while using their comparative advantage to pay for the cost, whereas some may go extreme by adopting forced saving and hence forced heavy industrialization through totalitarian controls and central planning like what happened in the Soviet Union and the Maoist China.

Our costs and productivity analyses have suggested that China did not produce in its comparative advantage, which lends tentative support to our conjecture. On the one hand, China's huge potential market was attractive to investors who could afford for initial high costs due to underdeveloped market institutions and infrastructures for modern industries. On the other hand, government involvement in China's initial development of heavy industries was inevitable because of the treats of foreign powers including its neighbour Japan as well as political and military conflicts at home.

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APPENDIX TABLES

TABLE A1: CALCULATION OF CHINESE PRICE LEVEL RELATIVE TO JAPAN IN 1935 (JAPAN = 1)

		Japanese weight			Chinese weight			Japanese		Chinese				Chinese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Source	Chinese/ Japanese	Japanese weight	Chinese weight	Fisher average
All industries														1.547	1.001	1.244
Food and kindred products		*0.108*			0.251									0.967	0.647	0.791
Liquor			*0.494*			0.234								0.615	0.666	0.640
	Liquor (*bai jiu*)			*0.768*			0.500	*100l*	40.057	*dan*	9.445	*b*	0.536			
	Beer			*0.232*			0.500	*100l*	46.599	*dan*	18.000	*b*	0.878			
Flour and Starch			*0.217*			0.497								0.513	0.513	0.513
	Wheat flour			*1.000*			1.000	*Kg*	0.152	*50kg*	1.710	*a*	0.513			
Cooking oil			*0.044*			0.134								0.862	0.763	0.811
	Rap oil			*0.475*			0.340	*kg*	0.367	*dan*	13.646	*b*	0.844			
	Sesame oil			*0.081*			0.330	*kg*	0.508	*dan*	13.327	*b*	0.596			
	Soybean oil			*0.444*			0.330	*kg*	0.356	*dan*	14.537	*a*	0.929			
Sugar			*0.173*			0.019								0.803	0.949	0.873
	Brown sugar			*0.130*			0.500	*kg*	0.230	*dan*	14.500	*a*	1.430			
	White sugar			*0.870*			0.500	*kg*	0.239	*dan*	7.453	*a*	0.710			
Salt			*0.037*			0.036								6.985	6.985	6.985
	Salt			*1.000*			1.000	*kg*	0.046	*dan*	14.070	*a*	6.985			
Tea			*0.020*			0.008								3.345	3.869	3.597
	Green tea			*0.943*			0.500	*kg*	0.524	*dan*	75.125	*b*	3.259			
	Black tea			*0.057*			0.500	*kg*	0.533	*dan*	111.708	*b*	4.760			
Other food			*0.015*			0.073								3.282	3.282	3.282
	Ice			*1.000*			1.000	*kg*	6.306	*tons*	18.211	*a*	3.282			
Textiles and their products		*0.310*			0.474									1.778	1.371	1.561
Silk			*0.160*			0.117								0.929	0.929	0.929
	Raw silk			*1.000*			1.000	*kg*	11.352	*dan*	463.963	*a*	0.929			
Yarn			*0.367*			0.502								1.003	1.137	1.068
	Cotton			*0.748*			0.340	*kg*	1.247	*jian*	162.100	*a*	0.814			
	Silk			*0.058*			0.330	*kg*	5.847	*dan*	323.951	*a*	1.259			
	Woolen			*0.194*			0.330	*kg*	2.437	*jian*	642.301	*a*	1.651			
Fabrics			*0.431*			0.268								2.761	2.840	2.800
	Cotton twill			*0.135*			0.295	*m*	0.132	*shichi*	0.087	*b*	2.250			
	Poplin			*0.125*			0.295	*m*	0.177	*shichi*	0.166	*b*	3.200			
	Calico			*0.269*			0.295	*tan (10m)*	0.526	*shichi*	0.062	*b*	4.018			
	Serge			*0.471*			0.114	*m*	1.617	*m*	2.948	*b*	2.072			
Knitgoods			*0.024*			0.082								1.612	1.612	1.612
	Cotton underwear			*1.000*			1.000	*dozen*	3.957	*dozen*	5.613	*b*	1.612			
Cotton			*0.018*			0.030								1.834	1.834	1.834
	Cotton wadding			*1.000*			1.000	*kg*	0.592	*dan*	47.782	*a*	1.834			
Wood products		*0.023*			0.003									0.964	0.964	0.964
Wood board			*1.000*	*1.000*		1.000	1.000	*3.3 sqm*	1.980	*3.3sq.m*	1.680	*d*	0.964	0.964	0.964	0.964
Paper and allied industries		*0.041*			0.045									1.368	1.205	1.284
Paper			*0.827*	*1.000*		0.542	1.000	*kg*	0.232	*kg*	0.294	*c*	1.443	1.443	1.443	1.443
Paperboard			*0.173*	*1.000*		0.458	1.000	*kg*	0.104	*kg*	0.093	*c*	1.008	1.008	1.008	1.008

		Japanese weight			Chinese weight			Japanese		Chinese				Chinese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Source	Chinese/ Japanese	Japanese weight	Chinese weight	Fisher average
Chemicals and allied products		*0.147*			0.070									2.010	0.859	1.314
Acid			*0.292*			0.015								2.956	2.900	2.928
	Sulfuric acid			*0.758*			0.740	*tons*	38.087	*tons*	92.247	*a*	2.752			
	Hydrochloric acid			*0.069*			0.250	*tons*	36.934	*50kg*	5.553	*b*	3.417			
	Nitric acid			*0.173*			0.009	*tons*	110.220	*tons*	355.420	*a*	3.664			
Soda			*0.082*			0.105								0.873	0.987	0.929
	Carbonated soda			*0.048*			0.334	*kg*	0.126	*tons*	99.562	*a*	0.900			
	Caustic soda			*0.829*			0.333	*kg*	149.906	*tons*	99.562	*a*	0.755			
	Bleaching powder			*0.123*			0.333	*tons*	67.397	*50kg*	4.928	*b*	1.662			
Other ind. chemicals			*0.066*			0.044								3.333	1.872	2.498
	Naphthalene			*0.266*			0.250	*kg*	0.085	*tons*	221.452	*b*	2.977			
	Alcohol			*0.208*			0.250	*kg*	0.756	*gallon*	1.114	*a*	8.844			
	Silicate			*0.355*			0.250	*kg*	0.070	*dan*	4.616	*a*	1.500			
	Alum			*0.170*			0.250	*kg*	77.818	*tons*	67.034	*b*	0.979			
Dye, Paint & Pigment			*0.082*			0.130								2.052	0.912	1.368
	Blue sulfide			*0.492*			0.334	*kg*	0.370	*jin*	0.421	*a*	2.587			
	Lacquer			*0.095*			0.333	*kg*	3.252	*pounds*	0.553	*a*	0.426			
	Paint			*0.413*			0.333	*kg*	0.540	*pounds*	0.385	*a*	1.788			
Oil			*0.087*			0.010								3.774	1.947	2.711
	Gasoline			*0.255*			0.200	*tons*	59.976	*kg*	0.323	*b*	6.120			
	Kerosene			*0.178*			0.200	*tons*	61.487	*kg*	0.218	*b*	4.029			
	Lubricants			*0.470*			0.200	*tons*	91.928	*kg*	0.211	*b*	2.608			
	Asphalt			*0.068*			0.200	*tons*	27.636	*tons*	89.982	*b*	3.700			
	Gelatin			*0.029*			0.200	*kg*	1.149	*dan*	33.644	*a*	0.665			
Vegetable oil and fat			*0.045*			0.016								1.040	1.170	1.103
	Cotton seed oil			*0.572*			0.334	*kg*	0.339	*dan*	10.671	*b*	0.715			
	Coconut oil			*0.419*			0.333	*kg*	0.274	*tons*	352.603	*b*	1.460			
	Tung oil			*0.009*			0.333	*kg*	0.427	*dan*	39.294	*b*	2.092			
Fertilizer			*0.191*			0.401								0.681	0.681	0.681
	Bean cake			*1.000*			1.000	*tons*	80.573	*dan*	2.415	*a*	0.681			
Soap			*0.030*			0.121								1.001	1.001	1.001
	Soap			*1.000*			1.000	*kg*	0.189	*Box/30kg*	5.000	*a*	1.001			
Pulp			*0.028*			0.007								2.789	2.789	2.789
	Pulp			*1.000*			1.000	*kg*	93.260	*tons*	228.914	*a*	2.789			
Tannery			*0.047*			0.081								0.777	0.844	0.810
	Cowhide			*0.800*			0.500	*pieces*	7.660	*pieces*	3.874	*a*	0.575			
	Acacia extract			*0.200*			0.500	*kg*	0.428	*gong-dan*	59.679	*a*	1.586			
Coke, coal			*0.052*			0.070								0.789	0.817	0.803
	Coke			*0.763*			0.500	*tons*	14.995	*tons*	10.040	*a*	0.761			
	Coal			*0.237*			0.500	*kg*	20.753	*tons*	16.090	*b*	0.881			
Stone, clay, and glass products		*0.026*			0.032									1.242	0.876	1.043
	Glass		*0.284*			0.141								0.997	0.997	0.997
	Glass plate			*1.000*			1.000	*box*	7.567	*box*	6.640	*b*	0.997			
Brick and Tile			*0.131*			0.207								0.936	0.893	0.914
	Black brick			*0.127*			0.334	*numbers*	0.014	*numbers*	0.008	*a*	0.648			
	Common brick			*0.724*			0.333	*numbers*	0.071	*numbers*	0.046	*a*	0.742			
	Tile			*0.148*			0.333	*numbers*	0.043	*10000ge*	807.117	*b*	2.135			
Cement			*0.420*			0.430						*b*		0.610	0.610	0.610
	Cement			*1.000*			1.000	*barrel*	3.213	*tons*	38.192		0.610			
Lime			*0.025*			0.014								4.074	4.074	4.074
	Lime			*1.000*			1.000	*tons*	6.997	*dan*	1.254	*a*	4.074			
Enamelware			*0.140*			0.208								3.417	3.417	3.417
	Washbasin or Cup			*1.000*			1.000	*numbers*	0.082	*dozen*	2.957	*b*	3.417			

		Japanese weight			Chinese weight			Japanese		Chinese				Chinese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Source	Chinese/ Japanese	Japanese weight	Chinese weight	Fisher average
Metals and metal products		*0.174*			0.046									1.392	0.984	1.171
Metal smelting materials			*0.714*			0.113								1.501	1.414	1.457
	Pig iron			*0.079*			0.250	*tons*	35.956	*tons*	64.477	*b*	2.038			
	Steel Plate			*0.777*			0.250	*kg*	0.093	*tons*	124.458	*b*	1.524			
	Copper casting, rough			*0.090*			0.125	*tons*	738.087	*tons*	624.542	*b*	0.962			
	Tinplate			*0.014*			0.125	*kg*	0.303	*tons*	351.677	*b*	1.317			
	Lead			*0.012*			0.125	*kg*	0.253	*dan*	14.592	*a*	1.309			
	Aluminum			*0.027*			0.125		1.507	*tons*	1653.450	*b*	1.247			
Casting			*0.077*			0.095								1.334	1.334	1.334
	Cast-iron pipe			*1.000*			1.000	*kg*	0.089	*pounds*	0.047	*a*	1.334			
Other metal products			*0.209*			0.792								1.040	0.916	0.976
	Nail			*0.649*			0.250	*barrel*	7.097	*pounds*	0.059	*a*	0.937			
	Nib			*0.083*			0.250	*gorss*	4.200	*gross*	1.950	*b*	0.528			
	Umbrella bone			*0.060*			0.250	*dozen*	1.274	*dozen*	1.556	*a*	1.388			
	Zinc plate			*0.208*			0.250	*kg*	0.186	*tons*	239.417	*b*	1.462			
Machinery		*0.135*			0.049									1.216	1.490	1.346
Machinery			*0.721*			0.171								0.941	0.993	0.967
	Generators			*0.230*			0.300	*numbers*	997.064	*numbers*	514.771	*a*	0.587			
	Motor *			*0.754*			0.300	*numbers*	115.957	*numbers*	104.882	*b*	1.028			
	Fans			*0.016*			0.400	*numbers*	20.1114	*numbers*	34.701	*a*	1.961			
Battery and Light bulb			*0.026*			0.266								2.111	1.259	1.630
	Accumulator			*0.050*			0.300	*numbers*	14.5720	*numbers*	22.500	*b*	1.755			
	Battery			*0.278*			0.300	*numbers*	0.11980	*dozen*	0.794	*a*	0.628			
	Light bulb			*0.672*			0.400	*numbers*	0.065	*numbers*	0.158	*a*	2.751			
			0.026			0.266								2.753	2.151	2.433
	Thermometer			*0.063*			0.300	*numbers*	0.575	*numbers*	2.000	*b*	3.950			
	AC voltage table			*0.380*			0.300	*numbers*	13.665	*numbers*	12.750	*b*	1.060			
	Clock			*0.557*			0.400	*numbers*	1.594	*numbers*	5.290	*a*	3.771			
Vehicle			*0.226*			0.296								1.811	1.811	1.811
	Bicycle			*1.000*			1.000	*numbers*	24.768	*numbers*	39.475	*a*	1.811			
Miscellaneous industries		*0.035*			0.031									2.221	1.165	1.608
Thermos bottle			*0.125*	*1.000*		0.125	1.000	*numbers*	0.331	*numbers*	0.628	*a*	2.160	2.160	2.160	2.160
Toothbrush			*0.125*	*1.000*		0.125	1.000	*dozen*	0.491	*numbers*	0.162	*a*	4.505	4.505	4.505	4.505
Handkerchief			*0.125*	*1.000*		0.125	1.000	*dozen*	0.476	*dozen*	0.202	*a*	0.482	0.482	0.482	0.482
Straw hat			*0.125*	*1.000*		0.125	1.000	*dozen*	3.634	*dozen*	16.926	*a*	5.293	5.293	5.293	5.293
Matches			*0.125*	*1.000*		0.125	1.000	*gross*	0.383	*box*	54.356	*a*	0.806	0.806	0.806	0.806
Pen			*0.125*	*1.000*		0.125	1.000	*dozen*	12.247	*dozen*	17.01	*b*	1.578	1.578	1.578	1.578
Pencil			*0.125*	*1.000*		0.125	1.000	*dozen*	0.071	*dozen*	0.145	*b*	2.322	2.322	2.322	2.322
Parasol			*0.125*	*1.000*		0.125	1.000	*numbers*	2.373	*dozen*	15.505	*a*	0.619	0.619	0.619	0.619

Sources: See the data section.

Notes: a) D.K. Lieu's Report on a Survey of China's Industry, Volume 2 (NRC, 1937); b) Archive Materials for Studies of Industrial and Agricultural Commodity Prices, Shanghai Volume, compiled by Office for Industrial and Agricultural Price Survey (OIAPS, 1956-57); and c) Zhen Chen's Study Materials of Industrial History in Contemporary China, Volume 4, Parts 1 and 2 (1961).

TABLE A2: CALCULATION OF JAPANESE PRICE LEVEL RELATIVE TO THE US IN 1935 (US = 1)

		Japanese weight			US weight			Japanese		US			Japanese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Yen/US$	US weight	Japanese weight	Fisher average
All industries													0.632	0.412	0.510
Food and kindred products		0.108			0.208								0.817	0.819	0.818
Grain-mill and products			0.223			0.282							0.540	0.569	0.555
	Wheat flour			0.966			0.84	kg	0.152	barrels	6.67	0.590			
	Noodles, macaroni, spaghetti, etc			0.034			0.16	kg	0.162	pounds	0.07	0.286			
Liquors			0.490			0.222							2.023	2.075	2.049
	Wines			0.020			0.09	100 liters	42.540	gallons	0.42	1.129			
	Beer			0.980			0.91	100 liters	46.599	barrels	8.76	2.111			
Sugar			0.172			0.156							0.726	0.736	0.731
	Sugar cane			0.130			0.06	kg	0.230	2000 pounds	65.85	0.926			
	Refined sugar			0.870			0.94	kg	0.239	2000 pounds	88.53	0.714			
Cooking oils			0.044			0.067							0.625	0.534	0.578
	Vegetable cooking oils			0.959			0.62	kg	0.385	pounds	0.10	0.526			
	Miscellaneous animal oils and fats			0.041			0.38	kg	0.351	pounds	0.06	0.789			
Other products			0.071			0.272							0.220	0.257	0.238
	Canned Vegetables							kg	0.771	case					
	Salt			0.262			0.01	kg	0.046	pounds	0.01	0.566			
	Ice			0.738			0.99	tons	6.306	2000 pounds	3.88	0.215			
Textiles and their products		0.310			0.132								0.385	0.341	0.362
Silk and yarn			0.545			0.216							0.476	0.533	0.504
	Raw silk			0.335			0.01	kg	11.352	pounds	2.09	0.718			
	Cotton yarn			0.603			0.86	kg	1.247	pounds	0.34	0.482			
	Spun silk for sale			0.047			0.09	kg	5.847	pounds	2.23	0.347			
	Twisted silk yarn			0.015			0.03	kg	10.558	pounds	2.22	0.629			
Fabrics			0.431			0.757							0.351	0.234	0.287
	Jeans			0.041			0.03	m	0.132	sq. yards	0.12	0.287			
	Drills			0.070			0.13	m	0.195	sq. yards	0.10	0.496			
	Other wide cotton fabrics			0.775			0.28	m	0.168	sq. yards	0.21	0.210			
	All silk fabrics			0.065			0.56	m	0.425	sq. yards	0.29	0.389			
	Jute bagging			0.002			0.00	m	0.282	sq. yards	0.07	1.067			
	Rayon fabrics			0.046			0.00	m	0.269	sq. yards	0.19	0.371			
	Rayon and cotton mixed fabrics			0.000			0.00	m	0.227	sq. yards	0.20	0.311			
Hosiery			0.024			0.027							0.586	0.380	0.472
	Underwear			0.074			0.64	doz.	13.925	doz.	5.71	0.711			
	Total gloves			0.926			0.36	doz.	2.330	doz.	1.85	0.366			
Wood & allied products a		0.023			0.036								1.130	0.364	0.641
Wood			0.700			0.675							1.612	1.595	1.603
	Pine, yellow, flooring, mill*			0.500			0.500	19.2m	2.000	1000ft	36.02	1.447			
	Pine, yellow, flooring, mill*			0.500			0.500	120 Syaku	1.550	1000ft	22.75	1.776			
Wage			0.300			0.325							0.130	0.130	0.130
	Wage for Furniture maker			1.000			1.000	daily	1.800	hourly	0.50	0.130			
Paper, printing & publishing		0.041			0.081								0.432	0.379	0.404
Paper			0.500			0.410							0.728	1.070	0.882
	Printing paper			0.675			0.077	kg	0.207	2000 pounds	35.19	1.547			
	Writing paper			0.041			0.164	kg	0.297	2000 pounds	139.20	0.560			
	Wrapping paper			0.082			0.295	kg	0.220	2000 pounds	77.85	0.741			
	Paperboard			0.202			0.464	kg	0.104	2000 pounds	42.61	0.642			
Printing			0.500			0.580							0.230	0.230	0.230
	Newspaper			1.000			1.00	1 issue	0.050	1 issue	0.06	0.230			

		Japanese weight			US weight			Japanese		US			Japanese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Yen/US$	US weight	Japanese weight	Fisher average
Chemicals & allied products		0.147			0.157								0.317	0.497	0.397
Chemicals not else where classified			0.254			0.029							0.904	0.854	0.878
	Sulfuric acid			0.411			0.39	tons	14.232	tons	7.11	0.584			
	Nitric acid			0.013			0.03	tons	142.928	tons	87.46	0.476			
	Soda ash			0.522			0.35	tons	74.998	tons	15.19	1.440			
	Iodine			0.005			0.00	kg	8.887	pounds	1.19	0.986			
	Chlorine			0.025			0.10	kg	0.102	tons	38.39	0.776			
	Carbon dioxide			0.007			0.06	kg	0.145	pounds	0.05	0.371			
	Alcohols			0.017			0.08	kg	0.756	pounds	0.12	0.803			
Ink, printing and writing			0.095			0.013							0.416	0.416	0.416
	Printing and lithographing inks			1.000			1.00	kg	0.680	pounds	0.22	0.416			
Soap			0.078			0.085							0.618	0.553	0.585
	Laundry soap (bar)			0.793			0.39	kg	0.189	pounds	0.05	0.528			
	Laundry soap (powder)			0.207			0.61	kg	0.225	pounds	0.04	0.675			
Oil			0.217			0.205							0.320	0.318	0.319
	Fuel oil			0.235			0.62	tons	61.487	gallons	0.23	0.123			
	Paraffin wax			0.177			0.02	tons	294.822	gallons	0.19	0.705			
	Asphalt			0.090			0.04	tons	27.636	2000 pounds	10.79	0.747			
	Cotton seed oil			0.301			0.16	kg	0.339	pounds	0.08	0.542			
	Linseed Oil			0.158			0.07	kg	0.410	pounds	0.09	0.606			
	Miscellaneous animal oils and fats			0.039			0.08	kg	0.351	pounds	0.06	0.789			
Fertilizers			0.220			0.137							0.363	0.799	0.539
	Chemicals fertilizers			0.835			0.01	tons	55.206	tons	14.75	1.092			
	Fish scrap			0.012			0.05	kg	0.083	tons	25.52	0.943			
	Bone meal			0.009			0.02	tons	75.087	tons	25.11	0.872			
	Oil cake, and meal			0.144			0.92	tons	78.517	2000 pounds	33.46	0.311			
Leather			0.028			0.433							0.141	0.144	0.142
	Cattle leather			0.971			1.00	pieces	7.660	sides	15.93	0.140			
	Horse,			0.029			0.00	pieces	5.912	half and whole fronts	1.74	0.990			
Gelatin and glue			0.006			0.010							0.669	0.622	0.645
	Gelatin			0.670			0.68	kg	0.428	pounds	0.07	0.777			
	Glue			0.330			0.32	kg	1.149	pounds	0.34	0.442			
Coke-oven			0.101			0.084							0.567	0.567	0.567
	Cokes			1.000			1.00	tons	14.995	short tons	6.99	0.567			
Wood distillation and Charcoal			0.000			0.003							0.815	0.815	0.815
	Charcoal			1.000			1.00	tons	36.487	bushels	0.12	0.815			
Stone, clay, glass products		0.026			0.021								0.373	0.459	0.414
Cement			0.500			0.030							0.619	0.618	0.618
	Portland cement			0.985			0.99	casks	3.213	barrels	1.51	0.621			
	Natural, puzzolan, and masonry cement			0.015			0.01	casks	2.136	barrels	1.42	0.438			
Lime			0.029			0.057							0.276	0.276	0.276
	Lime			1.000			1.00	tons	6.997	tons	7.39	0.276			
Glass			0.338			0.693							0.361	0.361	0.361
	Shade Globes			1.000			1.00	numbers	0.061	doz.	0.59	0.361			
Clay products			0.132			0.220							0.405	0.405	0.405
	Common brick, Building brick			1.000			1.00	numbers	0.014	thousands	10.07	0.405			

		Japanese weight			US weight			Japanese		US			Japanese price level		
		I	II	III	I	II	III	Unit	Price	Unit	Price	Yen/US$	US weight	Japanese weight	Fisher average
Metals and metal products		0.174			0.130								0.732	0.648	0.689
Metals			0.714			0.506							0.644	0.624	0.634
	Pig iron			0.229			0.62	tons	35.956	tons*	16.95	0.618			
	Ferro-alloys			0.065			0.08	kg	0.221	tons*	73.67	0.876			
	Steel plains			0.173			0.09	kg	0.093	tons*	70.92	0.381			
	Copper casting, rough			0.076			0.01	tons	738.087	tons	168.91	1.274			
	Copper plate			0.042			0.04	kg	0.816	tons	281.07	0.846			
	Copper wire			0.165			0.03	kg	0.783	pounds	0.14	0.763			
	Copper tubing, seamless, and pipe			0.021			0.02	kg	1.006	tons	354.19	0.828			
	Other copper metals			0.004			0.00	kg	0.756	pounds	0.21	0.473			
	Zinc casting, rough			0.035			0.01	kg	0.303	tons	98.02	0.903			
	Zinc plates and sheets			0.011			0.01	kg	0.259	tons	162.84	0.465			
	Lead			0.001			0.02	kg	0.253	tons	88.24	0.837			
	Lead plates			0.022			0.00	kg	0.265	tons	133.20	0.579			
	Lead tubing			0.021			0.00	kg	0.273	tons	145.91	0.545			
	Aluminum products			0.098			0.05	kg	1.507	pounds	0.35	0.573			
	Tin			0.038			0.00	kg	3.617	tons	987.77	1.068			
Metal products			0.286			0.494							0.821	0.717	0.767
	Cast-iron pipe fitting			0.241			0.14	kg	0.089	2000 pounds	47.53	0.544			
	Nails, brads, and spikes			0.248			0.12	casks	7.097	kegs	3.20	0.647			
	Tinplate			0.511			0.74	kg	0.310	pounds	0.05	0.900			
Machinery, including transportation equipment		0.135			0.177								0.963	0.363	0.591
Engines and turbines			0.148			0.042							0.777	0.560	0.660
	Steam engines			0.056			0.08	numbers	7774.67	numbers	3117.31	0.727			
	Steam turbines			*0.532*			*0.65*	*numbers*	*56423*	*numbers*	*5178.39*	*1.000*			
	Internal combustion engines (General gasoline)			0.334			0.06	numbers	186.070	numbers	137.29	0.395			
	Water wheels and water turbines			0.078			0.22	numbers	12432	numbers	15466.3	0.234			
Electric Machinery			0.412			0.404							0.872	0.206	0.424
	Power transformers			0.612			0.14	numbers	68.758	numbers	144.10	0.139			
	Fans			0.028			0.06	numbers	20.111	numbers	4.83	1.213			
	Storage batteries			0.046			0.58	numbers	14.572	numbers	4.09	1.039			
	Dry batteries			0.257			0.14	numbers	0.120	numbers	0.03	1.053			
	Elevators, winding machines			0.057			0.08	numbers	2914	numbers	2034.48	0.418			
Transportation equipment			0.440			0.554							1.043	0.891	0.964
	Steam-railroad cars			*0.121*			*0.28*	*numbers*	*63050*	*numbers*	*2828.70*	*1.000*			
	Electric-railroad cars			0.005			0.04	numbers	16588	numbers	14119.4	0.343			
	Motor vehicles			0.386			0.15	numbers	2588	numbers	331.38	2.277			
	Bicycles			0.012			0.13	numbers	24.768	numbers	18.36	0.393			
	Steel ships			0.451			0.26	numbers	249187	numbers	123932	0.586			
	Wooden ships, etc			0.025			0.14	numbers	2018.25	numbers	402.33	1.463			
Miscellaneous industries		0.035			0.058								0.210	0.159	0.183
Hats			0.732			0.711							0.151	0.149	0.150
	Felt hats			0.893			0.81	doz.	6.418	doz.	12.76	0.147			
	Straw hats			0.107			0.19	doz.	3.634	doz.	6.22	0.170			
Pens and pencils			0.268			0.289							0.356	0.198	0.265
	Pens			0.341			0.51	doz.	12.247	gross	77.70	0.551			
	Pencils			0.659			0.49	doz.	0.071	gross	1.67	0.149			

Sources: See the data section. *Notes*: *1 ton = 2240 pounds.

TABLE A3: CALCULATION OF KOREAN PRICE LEVEL RELATIVE TO JAPAN IN 1935 (JAPAN = 1)

		Japanese weight			Korean weight				Prices			Korean price level		
		I	II	III	I	II	III	Units	Japanese	Korean	Korean/ Japanese	Japanese weight	Korean weight	Fisher average
All industries												1.021	0.764	0.884
Food and kindred products		0.108			0.549							0.959	0.737	0.841
Liquors			0.436			0.615						0.996	0.707	0.839
	Rice wine sake			0.653			0.234	100*l*	38.658	39.768	1.029			
	Sweet rice wine mirin, including mirin with additives			0.022			0.000	100*l*	56.290	37.161	0.660			
	Low-class distilled spirits			0.085			0.628	100*l*	40.057	23.811	0.594			
	Beers			0.235			0.131	100*l*	46.599	50.555	1.085			
	Wines			0.005			0.006	100*l*	42.540	34.766	0.817			
Soy Sauce			0.070	1.000		0.003	1.000	100*l*	13.815	1.125	0.081	0.081	0.081	0.081
Miso (bean paste)			0.021	1.000		0.015	1.000	kg	0.103	0.141	1.368	1.368	1.368	1.368
Vinegar			0.002	1.000		0.001	1.000	100*l*	7.596	18.622	2.452	2.452	2.452	2.452
Sake lees			0.007	1.000		0.009	1.000	kg	0.087	0.012	0.136	0.136	0.136	0.136
Flours			0.178			0.110						1.035	1.035	1.035
	Wheat flour			1.000			1.000	kg	0.152	0.157	1.035			
Starch			0.014			0.030						1.637	1.637	1.637
	Miscellaneous Starch			1.000			1.000	kg	0.147	0.240	1.637			
Sugar			0.153			0.135						0.858	0.858	0.858
	Refined sugar			1.000			1.000	kg	0.239	0.205	0.858			
Food cans			0.050			0.038						1.571	1.099	1.314
	Canned beef			0.104			0.032	kg	0.903	1.557	1.723			
	Canned, bottled and potted meat			0.001			0.005	kg	0.331	1.181	3.568			
	Canned mackerel			0.059			0.094	kg	0.363	0.275	0.759			
	Canned Bonito			0.045			0.001	kg	0.349	0.556	1.591			
	Canned Sardine			0.208			0.226	kg	0.203	0.835	4.123			
	Canned Abalone			0.009			0.066	kg	0.635	2.045	3.220			
	Canned Crab			0.278			0.482	kg	1.113	0.993	0.892			
	Canned Fruits			0.148			0.001	kg	0.379	0.104	0.275			
	Canned Vegetables			0.146			0.094	kg	0.327	0.208	0.635			
Seafood			0.033			0.028						0.733	0.633	0.681
	Salt			0.401			0.900	kg	0.046	0.028	0.619			
	Agar			0.426			0.071	kg	2.592	2.280	0.879			
	Dried Bonito (Katsuobushi)			0.172			0.029	kg	1.109	0.704	0.634			
Tea			0.018			0.000						1.305	1.211	1.257
	Green teas			0.897			0.828	kg	0.524	0.585	1.117			
	Green teas			0.055			0.074	kg	0.322	0.368	1.140			
	Brown tea			0.049			0.098	kg	0.533	2.636	4.942			
Ice made			0.013	1.000		0.008	1.000	ton	6.306	6.913	1.096	1.096	1.096	1.096
Noodles			0.006	1.000		0.009	1.000	kg	0.162	0.175	1.080	1.080	1.080	1.080
Textile and their products		0.310			0.119							1.360	1.104	1.225
Yarn			0.225			0.192						0.930	0.931	0.931
	Raw silk			0.946			0.964	kg	11.352	10.453	0.921			
	Doupion raw silk			0.023			0.001	kg	7.423	5.488	0.739			
	Frison			0.030			0.035	kg	2.409	3.269	1.357			
Spun silk			0.098			0.212						0.800	0.814	0.807
	Cotton yarn			0.973			0.998	kg	1.247	1.015	0.815			
	Flax yarn			0.010			0.002	kg	1.093	0.534	0.489			
	Miscellaneous flax yarn			0.016			0.000	kg	0.998	0.114	0.114			
			0.025			0.009						2.721	3.752	3.195
	Cotton (for fishing net)			0.490			0.049	kg	1.275	1.304	1.023			
	Cotton (Miscellaneous)			0.510			0.951	kg	1.265	5.506	4.353			

		Japanese weight			Korean weight				Prices			Korean price level		
		I	II	III	I	II	III	Units	Japanese	Korean	Korean/ Japanese	Japanese weight	Korean weight	Fisher average
Fabrics			0.605			0.331						1.437	1.313	1.374
Cotton	Shirting			0.400			0.095	m	0.158	0.178	1.125			
	Sheeting			0.089			0.848	m	0.161	0.210	1.309			
	Ogura sheeting			0.039			0.000	m	0.283	0.526	1.857			
	Miscellaneous wide cotton fabrics			0.068			0.004	m	0.145	0.421	2.910			
	Canvas			0.029			0.006	m	0.432	0.517	1.197			
	White cotton cloth			0.043			0.000	tan	0.526	1.351	2.568			
	Stripe cotton cloth			0.023			0.000	tan	0.953	1.361	1.429			
	Woven color cotton			0.006			0.004	tan	0.948	1.153	1.216			
	Towel s			0.025			0.000	dozen	1.071	0.800	0.747			
Spun silk fabrics				0.011			0.002	m	0.300	0.363	1.211			
	Miscellaneous silk fabrics			0.001			0.000	*m*	0.221	0.259	1.168			
	Narrow silk crepes			0.113			0.000	tan	7.418	9.000	1.213			
	habutae silk			0.023			0.001	tan	5.183	4.615	0.890			
	Raw woven silk gauze and gossamer			0.007			0.001	tan	6.230	3.061	0.491			
	Meisen fabric			0.036			0.000	tan	4.462	8.333	1.868			
	Shaku Miscellaneous Japanese-style apparel			0.013			0.000	tan	8.390	2.449	0.292			
	Hakama			0.005			0.000	tan	7.760	2.809	0.362			
	Flat silk			0.000			0.001	tan	3.339	3.727	1.116			
	Miscellaneous narrow raw silk and white silk fabrics			0.007			0.003	tan	2.991	3.424	1.145			
Silk-cotton mixed fabrics				0.004			0.002	tan	2.610	2.059	0.789			
Hard and bast fiber fabrics				0.002			0.001	tan	2.142	4.476	2.090			
	Stripe flax fabrics			0.001			0.000	tan	2.965	4.000	1.349			
Rayon fabrics				0.040			0.014	m	0.153	0.327	2.133			
	shaku			0.014			0.000	tan	1.895	4.000	2.111			
Rayon filament mixed fabrics				0.001			0.011	m	0.175	1.916	10.933			
Hosiery			0.033			0.043						3.369	0.848	1.690
	Cotton textile underwear			0.364			0.024	dozen	1.195	8.554	7.157			
	Woolen, woolen-cotton mixed underwear			0.193			0.007	dozen	15.619	24.443	1.565			
	Cotton socks			0.268			0.906	dozen	1.463	1.203	0.822			
	Woolen, woolen-cotton mixed socks			0.092			0.001	dozen	3.566	3.704	1.039			
	Cotton gloves			0.041			0.063	dozen	1.088	1.000	0.919			
	Woolen, woolen-cotton mixed gloves			0.042			0.000	dozen	2.326	6.000	2.579			
Floss silks			0.000	1.000		0.000	1.000	kg	1.150	4.403	3.828	3.828	3.828	3.828
Wadding			0.014	1.000		0.213	1.000	kg	0.592	0.942	1.592	1.592	1.592	1.592
Wood & allied products		0.023			0.024							0.715	0.697	0.706
Wage			0.3			0.3						0.900	0.900	0.900
	Wage for Carpenter			1.000			1.000	daily	2.000	1.800	0.900			
Wood			0.7			0.7						0.635	0.635	0.635
	Firewood			1.000			1.000	10kg	26.600	16.900	0.635			
Paper, printing & publishing		0.041			0.028							1.545	1.032	1.263
Paper			0.500			0.280						2.090	1.124	1.533
	printing paper			0.377			0.001	kg	0.207	0.903	4.354			
	writing paper a			0.575			0.119	10 pieces	7.400	5.000	0.676			
	wrapping paper			0.048			0.880	kg	0.220	0.271	1.234			
Printing			0.500			0.720						1.000	1.000	1.000

		Japanese weight			Korean weight				Prices			Korean price level		
		I	II	III	I	II	III	Units	Japanese	Korean	Korean/ Japanese	Japanese weight	Korean weight	Fisher average
	Newspaper b			1.000			1.000	1 issue	5.000	5.000	1.000			
Chemicals and allied products		0.147			0.187							0.733	0.691	0.712
Chemicals			0.253			0.141						0.374	0.277	0.322
	Sulfate			0.107			0.288	ton	14.952	14.157	0.947			
	Caustic soda			0.161			0.001	ton	149.906	34.719	0.232			
	Iodine			0.001			0.001	kg	8.887	7.229	0.813			
	Oxygen gas			0.042			0.019	m3	0.221	0.003	0.013			
	Hydrogen gas			0.006			0.015	kg	0.336	0.080	0.238			
	Ammonium chloride			0.154			0.462	kg	0.223	0.069	0.308			
	Methanol			0.006			0.040	ton	0.360	0.273	0.757			
	Naphthalene			0.005			0.002	ton	0.085	0.028	0.331			
	Alcohol			0.004			0.002	kg	0.756	1.050	1.388			
	Glycerin			0.039			0.141	kg	0.991	1.295	1.308			
	Chloridation kalium			0.001			0.000	ton	81.551	80.000	0.981			
	Miscellaneous			0.474			0.028	kg	1.626	0.417	0.256			
Synthetic dyes			0.027			0.001						0.579	0.579	0.579
	Miscellaneous synthetic dyes			1.000			1.000	kg	3.567	2.067	0.579			
Paints			0.027			0.000						0.880	0.922	0.901
	Chinese ink			0.017			0.278	kg	0.783	0.833	1.065			
	Miscellaneous ink			0.983			0.722	dozen	1.236	1.083	0.877			
Soap			0.044			0.009						0.787	0.820	0.803
	Bath soap			0.459			0.036	dozen	0.837	0.769	0.920			
	Industrial detergents			0.070			0.005	kg	0.242	0.170	0.703			
	Laundry soap (bar)			0.373			0.958	kg	0.189	0.157	0.831			
	Laundry soap (Powder			0.097			0.001	kg	0.225	0.012	0.051			
Oil			0.099			0.024						0.890	0.997	0.942
	Coal-tar			0.067			0.147	ton	25.184	19.567	0.777			
	Benzol			0.060			0.136	ton	234.376	173.509	0.740			
	Toluol			0.005			0.000	ton	349.728	299.250	0.856			
	Creosote			0.030			0.003	ton	50.867	49.914	0.981			
	Volatile oil			0.481			0.008	ton	113.223	79.414	0.701			
	Light oil			0.072			0.054	ton	59.976	84.009	1.401			
	Machine oil			0.132			0.191	ton	91.928	110.240	1.199			
	Heavy oil			0.068			0.058	ton	29.044	34.999	1.205			
	Paraffin			0.038			0.050	ton	294.822	141.370	0.480			
	Pitch			0.022			0.080	ton	15.878	20.986	1.322			
	Miscellaneous			0.026			0.274	ton	48.741	64.780	1.329			
Vegetable oils			0.062			0.017						0.930	0.978	0.954
	Sesame oil			0.080			0.060	kg	0.508	0.663	1.304			
	Cotton seed oil			0.186			0.603	kg	0.339	0.324	0.955			
	Soybean oil			0.439			0.336	kg	0.356	0.348	0.978			
				0.295			0.001	kg	0.503	0.372	0.740			
Animal oils and fats			0.011			0.108						1.076	1.293	1.179
	Sardine oil			0.085			0.992	kg	0.133	0.172	1.294			
	Sperm oil			0.093			0.001	kg	0.159	0.090	0.566			
	Miscellaneous (fish oil)			0.530			0.007	kg	0.185	0.259	1.404			
	Pupa oil			0.018			0.000	kg	0.194	0.153	0.789			
	Fat			0.273			0.000	kg	0.406	0.229	0.565			

		Japanese weight			Korean weight				Prices			Korean price level		
		I	II	III	I	II	III	Units	Japanese	Korean	Korean/ Japanese	Japanese weight	Korean weight	Fisher average
Candles			0.004	1.000		0.002	1.000	kg	0.466	0.562	1.207	1.207	1.207	1.207
Processed oil			0.027			0.121						0.946	0.950	0.948
Hydrogenated oils				0.770			0.806	ton	0.234	0.233	0.996			
Hydrogenated wax				0.010			0.071	kg	0.287	0.240	0.835			
Stearin				0.220			0.123	kg	0.302	0.235	0.777			
Rubbers			0.104			0.095						0.614	0.614	0.614
	Miscellaneous Rubber shoes			1.000			1.000		0.525	0.322	0.614			
Fertilizers			0.219			0.418						0.918	0.970	0.943
	Soybean cakes			0.140			0.021	ton	80.573	75.817	0.941			
	Fish scraps			0.015			0.160	ton	0.083	0.069	0.838			
	Pupa cakes			0.004			0.001	ton	0.076	0.053	0.699			
	Bone meal			0.012			0.001	ton	75.087	71.143	0.947			
	Super-phosphate			0.348			0.028	ton	31.212	30.581	0.980			
	Ammonium phosphate			0.000			0.164	ton	41.036	98.835	2.409			
	ammonium sulfate			0.481			0.625	ton	93.520	81.304	0.869			
Leather			0.027			0.012						1.643	1.421	1.528
	Cattle leather			0.523			0.365	sheets	7.660	15.598	2.036			
	Sole leather			0.477			0.635	sheets	24.828	30.071	1.211			
Gelatin and glue			0.006			0.000						1.060	1.060	1.060
	Gelatin and glue			1.000			1.000	kg	0.428	0.453	1.060			
Others			0.087			0.051						0.673	0.671	0.672
	cokes													
	Miscellaneous			0.672			0.673	ton	17.417	12.163	0.698			
	Briquettes and briquette balls			0.328			0.327	ton	20.753	12.912	0.622			
Stone, clay and glass products		0.026			0.025							1.151	0.841	0.984
Clay			0.237			0.065						1.385	1.385	1.385
	Clay pipes			1.000			1.000	numbers	0.186	0.258	1.385			
Glass			0.046			0.033						1.104	1.104	1.104
	Shade, globes			1.000			1.000	dozen	0.061	0.067	1.104			
Bricks			0.065			0.083						0.913	1.036	0.972
	Building brick			0.250			0.822	numbers	0.014	0.015	1.085			
	Fire bricks			0.750			0.178	numbers	0.071	0.060	0.856			
Tiles			0.023			0.016						0.766	0.760	0.763
	Smoked roofing tile			0.790			0.992	numbers	0.043	0.033	0.759			
	Miscellaneous roofing tiles			0.210			0.008	numbers	0.051	0.040	0.791			
Cement (including Portland cement)			0.479	1.000		0.637	1.000	tarus	3.213	3.493	1.087	1.087	1.087	1.087
Cement products			0.046			0.057						0.354	0.161	0.239
	Cement Tiles			0.142			0.513		0.047	0.057	1.207			
	Cement pipes			0.576			0.198		1.481	0.430	0.290			
	Cement slates			0.282			0.289		1.419	0.080	0.056			
Lime			0.028	1.000		0.020	1.000		6.997	8.285	1.184	1.184	1.184	1.184
Enameled iron			0.077			0.089						1.630	1.630	1.630
	Tableware			1.000			1.000		0.082	0.134	1.630			
Metal and metal products		0.174			0.035							0.783	0.760	0.771
Metals			1.000			1.000						0.783	0.760	0.771
	Pig Iron			0.076			0.415	ton	35.956	27.389	0.762			
	Ｓｔｅｅｌ (cast)			0.295			0.348	ton	57.939	51.182	0.883			
	Steel (Miscellaneous sheets)			0.163			0.167	ton	0.108	0.063	0.579			
	Steel (Miscellaneous)			0.466			0.069	ton	0.092	0.073	0.794			

		Japanese weight			Korean weight				Prices			Korean price level		
		I	II	III	I	II	III	Units	Japanese	Korean	Korean/ Japanese	Japanese weight	Korean weight	Fisher average
Machinery, including transportation		0.135			0.015							0.648	0.433	0.530
Boilers			0.108			0.005						0.058	0.041	0.048
	Water tube boilers			0.797			0.368	numbers	55025.596	928.571	0.017			
	Miscellaneous tube boilers			0.203			0.632	numbers	2047.217	447.200	0.218			
Engines and turbines			0.216			0.063						0.983	0.750	0.858
	Steam engines			0.045			0.019	numbers	7774.674	666.667	0.086			
	General gas engines			0.002			0.007	numbers	3090.000	1500.000	0.485			
	General gasoline			0.266			0.904	numbers	186.070	529.308	2.845			
	General oil engines			0.626			0.067	numbers	3623.782	1286.364	0.355			
	Water turbines			0.062			0.002	numbers	12431.677	50.000	0.004		1.000	0.000
Elevators			0.006	1.000		0.000	1.000	numbers	2913.606	40.000	0.014	0.014	0.014	0.014
Winding machines			0.078			0.019						0.031	0.031	0.031
	Winding machines			1.000			1.000	numbers	9607.574	293.423	0.031			
Pumps			0.004	1.000		0.006	1.000	numbers	1121.285	40.828	0.036	0.036	0.036	0.036
Blowers			0.012	1.000		0.001	1.000	numbers	316.427	2.618	0.008	*0.008*	*0.008*	0.008
Measures			0.033			0.105						1.019	1.077	1.048
	Universal measures			0.181			0.063	numbers	0.123	0.103	0.837			
	Voltmeters			0.099			0.285	numbers	0.852	1.128	1.324			
	Balances and scales			0.720			0.652	numbers	2.658	2.718	1.023			
General lighting bulbs												0.155	0.155	0.155
			0.063	1.000		0.004	1.000	numbers	0.065	0.010	0.155			
Railroad cars and locomotives			0.159	1.000		0.487						0.794	0.823	0.808
	Steam Locomotives			0.509			0.023	numbers	63050.548	43640.000	0.692			
	Gasoline cars			0.050			0.040	numbers	6346.336	13333.333	2.101			
	Passenger cars and freight cars			0.442			0.890	numbers	3952.248	3023.548	0.765			
Motor vehicles			0.023	1.000		0.128	1.000	numbers	829.996	452.912	0.546	0.546	0.546	0.546
Bicycles			0.007	1.000		0.006	1.000	numbers	24.768	19.764	0.798	0.798	0.798	0.798
Miscellaneous cars			0.016			0.021						1.514	1.514	1.514
	Carts			1.000			1.000	numbers	20.566	31.131	1.514			
Ships			0.273			0.154						0.817	0.817	0.817
	Miscellaneous (excepting steel ships)			1.000			1.000	numbers	2018.251	1648.333	0.817			
Miscellaneous industries		0.035			0.017							1.536	1.484	1.510
Tatami matting			0.002	1.000		0.001	1.000	sheets	0.676	0.800	1.183	1.183	1.183	1.183
Straw products			0.064			0.101						3.336	3.336	3.336
	Straw-mats and mat bases			1.000			1.000	sheets	0.684	2.283	3.336			
Leather products			0.437			0.707						2.296	2.290	2.293
	leather footwear			0.916			0.926	numbers	2.800	6.348	2.267			
	Leather bags			0.084			0.074	numbers	2.776	7.263	2.616			
Brushes			0.063			0.022						0.872	0.872	0.872
	Miscellaneous brushes			1.000			1.000	dozen	1.132	0.988	0.872			
Hats			0.414			0.168						0.548	0.545	0.546
	Textile hats			0.357			0.216	dozen	2.624	1.476	0.562			
	Straws			0.643			0.784	dozen	3.634	1.962	0.540			
Japanese-style umbrellas			0.020	1.000		0.001	1.000		0.400	0.680	1.701	1.701	1.701	1.701

Sources: See the data section.