Globalization, Trade & Wages: What Does History Tell us about China?

Kris James Mitchener
Department of Economics
Santa Clara University
& NBER
kmitchener@scu.edu

and

Se Yan
Guanghua School of Management
Peking University
seyan@gsm.pku.edu.cn

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We show that Chinese exports grew rapidly during the first three decades of the twentieth century as China opened up to global trade. Using a new data set on the factor-intensity of traded goods at the industry level, we show that Chinese exports became more unskilled-intensive during these three decades and imports became more skill-intensive. The exogenous shock of World War I increased the demand for Chinese goods overseas, dramatically raised the price of Chinese exports, and increased the demand for unskilled workers producing these export goods. These trends continued even after the war ended. We show that the timing of the rise in export prices is consistent with the observed decline in the skill premium in China. The skill-unskilled wage ratio flattened out during the 1910s and then fell by eight percent during the 1920s. We simulate the exogenous demand shock of World War I using a general equilibrium factor-endowment model of trade and find evidence that is consistent with the observed fall in the skill premium in China during the 1920s.

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One of the most contentious issues with respect to the global growth in trade is its effects on wages. Much of the debate has focused on how the expansion in trade between developing and developed countries affects the wages in the United States and Europe. The logic of trade theories such as the Heckscher-Ohlin-Vanek (HOV) model and Stolper-Samuelson (1941) suggest that an expansion of trade will raise the wages of skilled workers and lower those of unskilled workers in developed countries if these countries are relatively well endowed with skilled labor. This has led some commentators to link the growing wage inequality within the U.S. to trade with the rest of world; even more specifically, some have suggested that as U.S. trade with China grows, wages for unskilled workers in the U.S. will fall in response. An equally interesting question, and one which has received comparatively less attention, is how the growth in trade is altering wages in developing countries. For example, trade models based on factor endowments predict that the skill premium should be falling in rapidly developing countries like China. On the other hand, recent empirical studies suggest that globalization has likely increased inequality in developing countries in the last three decades, although these findings depend on country-specific and time-specific factors.[1]

Determining the sources for wage inequality today is complicated by many factors. First, trade has become much more complicated than what is typically described in factor endowment models. The growth in intra-industry trade, outsourcing and offshoring, and multinationals are some factors which perhaps cast

[1] For a survey, see Goldberg and Pacvcnik (2007). For articles on the effects of trade on skill premia in specific countries see, for example, Robbins (1996), Beyer, Rojas, and Vergara. (1999), Gasparini (2003), Hanson (2004), Robertson (2000, 2004).

doubt on the reliability of estimates that are based on the predictions of theoretical models produced more than 50 years ago. More generally, there are many confounding influences that make the task of causal inference extremely challenging. For example, in thinking about the impact of expanding trade on the wage premium in developing countries today, empirical researchers may also need to account for declining union power, falling minimum wages, increased rates of immigration of unskilled workers, and greater skill-biased technological change. Analyses that instead focused on important developing countries, like China, would also face an array of challenging empirical issues that make identification difficult, including assessing the impacts of technological change, foreign direct investment, and state intervention on factor prices.

A number of scholars have suggested that the late nineteenth and early twentieth centuries may be better periods for testing the empirical predictions of factor endowment models of trade. Estevadeordal and Taylor (2002) argue that low barriers to trade (especially in simple manufactured goods and agriculture), more skewed factor endowments, less trade in differentiated products and services, and minimal intra-industry trade are some characteristics of the first era of globalization that may make a good laboratory for testing this class of models. O'Rourke and Williamson (1994, 1999) have provided empirical evidence of factor price convergence and other predictions of these models during the great expansion of trade in the late nineteenth century.

In this paper, we use the lens of history to better understand two issues of interest to policymakers and economists today. First, when a relatively closed economy opens up its borders to trade, how does a rapid expansion in trade affect the skill premium for a developing country? Second, how has the skill premium in China previously responded to global growth in trade and a domestic trade boom? We assemble new data sets on Chinese trade and wages for the period from 1903 to 1928 and use the demand shock of World War I on Chinese exports to shed light on these questions as well as on the Chinese economy's response to an earlier era of globalization.

During the first three decades of the twentieth century, China experienced a tremendous growth in trade with the rest of the world. The nominal value of exports sextupled and imports rose roughly by the same amount (Figure 1). Although China had been forcibly opened to trade in the 1840s, the scale of trade was quite small until the Treaty of Shimonoseki and the cessation of hostilities with Japan. The beginning of our sample period corresponds to China's entry into the global trade boom of the late nineteenth and early twentieth centuries. Like the current period of globalization, China's economy dramatically opened up to world trade: total trade as a share of GDP almost tripled during our sample period, an increase that is roughly comparable what China has experienced since 1980. With respect to the effects that trade had on wages, the most important change may have occurred in response to World War I. The war altered trade patterns and created a surge in demand for Chinese tradables, raising the price of its exports and dramatically increasing employment in the trade sector. Rising export prices and surging export demand led to higher wages for unskilled workers, which were utilized intensively in the production of Chinese exports.

We marshal new data on the factor content of Chinese trade to show that China's export boom in the first three decades was characterized by a rapid expansion in the production and sale of unskilled-intensive products to the rest of the world. In the second decade of the 20th century, China's growth in exports of unskilled-intensive manufactures, mining, and agricultural products received an additional boost in demand from World War I. Whereas the war disrupted trade in many other parts of the world, it led to an expansion in Chinese exports, creating new markets for Chinese goods that had previously been served by producers in belligerent countries.

Employing unit value data from Chinese trade statistics, we show that the prices of key exports rose rapidly in response to this exogenous shock in demand and continued to rise even after hostilities ended. As demand for Chinese products from the rest of the world grew, its exports were integrated into the global trade network: higher prices reflected overseas demand for its products.

Using new data on wages for unskilled and skilled workers, we argue that the growth in Chinese trade and the demand shock of World War I largely account for the flattening out of the skill premium in the 1910s and the subsequent 8 percent fall in the skill premium between 1920 and 1928 (Figure 2). We develop a simple general equilibrium model of trade (based on factor endowments) and show how a demand shock affects the skill premium. We then simulate the model and compare the results to the observed data on changes in the skill premium. We find that our model accounts for xx% of the observed decline in the skill premium.

In the next section, we provide some historical background on the growth in Chinese trade during the first three decades of the twentieth century. Section III describes how we employ the theoretical predictions from factor endowment models to conduct a factor content analysis of Chinese trade. Section IV describes our new trade database assembled from the publications of the Chinese Maritime Customs Service and our methodology for estimating the factor content of trade. Section V assesses the relationship between factor content and export growth, calculates the change in export prices, and relates our trade data to changes in the skill premium in China during the first three decades of the twentieth century. Section VI presents a general equilibrium model of trade, simulates a demand shock, and compares the results from the model to observed changes in the skill premium. We then offer conclusions and discuss the implications of our findings.

II. China's First 20th-Century Trade Boom

Our analysis focuses on the first three decades of the twentieth century since this period marks when China's trade with the rest of the world began to expand significantly. Until the 1840s, China was largely a closed, agrarian economy. Pressure from Great Britain and other foreign powers led China to open its economy to international trade. The 1842 Treaty of Nanking permitted foreigners to trade with the Chinese in five open ports, and stipulated a general five percent ad valorem tariff on all goods leaving and entering China. However, the foreign trade of China experienced only sluggish growth until the end of the century. Between 1875 and 1895, annual growth rates of imports and exports averaged 2.95 percent and 2.54 percent respectively. During this period, the largest import commodities were opium, cotton textiles, and petroleum products (kerosene, gasoline, etc.). Major exports were tea and silk.

China's defeat in the Sino-Japanese war in 1895 ushered in further changes in Chinese production and trade. The Treaty of Shimonoseki allowed Japanese businesses to invest directly in China, and produce goods and services that could be sold to other nations as well as marketed within China. Soon after the treaty was signed, this privilege was extended to other foreign nations via most-favored-nation agreements. Foreign capital financed railroad, telecommunications, and shipping enterprises and spurred industrialization. By the early twentieth century, the number of cities open to trade had climbed to 48 cities.

The transition from a closed to an open economy, with virtually free trade policy, sparked rapid, sustained growth in international trade (Figure 1). Cheng (1956) estimates that between 1900 and 1913 the total value of trade grew twice as much as it had between 1868 and 1900. In the first 13 years of the twentieth century, the value of foreign exports nearly tripled, imports almost quadrupled, and the annual growth rate of trade averaged 7.4 percent. China's trade growth was faster than the world average in the first three decades of the twentieth century; its share of world trade increased from 1.5 percent around 1898 to 3.44 percent by 1928. Hence, by the beginning of the twentieth century, the Chinese economy was exploiting its comparative advantage in unskilled manufactures. Indicative of this growth in trade was cotton textiles, which became one of the fastest growing industries over the subsequent decades.

As we emphasize throughout this paper, World War I had transformative effects on the Chinese economy. It disrupted trade in other parts of the world and redirected it in ways that directly benefited China, including a large increase in demand for its exports. Although China did not experience a dramatic acceleration in the growth rate of exports during World War I, this fact disguises several important effects the war had on Chinese exports and wages. Many countries experienced a contraction in trade during World War I (Glick and Taylor 2001). Trade growth for China, on the other hand, was superior to the average country during this period. Imports were disrupted throughout World War I, but exports were only temporarily affected. After declining for one year, exports resumed their upward trajectory. Even during the war, they continued to grow at trend rather than below trend (Figure 1). In the ten years from 1917 to 1927, they grew at 7 percent annually. Perhaps just as important, the price of exports began to rise during the war, and continued an upward trajectory through the 1920s. Chinese exports to new trading partners like the United States and Japan increased rapidly. The war redirected trade between other countries to China, and allowed it to expand production and further specialize according to comparative advantage. Most of China's top exports (coal, minerals and mineral products, raw cotton and cotton textiles, bristle, and oils) received a considerable boost from World War I; moreover, demand from the rest of the world did not subside after the war ended. For example, trade records indicate that domestic yarn firms (cotton textiles) started to export in 1913, and by the mid 1920s, had largely displaced imports (Figure 3). Bristle (one of China's top 10 exports) was used to make brushes for machines, guns, and cannons; by 1930, China was supplying 90% of the world's bristle (You, 1990). Another top 10 export, edible oil, also received a considerable boost from World War I. After the outbreak of war, the oil-pressing industry in Europe, switched to the production of military-related products, leaving a huge gap in demand for edible oil in these countries. China filled this gap by dramatically increasing its exports to European belligerent countries.

III. Theoretical Framework

To formulate testable predictions of the effects of this trade boom on wages, we draw on the factor endowments literature. The Heckscher-Ohlin-Vanek (HOV) model predicts that when an economy that is relatively well endowed with unskilled labor opens up to foreign trade, it will specialize in producing unskilled labor intensive products for export. According to the Stolper-Samuelson theorem, as trade expands, wages for unskilled workers will rise relative to those of skilled workers.

Although HOV models and their related theorems often abstract from reality in their parsimony (two countries, two goods, two factors) and in their theoretical assumptions (constant returns to scale, perfect competition, identical production technologies, free mobility of goods, etc.), they are nevertheless useful for framing how trade based on comparative advantage affects factor prices within countries and for drawing attention to the winners and losers in trade. For example, policymakers have used the simple predictions of the 2x2x2 version of the models to explain how increased trade and globalization is impacting wages. They also have been used by economists to consider the extent to which trade is driving increased wage inequality in the U.S. (Revenga, 1992; Lawrence and Slaughter, 1993; Leamer, 1998), and similarly, in predicting the consequences that China's expanding bilateral trade with the U.S. will have on U.S. wages (Krugman, 2008; Lawrence, 2008).

Despite their theoretical elegance, testing the predictions of the HOV model and its theorems (such as Stolper-Samuelson, Rybczynski, and factor price convergence) has proved vexing. Empirical researchers often restrict their attention tests to simple versions of factor content models so that they can retain clearer theoretical predictions and avoid issues such as factor substitutability. There are nevertheless identification issues that make estimating the effects of trade on wages using modern data extremely challenging. Skill premiums today may be driven by a variety of factors that are difficult to disentangle, including technology, migration, and institutional changes in labor markets.

There are several reasons why factor endowment models likely have more power in explaining the effect that trade has on wages in earlier periods (including

China in the first three decades of the 20th century) than today.[2] First, bulky standardized commodities, such as wheat and meat, and simple manufactures, like cotton goods, were the basis for the global growth in trade in the late nineteenth and early twentieth centuries (Findlay and O'Rourke, 2003) In contrast to the differentiated trade in goods and services today, differences in factor endowments may be sufficient for explaining the movement of raw materials and simple manufactures across national boarders (i.e., it may be unnecessary to appeal to more recent models that emphasize product differentiation or the within-industry effects of trade, such as Melitz (2003)). Second, there were fewer tariff and non-tariff barriers to trade, especially with respect to agricultural goods and low-skilled manufactured goods – two important areas of export for China during our sample period (Estevadeordal and Taylor, 2002).[3]

Third, we cannot rule out that technological change may have played some role during this period, in many developing countries, like China; but unlike today, technology may have bee more of a complement to than a substitute for unskilled workers in the production process.[4] For example, in a fast-growing export sector like cotton textiles, the introduction of new machinery, which improved labor productivity, did not displace the demand for unskilled labor in this industry (Zhao and Chen, 1997). Between 1912 and 1920, employment in cotton textiles in China expanded by 32%

[2] For a review of factors driving skill premium today in developing countries, see Goldberg and Pavcnik (2007). As noted here, there are likely large differences in how trade operated in the earlier period of globalization in comparison to today.
[3] Much of the literature on the recent period of globalization has used evidence from changes in trade policy (i.e., tariff liberalization) to understand the impact of trade on wage inequality; however, since trade policy is the outcome of a politics, it is an endogenous variable. Several recent studies have exploited additional cross-sectional (industry) and time variation in the data in order to deal with issues of causality (Hanson, 2007; Wei and Wu, 2002; Topalova, 2004; Goldberg and Pavcnik, 2005.) In this paper, we exploit an alternative source of exogenous variation to identify the impact of trade on wages – World War I – which we argue is an exogenous demand shock for Chinese exports.
[4] If skill-biased technological change is concentrated in low-skilled sectors, then it could generate a decline in the skill premium (Leamer, 1998), which would be indistinguishable from a fall in the skill premium induced by a trade shock.

(from 228, 497 to 301,544) over our sample period (Ministry of Agriculture and Commerce, 1928, in pp. 9-11). However, the vast majority of production, in particular agriculture, handicraft industries, mining industries, experienced little technological progress during our sample period (Jingyu, 1998; Wright, 1984). It thus seems unlikely that technological changes were the driving force behind the decline in the wages of unskilled workers.

Fourth, the growth in the stock of educated workers in China during the first three decades of the twentieth century was likely too small to alter the skill premium significantly. Enrollment rates in secondary schools rose late in the period and the stock of these newly educated workers was likely too small to have much of an effect on the wages of skilled workers (Xiong, 1990). Moreover, unlike today, there appears to have been no surge in demand for skilled workers during this earlier era of globalization so that skill complementarity is less likely to explain the movements in skill premium in developing countries like China.[5] Fifth, although workers departed Europe in large numbers and went to the Americas during the nineteenth and early twentieth centuries, China's participation in this wave of global migration was much smaller. Roughly ten million Chinese emigrated between 1840 and 1920s, which would translate into an average of a little less than one hundred thousand per year (Ge, Cao, Wu, 1993, pp.485-6). In relation to the total population of China, roughly 400 million, the emigration would have had a negligible effect on the internal labor market of China. Hence, it seems reasonable to conclude that the effects of Chinese emigration on the wages of unskilled workers during our sample period is likely much more muted than the effects that emigration might be having on wages in developing

[5] This is a notable difference from what is observed in developing countries like Argentina, Brazil, Mexico, Chile, and Colombia today where the share of skilled workers within industries has increased dramatically over the past two decades (Robbins (1996), Sanchez-Paramo and Schady (2003), Attanasio, Goldberg, Pavcnik (2004)), Hong-Kong (Hsieh and Woo (2005) and India (Kijima (2006)).

countries like China today. It is true that, after 1894, foreign direct investment was permitted in China. The rate of growth in FDI was fairly steady throughout the first three decades of the twentieth century, and exhibits no break or surge around World War I. FDI was most concentrated in the mechanized portion of the manufacturing industry, but its effects on the skill premium are likely ambiguous (it may have increased the demand for skilled workers (as it has today) or, as in the case of the role of technology in early-twentieth-century China, been complementary to unskilled labor).[6] Sixth, unlike today, when institutions such as unions and minimum or state wages can impact observed wage rates, there is no evidence that the Chinese labor market faced significant regulation; hence the skill premium was not likely influenced by labor market institutions during the first three decades of the twentieth century. Finally, trade in intermediate products (i.e. outsourcing, offshoring, and "global product sharing") was insignificant in the earlier era of globalization.

IV. The Factor Content of Chinese Trade

A. Data

We assembled a new data set of detailed trade data from China Maritime Customs' (hereafter "CMC") trade publications. CMC was likely the only bureaucratic organization in China that operated without interruption (due to wars or funding shortages) from 1858 to 1949. Although it reported to the Chinese government, its top administration as well as mid-level managers and technocrats were largely foreigners – initially British citizens, but later on also Japanese and Americans. CMC's primary tasks were collecting customs revenue and recording and

[6] Stolper-Samuelson effects assume that labor and capital are mobile within a country, but immobile across borders.

publishing data on foreign trade; however, it eventually expanded its operations to include collecting revenues from domestic trade, administering the postal system, developing inland and coastal waterways, and representing China at international fairs. CMC's geographical reach grew from just fourteen stations during the 1860s to nearly fifty during the 1920s, covering not only the coastal regions but also inland cities, including those near the border with Burma and along the Amur River on China's northern tip.

CMC is most widely known for its 160 volumes of detailed trade statistics, which span roughly 90 years of commercial transactions (1858-1949). The trade records, which were collected at the port level, include information on the quantities and the values of all commodities passing through each treaty port and, in aggregate, provide a detailed picture of China's trade with the rest of the world. In comparison to other economic or demographic data on China during this period, the quality and detail of the CMC trade data is exceptional, and rivals the trade publications of the advanced nations of the late nineteenth century.

These statistics were primarily published at the port level. The units of measurement and currency sometimes varied across ports and over time. We therefore standardized the measurement and currency units and then aggregated the product data to the national level.

B. Measurement

To assess the role that the expansion in trade played in reducing the skill premium in China, we first examine the factor content of Chinese exports in order to see if, according to the HOV framework, (1) Chinese exports were dominated by products that used unskilled labor intensively in their production and (2) the growth in exports was driven by increased sales of these unskilled-intensive products. We keep our factor content analysis simple, and consider differences in production based only on labor characteristics – whether workers were skilled or unskilled. Although this is clearly a simplification, it enables us to take advantage of our detailed trade data to learn something about China during an important period of Chinese history when little other information on firm or industry characteristics exists.

After creating a database of quantities and values of all the traded commodities using the CMC trade publications, we classified exports and imports based on economic activity and skill intensity. The first step was to choose a standard classification system so that we could systemize the aggregates of economic activity and then measure factor content by "industry group." This is especially important because our database covers Chinese trade for all the treaty ports over three decades, the nomenclature of traded goods sometimes changed, and the individual customhouses sometimes collected trade statistics using their own naming systems.

Since the Standard Industrial Classification System (SIC) was not adopted in major industrial surveys or censuses, it has limited usefulness for the wide variety of commodities in our Chinese trade data. Instead, we use the Index of Occupations and Industries from the 1950 Census of Population ("IND1950"). Although IND1950 recodes industries contained in the 1950 Census Bureau, the basic content of the occupational and industrial classification was largely derived from earlier censuses, in particular the 1940 Census. Thus, since IND1950 is somewhat retrospective in design, it provides a consistent set of industry codes that is broad enough to capture the trade being conducted by China between 1903 and 1928.

We next classified the industries according to skill intensity. Since there is no agreed upon methodology for determining the factor content of products or industries based on available data sources, empirical studies use a variety of approaches to proxy factor content. One approach is to rank industries according to average wages. If workers are paid their marginal products (as would prevail in competitive markets for factors and goods), then, on average, higher paying industries ought to reflect higher average productivity or skill. Another way for proxying skill intensity is to rank industries by average education levels. A third approach is to calculate the share of production workers (relative to non-production workers) in each industry.

Because U.S. historical census data offer broad industry coverage and detailed information on education and wages, our starting point for classifying skill intensity for Chinese industries was to create benchmarks based on the 1940 U.S. Census. Since the majority of goods imported and exported by China were also traded in the U.S., measures derived from the U.S. census provide a reasonable approximation of skill intensity at the industry level that can be used for our factor content analysis of trade.

The 1940 U.S. Census is the first one that collects information on both individuals' education and annual wages. The 1940 Census records each individual's highest level of educational attainment, ranging from no education to five or more years of post-secondary education. In our analysis, we classify workers with nine or more years of education as skilled workers. We then aggregated education information for all individuals in the 1940 Census by industry (using the IND1950 classification described above) and calculated the fraction of workers in each industry that had nine or more years of education.

The 1940 Census also records each individual's annual wage, allowing us to aggregate these data and obtain average industry wages (again based on IND1950 industry classification). Hence, using U.S. Census data, we are able to obtain information on skill intensity at the industry level based on (1) education and (2) wages. We report industry rankings using these two metrics in Tables 1 and 2.

V. Analyzing the Effects of the Chinese Trade Boom on Wages

A. Factor Content Analysis

We now turn to examining how the Chinese trade boom of the first three decades of the twentieth century affected the skill premium in China. Figure 2 shows that the skill premium rose during the first decade of the trade boom (when the size of Chinese trade was miniscule as a share of its GDP), but then flattened out and declined as Chinese trade grew in importance and as the export boom continued virtually uninterrupted until 1929. Although the time series graph is broadly consistent with the view that the rapid growth in trade may have impacted the wages of skilled and unskilled workers in China, we subject this hypothesis to more scrutiny by considering whether data on the factor content of trade are consistent with the predictions of factor endowment models in the spirit of HOV-SS.

Such factor endowment models predict that, as China opens up to trade with the rest of the world and then receives an additional boost in demand for its export during World War I, exports of goods that use relatively more unskilled labor (the abundant factor in China) in the production process will increase. The demand for unskilled labor will rise as the economy exports more. China will also begin to import more goods that are produced with relatively more skilled labor, thus reducing the domestic demand for skilled labor. Assuming the supply curves for labor are not perfectly elastic, the shifts in demand for skilled and unskilled workers will cause the wages of skilled workers to fall relative to unskilled workers. Hence, the model predicts that China's trade boom will cause the skill premium to fall.

A first test in the spirit of factor endowment models would be to examine whether total exports were becoming more unskilled-intensive in their composition over the course of our sample period. Using the data on industry averages for wages and education, we classify the industrial sectors into two broad groups, unskilled and skilled. We denoted industries where the fraction of workers with nine or more years of education exceeded 0.48 as skilled industries. We divided the data at this value since the two industries above and below this cutoff seemed most dissimilar in terms of labor force characteristics (Motor vehicles and motor vehicle equipment versus glass and glass products). Industries with log wage values greater than 2.986 are classified as skilled, which puts metal mining and pottery producing as the two industries on the dividing line.[7] Figures 4 and 5 show the composition of exports and imports in terms of factor content. In 1903, when the magnitude of foreign trade was fairly small and China was relatively closed, most of its imports and exports were composed of unskilled-intensive products. But, as Chinese trade grew in importance over the next 25 years, we see significant movements in the ratios for both exports and imports. Using either wages or education as our measure of skill, exports became more unskilled-intensive over the entire sample period – rising from about 0.92 to 0.99 for the education ratio and from roughly 0.8 to roughly 0.9 for the wage ratio (Figure 4). In contrast, the share of unskilled imports declines substantially. For example, using the measure based on education, the share of unskilled exports falls form 0.88 to 0.75 (Figure 4). In the same vein, the fraction of imports that are skill-intensive increases from 0.11 to 0.25 over the sample period (Figure 5).

[7] The results reported later in the paper do not appear that sensitive to changing these cutoffs.

Another way of assessing the general factor content of trade is to examine the detailed industry data. In Figures 6-9, we display the value of exports and imports for each industry on the y-axis and its corresponding skill intensity on the x-axis for four years: 1903, 1913, 1919, and 1928. Skill intensity increases as we move in a rightward direction along the x-axis. We present this evidence for skill intensity based on education (Panel A of Figures 6-9) and log wages (Panel B of Figures 6-9). The figures show that exports are largely clustered at the lower levels of skill intensity whereas imports dominate the highest values of skill intensity. These characteristics of the figures are even more evident by 1928.

These results constitute strong evidence that trade was fundamentally responding in ways that are consistent with factor endowment models of trade. Even if we found no evidence that the that unskilled-intensive exports were rising over our sample period, the factor content data could still be consistent with the predictions of factor endowment models if it were true that, overall, Chinese exports grew faster for unskilled-intensive industries than for skill-intensive industries. This would indicate that the expansion in exports shown in Figure 1 was driven by unskilled-intensive exports. (Similarly, skill-intensive imports should grow faster than those for unskilled industries.)

To test this prediction, we create ten industry groups based on skill intensity and compute the growth rates for each of these industry groups. Tracking the growth in exports of individual industries might be preferable, but it is complicated by the fact that some industries lack data for our whole sample period. Using industry groupings allows us to examine industries of similar skill intensity and follow them over the entire sample period. We weight the deciles by their share of the total value of exports, and then plot the growth rate of exports for each group relative to its skill intensity.

Figures 10-11 graph the average annual growth rates for exports and imports from 1903 to 1928, where industry groups are ordered by skill intensity (using either the wage or education classifications as indicated on the graph). The figures show that the fastest growing deciles for exports tended to be those with the lowest skill intensity. On the other hand, the fastest growing deciles for imports tended to be the most skill intensive.

B. Robustness Check

In our empirical analysis, we have implicitly drawn on an assumption of the HOV model – that technology is the same across countries – to justify deriving skill intensities for Chinese industries based on 1940 U.S. census benchmarks. However, because the assumption of common technology may not have held in practice and because our U.S. skill-intensity benchmarks are based on data from 1940, we explore whether the factor content analysis is robust to an alternative classification scheme. To carry out our robustness check, we had to identify an alternative survey for deriving skill intensity at the industry level. Unfortunately, survey data at the individual, occupational, or industry level for China during the first three decades of the twentieth century is scarce.

The 1928 Shanghai Census is the earliest survey with sufficient detail to derive estimates of skill intensity at the industry level. It was administered by the Bureau of Industry, Agriculture, and Commerce of the Greater Shanghai Municipality, and included information on factory names and addresses, ownership, capitalization, number of workers, wages, raw materials, and power utilization. Unfortunately, the survey records only the highest and lowest wage rates by industry; after closer inspection, we determined that the minimum and maximum wages in each industry were insufficient to generate reliable average industry wage rates. Instead, we computed the capital-labor ratio to evaluate skill intensity of industries under the assumption that industries which use more labor are, on average, characterize by lower-skilled workers. We first classified the traded goods using the classification system adopted in the 1928 Shanghai Survey, and then calculated the capital-labor ratio by dividing the total physical capital (value of physical capital stock) by the number of workers in each industry. We then ranked the traded goods industries according to their capital-labor ratios (Table 3).

Using the 1928 Shanghai Survey, we show the growth rates of exports and imports based on grouping the industries into deciles. Figures 12 and 13 show that our results are similar to those based on the U.S. skill-intensity benchmarks. Growth rates for Chinese exports were highest for unskilled industry deciles and growth rates for imports were highest for the skilled deciles.

C. Evidence on the Price of Exports

If increased trade is driving up the wages of unskilled workers in countries that are well-endowed with unskilled labor then, according to factor-endowment models, export prices should also be rising. That is, the fact that China became more specialized in producing and exporting unskilled intensive commodities does not necessarily lead to rising unskilled wages relative to skilled wages and hence a declining skill premium. The expansion of export-related industries might only result in expanding employment in these industries. For wages of unskilled workers to rise, one would also need to observe rising prices for exports (assuming the marginal product of workers has not changed). The demand shock of World War I needs to raise the price of goods that use unskilled labor intensively.

Hsiao's (1974) export price index shows that export prices grew markedly after 1913 (Figure 14). Consistent with other global studies of trade, prices of traded goods rose during World War I. Moreover, it appears that in China's case, the positive shock in demand was large enough to significantly move prices upward after a decade of little change. After a brief cessation after the war, prices resumed their upward trajectory. During the period when the skill premium was flattening out and falling, export prices roughly doubled. Rising sales and prices led to growing revenue for exporting firms, providing considerable scope for raising the wages of unskilled workers that were used intensively in their production.

We used the unit value data contained in our database to compute the growth rates in prices for China's ten most important exports (based on value). Figure 15 shows positive average annual growth rates in unit values for these major exports over the period 1903 to 1928. In addition, the commodities shown in this figure that used unskilled labor more intensively (agricultural goods and cotton yarn) experienced particularly strong rates of growth in their prices. Figure 16 shows that prices in cotton yarn grew by 275 percent after 1913. Cotton spinning was widely considered a typical unskilled-intensive manufacturing industry. China had been a large importer of cotton yarn, but by the beginning in the twentieth century, a domestic cotton textile industry began to compete with foreign products. The industry grew rapidly, and by the mid-1920s, cotton-spinning exports exceeded imports. As the cotton spinning industry expanded, it drew in large numbers of unskilled workers. Real wages in cotton textiles increased by more than 50% during the war, and remained at those levels after the war ended, and then continued an upward trajectory into the 1920s.

Although industry level wage data are quite scarce, we were able to obtain figures for real wages for two other key exports. These also suggest that wages were rising in the export sector in response to higher product prices. For example, real wages in the silk industry grew by more than 150% during the war and then, after flattening out at the conclusion of the war, continued their upward trajectory. Similarly, real wages for coal workers (based on Kailun, one of the largest mines in China at that time) grew by more than 25% during the 1920s.[8] In contrast, wages for nontradables show no discernable upward trend: using data on Beijing construction workers, 1914 and 1919 real wages are roughly the same and the value in 1924 has fallen. The somewhat limited evidence available on industry wages nevertheless suggests that wages rose faster in export sectors of the economy than in nontradables.

Although it is impossible to rule out alternative explanations, the pattern of the wage data seem most consistent with a trade-induced demand shock rather than either a dramatic rise in the quantity of skilled workers in the 1920s or very rapid technological change. As noted above, the most important technological advances in China during our sample period appear to have taken place in industries, like cotton textiles, and tended to raise the demand for skilled workers rather than displace them. In cotton textiles and other mechanized manufacturing industries the pace of technological change was incremental: i.e., there were no sudden positive shocks to technology that occurred in the 1910s and 1920s that would be consistent with the observed pattern of the wage premium. If anything, the pace of technological change was slower during the war period due to the difficulty of importing new machinery from western countries engaged in combat. In the vast majority of other sectors of the economy, particularly agriculture, handicraft industries, and mining, there was little

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[8] We could not locate data for real wages in the coal industry prior to 1919 or for other key export industries so that we could carry out a more detailed cross-sectional analysis.

technological progress during our sample period. As noted earlier, the limited available data we have on Chinese education rates suggests that the expansion of skilled workers due to increased opportunities was small and likely came too late to account for the observed decline in the skill premium.

To better understand trade's contribution to the change in the skill premium in the 1910s and 1920s, we now model a demand shock to Chinese exports in a general-equilibrium, factor-endowments framework. We simulate this model using data on the Chinese economy to examine whether our empirical findings are plausible and consistent with theory.

VI. Model and Simulation

We want to analyze the effects of a demand shock in a factor endowment based model where China is assumed to have relatively more unskilled labor than skilled labor. Consider an economy in which economic activity is characterized by the production of two final consumption goods and two intermediate goods. In each period, a nontradable good, N, and a tradable good, X, are produced with two intermediate goods: a skill-intensive intermediate good, I_S, and a unskilled-intensive intermediate good, I_U, while these two intermediate goods are produced with two factors of production, skilled labor, H, and unskilled labor, L. The supply of skilled and unskilled labor is endogenously determined.

A. The Household

There are two types of infinitely-living individuals: skilled, H, and unskilled, L. The economy's endowment of skilled and unskilled labor is pre-determined: we assume no change in type so that workers that begin life as unskilled remain unskilled, and so do for skilled workers.

These two types of individuals consume both imported good and domestic nontradable good, and make decisions of labor they will contribute. The utilities of skilled and unskilled labor are given by:

$$u^H = \alpha \log c^{HM} + (1-\alpha)\log c^{HN} - \omega \log H \quad (1)$$

and

$$u^L = \alpha \log c^{LM} + (1-\alpha)\log c^{LN} - \omega \log L , \quad (2)$$

where c^{HM} and c^{HN} are skilled individual's consumption of imported goods, M , and domestic nontradable goods, N , respectively, and c^{LM} and c^{LN} are unskilled individual's consumption of these two goods. H is the amount of labor skilled individuals will contribute, L is the amount of labor unskilled individuals will contribute, and ω is the coefficient measuring the disutility of labor. By assumption, exportable good X does not enter into either of the utility functions.

The budget constraints for skilled and unskilled individuals are given by:

$$p^M c^{HM} + c^{HN} \le w^H H , \quad (3)$$

and

$$p^M c^{LM} + c^{LN} \le w^L L , \quad (4)$$

where the price of the nontradable good N is the numeraire, and p^M is the relative price of the imported good in terms of the nontradable good, which is exogenously determined by the world market.

The optimal consumptions of the two goods entering into the utility functions for the two types of labor are given by:

$$\frac{\alpha}{p^M c^{HM}} = \frac{(1-\alpha)}{c^{HN}} = \frac{\omega}{w^H H} \tag{5}$$

and

$$\frac{\alpha}{p^M c^{LM}} = \frac{(1-\alpha)}{c^{LN}} = \frac{\omega}{w^L L} . \tag{6}$$

It is clear from the optimal conditions that the consumption patterns of skilled and unskilled labor are the same; the only reason that they consume different amounts of imported and nontradable goods is that the income of the skilled labor, $w^H H$, is greater than that of the unskilled labor, $w^L L$.

B. Production

The domestic economy produces two final consumption goods, the domestic nontradable good, N , and the exportable good, X ; and two intermediate goods, unskilled-intensive intermediate good, I_U , and skill-intensive intermediate good, I_S .

The outputs of N and X are governed by two constant returns to scale production technologies:

$$Y^N = \left(I_U^N\right)^{\phi} \left(I_S^N\right)^{1-\phi} \tag{7}$$

and

$$Y^X = \left(I_U^X\right)^{\sigma} \left(I_S^X\right)^{1-\sigma} , \tag{8}$$

where I_U^N and I_U^X are the amounts of unskilled-intensive intermediate good used in nontradable and exportable goods respectively, and I_S^N and I_S^X are the amounts of the skill-intensive intermediate goods used respectively. ϕ and $1-\phi$ are the shares of I_U and I_S used in the production of N , and σ and $1-\sigma$ are the shares of I_U and I_S used in the production of X. By assumption $\phi \neq \sigma$, indicating that N and X are different consumption goods.

The outputs of two intermediate goods, I_U and I_S, are also governed by constant returns to scale production functions:

$$I^U = \left(L^U\right)^{\eta} \left(H^U\right)^{1-\eta} \tag{9}$$

and

$$I^S = \left(L^S\right)^{\theta} \left(H^S\right)^{1-\theta}, \tag{10}$$

where L^U and L^S are the amounts of unskilled labor used in the production of the two intermediate goods N and X, and H^U and H^S are the amounts of skilled labor used in the production of the two intermediate goods. η and $1-\eta$ are the shares of two types of labor used in the production of I^U. We assume $\eta > 0.5$ in order to characterize the unskilled-intensive feature of this production technology. θ and $1-\theta$ are the shares of two types of labor used in production of I^S. We set $\theta < 0.5$ in order to characterize the feature of the skill-intensive production.

We assume that the markets for intermediate goods and labor are perfectly competitive. It follows that the inverse demand for unskilled and skilled labor in the labor-intensive and skill-intensive sectors are:

$$w^L = \eta p_U \left(\frac{H^U}{L^U}\right)^{1-\eta} = \theta p_S \left(\frac{H^S}{L^S}\right)^{1-\theta} \tag{11}$$

and

$$w^H = (1-\eta) p_U \left(\frac{H^U}{L^U}\right)^{-\eta} = (1-\theta) p_S \left(\frac{H^S}{L^S}\right)^{-\theta}, \tag{12}$$

where w^L and w^H are the wages of an unskilled and a skilled labor; p_U and p_S are the relative prices of the unskilled-intensive and the skill-intensive intermediate goods in terms of the nontradable good. Since the workers of the same type are perfectly mobile between the two sectors, the wages of the same types of labor will be equalized in the two sectors. Therefore, the relative price of the unskilled-intensive intermediate good in terms of the skill-intensive intermediate good is

$$\frac{p_U}{p_S} = \frac{\theta\left(\frac{H^S}{L^S}\right)^{1-\theta}}{\eta\left(\frac{H^U}{L^U}\right)^{1-\eta}} = \frac{(1-\theta)\left(\frac{H^S}{L^S}\right)^{-\theta}}{(1-\eta)\left(\frac{H^U}{L^U}\right)^{-\eta}} . \tag{13}$$

Dividing (12) by (11), we derive the skill premium, r:

$$r = \frac{w^H}{w^L} = \frac{(1-\eta)}{\eta}\frac{L^U}{H^U} = \frac{(1-\theta)}{\theta}\frac{L^S}{H^S} . \tag{14}$$

From equation (14), it is clear that the skill premium is determined by two factors: relative factor endowments, L/H, and relative share of factors, $(1-\eta)/\eta$ and $(1-\theta)/\theta$. If the economy is endowed with more unskilled labor, L/H will be larger, and the skill premium will be higher.

Similarly, from equations (7) and (8), the inverse demand for the two intermediate goods in the productions of the two final consumption goods are given by:

$$p_U = \phi\left(\frac{I_S^N}{I_U^N}\right)^{1-\phi} = p^X \sigma\left(\frac{I_S^X}{I_U^X}\right)^{1-\sigma} \tag{15}$$

and

$$p_S = \left(1-\phi\right)\left(\frac{I_S^N}{I_U^N}\right)^{-\phi} = p^X \left(1-\sigma\right)\left(\frac{I_S^X}{I_U^X}\right)^{-\sigma} , \tag{16}$$

where p^X is the price of the exportable good. Since the two intermediate goods used in the two sectors are the same, their prices will be equalized in the two sectors. Therefore the price of the exportable good is:

$$p^X = \frac{\phi \left(\frac{I_S^N}{I_U^N} \right)^{1-\phi}}{\sigma \left(\frac{I_S^X}{I_U^X} \right)^{1-\sigma}} = \frac{(1-\phi)\left(\frac{I_S^N}{I_U^N} \right)^{-\phi}}{(1-\sigma)\left(\frac{I_S^X}{I_U^X} \right)^{-\sigma}}, \tag{17}$$

and the relative price of the unskilled-intensive intermediate good in terms of the skill-intensive intermediate good is:

$$\frac{p_U}{p_S} = \frac{\phi}{1-\phi} \frac{I_S^N}{I_U^N} = \frac{\sigma}{1-\sigma} \frac{I_S^X}{I_U^X}. \tag{18}$$

From equation (18), it is clear that the compositions of tradable and nontradable goods depend on the relative price of the skill-intensive and the unskilled-intensive intermediate goods. If the relative price of the skill-intensive intermediate good is higher, the compositions of the two final consumption goods will be more biased toward the unskilled-intensive intermediate good, and I_S / I_U will be larger.

C. Aggregate Allocations of Labor, Intermediate Goods, and Consumption Goods

The equilibrium condition for the intermediate goods is that the supply of the two intermediate goods equals the demand for them, denoted by:

$$I_U^X + I_U^N = I^U = \left(L^U\right)^{\eta} \left(H^U\right)^{1-\eta} \tag{19}$$

and

$$I_S^X + I_S^N = I^S = \left(L^S\right)^{\theta} \left(H^S\right)^{1-\theta}. \tag{20}$$

Similarly, the equilibrium condition for the nontradable good is that the supply of the nontradable good equals its supply, denoted by:

$$c^{HN} + c^{LN} = Y^{N} . \tag{21}$$

In equilibrium, the following condition holds for the foreign trade sector:

$$p^{X} X = p^{M} M + B , \tag{22}$$

where B is the trade surplus when it is positive, and is the trade deficit if it is negative. The trade is in balance if B equals 0. Foreign demand for the domestic exportable good, X , is exogenously determined.

The imported good is consumed by both skilled and unskilled labor, which is denoted by:

$$c^{HM} + c^{LM} = M . \tag{23}$$

The equilibrium aggregate labor allocations are given by:

$$H = H^{U} + H^{S} \tag{24}$$

The equilibrium aggregate labor allocations are given by:

$$L = L^{U} + L^{S} . \tag{25}$$

D. Foreign Demand Shock for the Exportable Good

The foreign demand for the exportable good X is exogenously determined. If there is a sudden increase in foreign demand for X , the amounts of the two intermediate goods engaged in the production of X will also rise. However, given the domestic economy is abundant in unskilled labor and scarce in skilled labor, the increased demand for the exportable good will lead to a larger demand for unskilled labor than skilled labor. Therefore the wage of unskilled labor will rise faster than the wage of skilled. In this case, skill premium declines. Attracted by higher wage rate, unskilled labor will sacrifice more leisure and spend more time in the production of labor intensive intermediate good. Higher wage and higher income will lead to higher consumption of both the domestic nontradable good and the imported good.

E. Computational Exercise

We assign the following values to the parameters and the two exogenous variables to simulate the demand shock of the exportable good.

α	0.3
ω	2
ϕ	0.5
σ	0.85
η	0.9
θ	0.4

[The computational results are to be completed.]

VII. Conclusion

Our findings suggest that the opening of China to trade during the first three decades of the twentieth century and the demand shock of World War I led to a dramatic expansion in exports. Foreign demand for Chinese goods led to greater specialization and increased production of unskilled-intensive products. Unskilled-intensive exports, already dominant in Chinese trade, increased their share of total trade over these decades. Industries that used unskilled workers intensively in their production saw the fastest growth rates in exports between 1903 and 1908. Prices of exports, especially those for unskilled goods, grew rapidly after 1913.

Although we cannot rule out alternative explanations, the evidence on factor content of trade and unit values suggests that the rapid expansion in exports from Chinese trade had a significant impact on the skill premium in China. It appears that once export prices began to increase significantly during the second decade of the trade boom, wages of unskilled workers relative to skilled workers changed sufficiently to alter the slope of the skill premium. By the 1920s, the skill premium had reversed course and declined by roughly 8 percent.

We also cannot entirely rule out reverse causality, but the exogenous nature of the demand shock and the coincidental large upward movement in export prices with World War I suggests that the causality likely runs from trade to wages. Using a simulation from a simple general equilibrium model, we further verify that a demand shock a la World War I can produce the observed movements in the skill premium.

Our findings suggest that, in a world when trade was dominated by the movement of relatively homogenous goods across borders, trade may have had a considerable impact on wages. The declining wage inequality in China during the second two decades of the twentieth century stands in contrast to studies examining the recent period of globalization, which emphasize how trade and globalization has widened skill premiums in developing countries (Goldberg and Pavcnik, 2007). The growth in Chinese exports during the first three decades of the twentieth century was centered on products that used unskilled labor intensively. We have suggested that this earlier era of globalization was less influenced by trade in intermediate inputs (i.e., outsourcing), increases in capital flows, and complementarity of capital with skilled labor – factors that have played a role in widening skill premiums today in developing countries.[9] However, as emphasized in the research on the current period of globalization, we acknowledge that our findings pertain only to China and may not

[9] The observed decline in the skill premium in China also seems inconsistent with Melitz-type models of “firm upgrading” in that these predict a higher demand for skilled workers as trade openness occurs; this suggests that these models may be less well suited for explaining trade-induced movements in the skill premium during the first era of globalization.

generalize to other developing countries even during our sample period, since countries experienced globalization in different ways and at different times.

Appendix I. Data on the Skill Premium

Yan (2007) constructs detailed estimates of real wages and the skill premium for China between 1858 and 1936. Nominal wages are collected from the records of employees in the CMC for nearly fifty Chinese cities, and the wage series are estimated from these records using the Hedonic regression method. The author also constructs group-specific cost of living indices from price data and household budget information contained in CMC trade statistics and surveys. The resulting nominal wage series and cost of living indices make it possible to estimate long-run trends in real wages and skill premia for three basic categories of Chinese workers: unskilled, skilled, and highly skilled. 44,600 wage observations are collected from CMC archives. Roughly half of the archives pertain to labor, which include surveys of local wages and standards of living, CMC wage scales, and most importantly, the Service Lists – that is, the individual personnel records of CMC employees. In each year the Service Lists recorded each employee’s name, home town, year of joining the service, year of being promoted, year transfer to the current customhouse, rank, and monthly salary.

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Table 1. Ranking of Industries by Educational Attainment

IND1950	Industry	Fraction of Skilled Employees
377	Aircraft and parts	0.72
459	Printing, publishing, and allied industries	0.68
357	Office and store machines	0.64
386	Professional equipment	0.62
367	Electrical machinery, equipment and supplies	0.62
476	Petroleum refining	0.59
468	Paints, varnishes, and related products	0.58
458	Misc paper and pulp products	0.57
407	Dairy products	0.57
346	Fabricated steel products	0.55
478	Rubber products	0.54
226	Crude petroleum and natural gas extraction	0.54
466	Synthetic fibers	0.54
358	Misc machinery	0.54
469	Misc chemicals and allied products	0.53
356	Agricultural machinery and tractors	0.53
418	Beverage industries	0.52
388	Watches, clocks, and clockwork-operated devices	0.52
409	Grain-mill products	0.51
416	Bakery products	0.51
449	Misc fabricated textile products	0.49
376	Motor vehicles and motor vehicle equipment	0.49
316	Glass and glass products	0.48
338	Primary nonferrous industries	0.48
436	Knitting mills	0.48
457	Paperboard containers and boxes	0.47
426	Not specified food industries	0.47
456	Pulp, paper, and paper-board mills	0.47
417	Confectionary and related products	0.47
406	Meat products	0.46

Note: Traded goods were classified into industries using the IND1950 described in the text. Educational attainment is derived using 1940 US census. Please see the text for details.

Table 1. Ranking of Industries by Educational Attainment (continued)

IND1950	Industry	Fraction of Skilled Employees
489	Leather products, except footwear	0.46
378	Ship and boat building and repairing	0.45
487	Leather: tanned, curried, and finished	0.45
337	Other primary iron and steel industries	0.44
477	Misc petroleum and coal products	0.44
379	Railroad and misc transportation equipment	0.44
488	Footwear, except rubber	0.43
326	Misc nonmetallic mineral and stone products	0.43
408	Canning and preserving fruits, vegetables, and seafood	0.43
319	Pottery and related prods	0.43
446	Misc textile mill products	0.42
437	Dyeing and finishing textiles, except knit goods	0.42
308	Misc wood products	0.42
309	Furniture and fixtures	0.42
348	Not specified metal industries	0.41
206	Metal mining	0.41
336	Blast furnaces, steel works, and rolling mills	0.4
317	Cement, concrete, gypsum and plaster products	0.4
448	Apparel and accessories	0.39
116	Forestry	0.37
438	Carpets, rugs, and other floor coverings	0.35
318	Structural clay products	0.33
439	Yarn, thread, and fabric	0.32
246	Construction	0.31
429	Tobacco manufactures	0.3
307	Sawmills, planting mills, and mill work	0.28
236	Nonmetallic mining and quarrying, except fuel	0.27
126	Fisheries	0.26
105	Agriculture	0.22
306	Logging	0.22
216	Coal mining	0.2

Table 2. Ranking of Industries by Log Wages

IND1950	Industry	Log Wage
476	Petroleum refining	3.207
226	Crude petroleum and natural gas extraction	3.127
468	Paints, varnishes, and related products	3.126
378	Ship and boat building and repairing	3.124
459	Printing, publishing, and allied industries	3.124
357	Office and store machines	3.122
358	Misc machinery	3.109
418	Beverage industries	3.1
469	Misc chemicals and allied products	3.099
376	Motor vehicles and motor vehicle equipment	3.098
367	Electrical machinery, equipment and supplies	3.095
386	Professional equipment	3.092
478	Rubber products	3.092
336	Blast furnaces, steel works, and rolling mills	3.091
356	Agricultural machinery and tractors	3.078
346	Fabricated steel products	3.075
406	Meat products	3.07
377	Aircraft and parts	3.067
407	Dairy products	3.06
337	Other primary iron and steel industries	3.055
338	Primary nonferrous industries	3.055
456	Pulp, paper, and paper-board mills	3.048
316	Glass and glass products	3.047
348	Not specified metal industries	3.045
317	Cement, concrete, gypsum and plaster products	3.036
416	Bakery products	3.032
426	Not specified food industries	3.031
379	Railroad and misc transportation equipment	3.03
487	Leather: tanned, curried, and finished	3.028
326	Misc nonmetallic mineral and stone products	3.024
466	Synthetic fibers	3.023
388	Watches, clocks, and clockwork-operated devices	3.02

Note: Traded goods were classified into industries using the IND1950 described in the text. Log wage is derived using 1940 US census. Please see the text for details.

Table 2. Ranking of Industries by Log Wages (continued)

IND1950	Industry	Log Wage
477	Misc petroleum and coal products	3.017
409	Grain-mill products	3.011
458	Misc paper and pulp products	3.007
206	Metal mining	3.006
319	Pottery and related products	2.986
446	Misc textile mill products	2.984
438	Carpets, rugs, and other floor coverings	2.973
318	Structural clay products	2.954
457	Paperboard containers and boxes	2.953
309	Furniture and fixtures	2.943
437	Dyeing and finishing textiles, except knit goods	2.937
308	Misc wood products	2.931
489	Leather products, except footwear	2.913
417	Confectionary and related products	2.905
216	Coal mining	2.9
436	Knitting mills	2.897
488	Footwear, except rubber	2.886
429	Tobacco manufactures	2.865
236	Nonmetallic mining and quarrying, except fuel	2.85
439	Yarn, thread, and fabric	2.847
408	Canning and preserving fruits, vegetables, and seafood	2.827
307	Sawmills, planting mills, and mill work	2.815
448	Apparel and accessories	2.812
246	Construction	2.796
449	Misc fabricated textile products	2.79
306	Logging	2.703
116	Forestry	2.682
126	Fisheries	2.666
105	Agriculture	2.095

Table 3. Ranking of Industries by the 1928 Shanghai Survey

Industry Code	Industry Name	Capital-Labor Ratio Unit: Chinese Yuan per worker
93	Electric and water works	10628.86
46	Condiments	5169.01
26	Medicine	4356.16
47	Cigars and cigarettes	4298.39
71	Metal products	3746.26
27	Manufacture of paper	3118.92
31	Manufacture of varnish	2099.24
29	Manufacture of enameled ware	2009.51
73	Musical instruments and toys	1810.9
28	Match making	1668.87
91	Building material	1582.64
25	Glassware	1342.49
63	Founding	1163.01
86	Clothing	1142.16
92	Coal briquettes	1140.46
23	Cosmetics	977.14
74	Scientific apparatus	955.95
41	Wheat flour mills	900.91
43	Oil mills	881.55
45	Frozen egg products	782.83
32	Other chemical	739.37
51	Printing	727.67
81	Hats	722.83
75	Other tools and instruments	641.51
21	Dyeing and printing of textiles	618.92
48	Candies and canned food	598
49	Other food	501.96

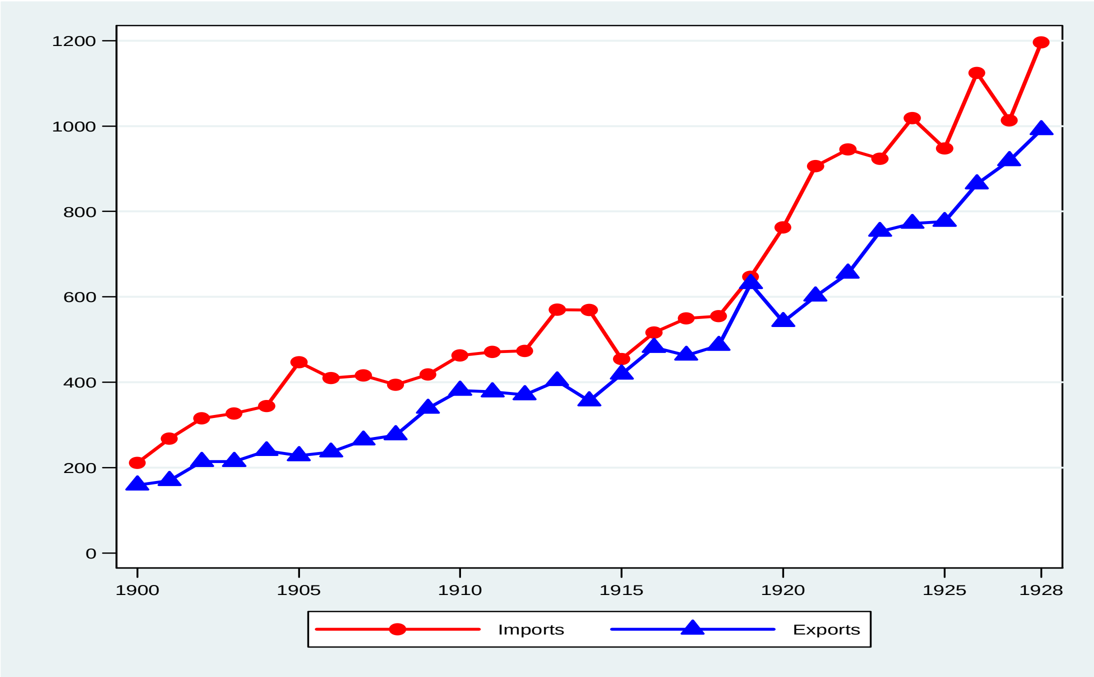
Note: Traded goods were classified into industries using the 1928 Shanghai survey data described in the text. Capital-labor ratio is derived using this survey too. Please see the text for details.

Table 3. Ranking of Industries by the 1928 Shanghai Survey (continued)

Industry Code	Industry Name	Capital-Labor Ratio
16	Knitted goods	488.5
17	Other textile	477.26
62	Manufacture of electrical instruments	396.32
94	Trimmings and ribbons	387.11
82	Umbrellas	379.27
11	Cotton spinning	357.99
97	Other miscellaneous industries	344.68
83	Brushes	325.1
84	Writing outfit	294.87
12	Cotton weaving	277.37
15	Wool weaving	258.09
22	Leather manufacturing	241.06
64	Shipbuilding	240.55
14	Silk weaving	204.25
96	Cotton ginning	203.19
85	Spectacles	188.54
72	Wooden, rattan, and bamboo articles	146.68
44	Soda water and other soft drinks	129.78
24	Soap and candles	127.62
87	Other daily necessities	114.09
61	Manufacture and repairing of machines	81.27
42	Rice mills	59.77
13	Silk reeling	47.69
95	Cartons	38.1

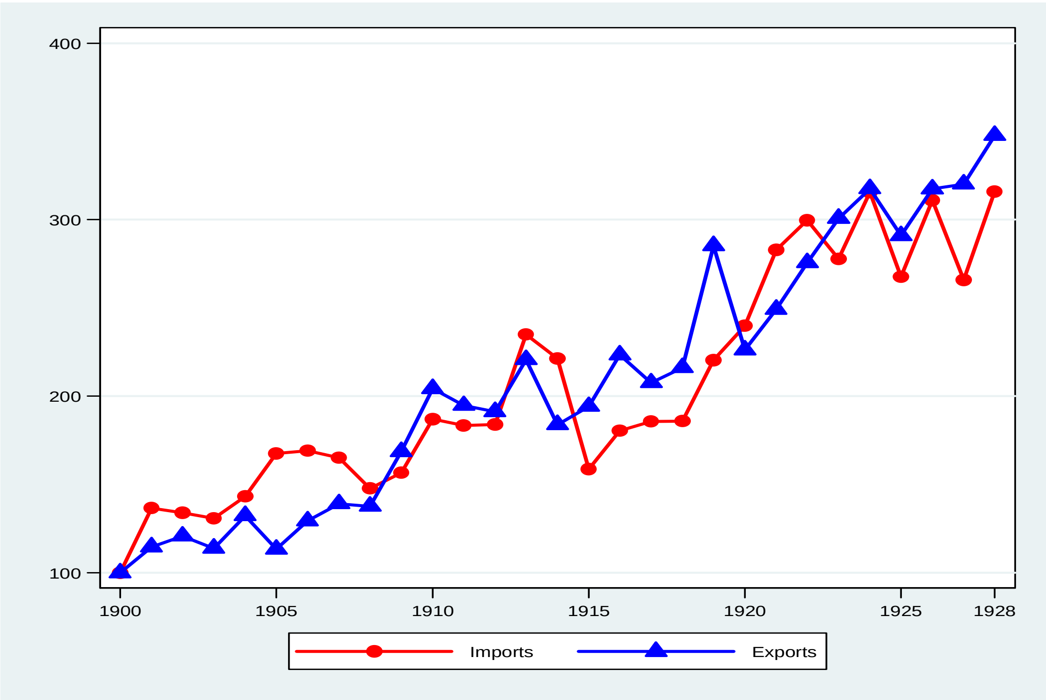
Figure 1. The Value of China's Foreign Trade

Panel A: Nominal value of trade Unit: thousand Haikwan Tael



Source: Hsiao (1974)

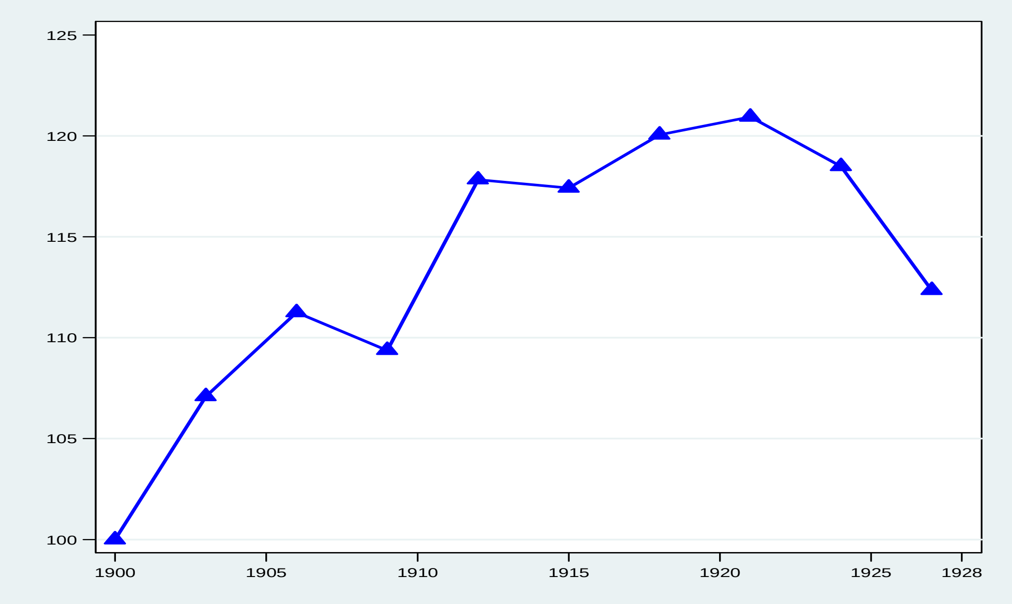
Panel B: Real value of trade Index: 1900=100



Source: Authors' calculations based on data from Hsiao (1974)

Figure 2. Real Wage Premium in China

Index: 1900=100



Source: Yan (2008)

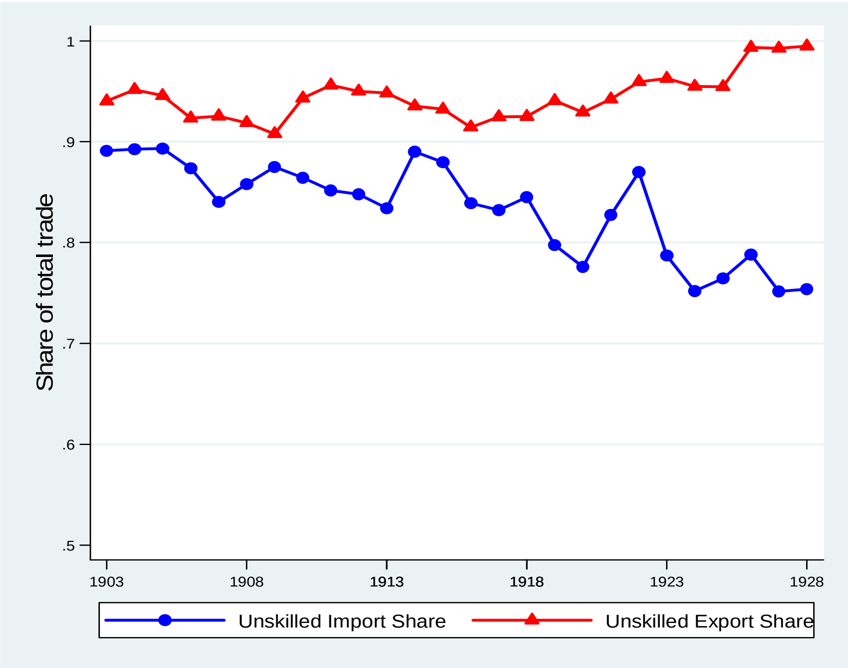
Figure 3 Quantities of Foreign Imports and Exports of Cotton Yarn, 1910-1935

Unit: thousand piculs

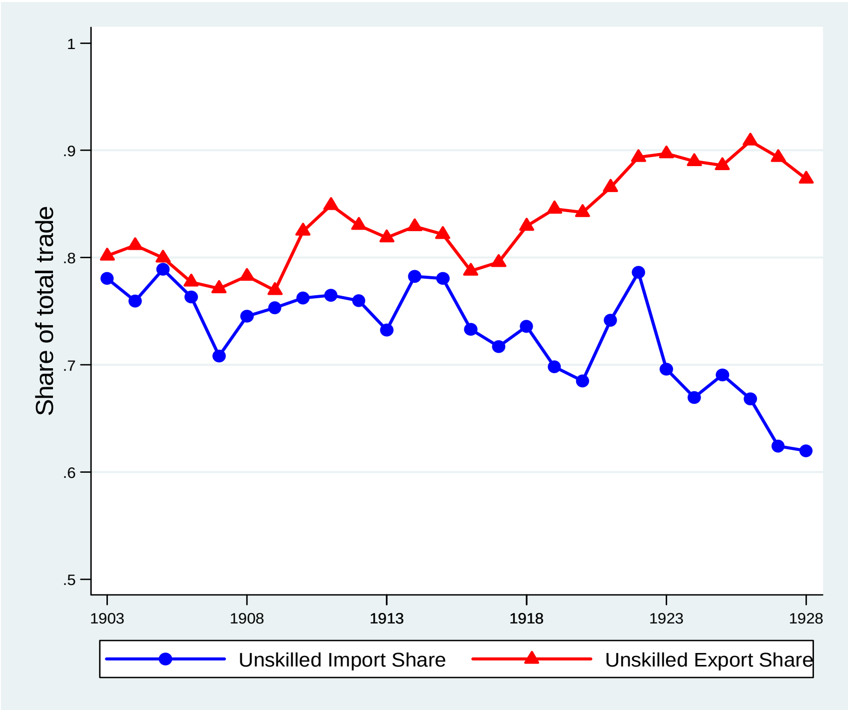
Source: Hsiao (1974)

Figure 4. Unskilled Export and Import Shares, 1903-1928

Panel A: Unskilled trade as classified by educational attainment



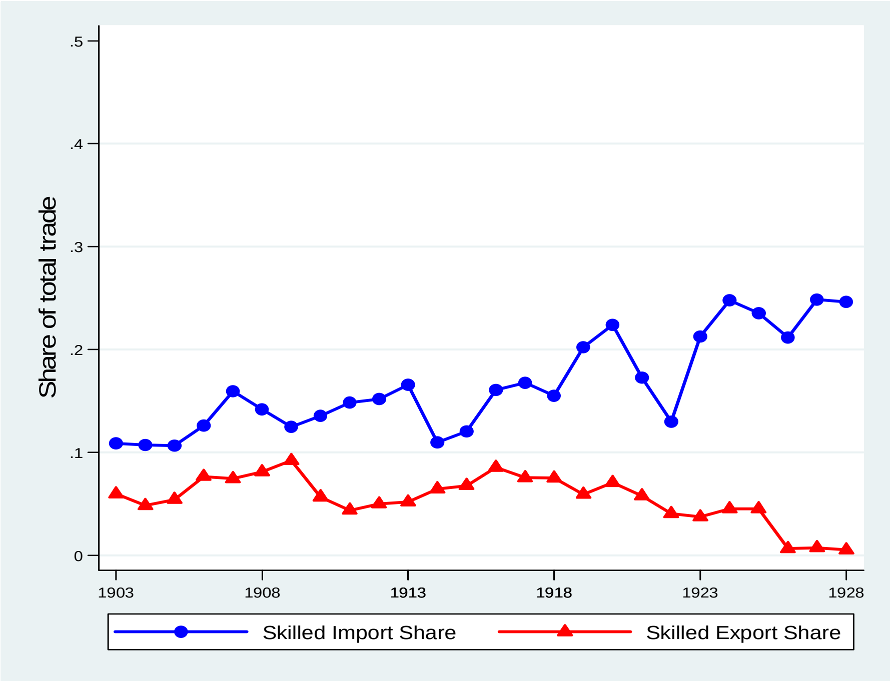
Panel B: Unskilled trade as classified by log wage



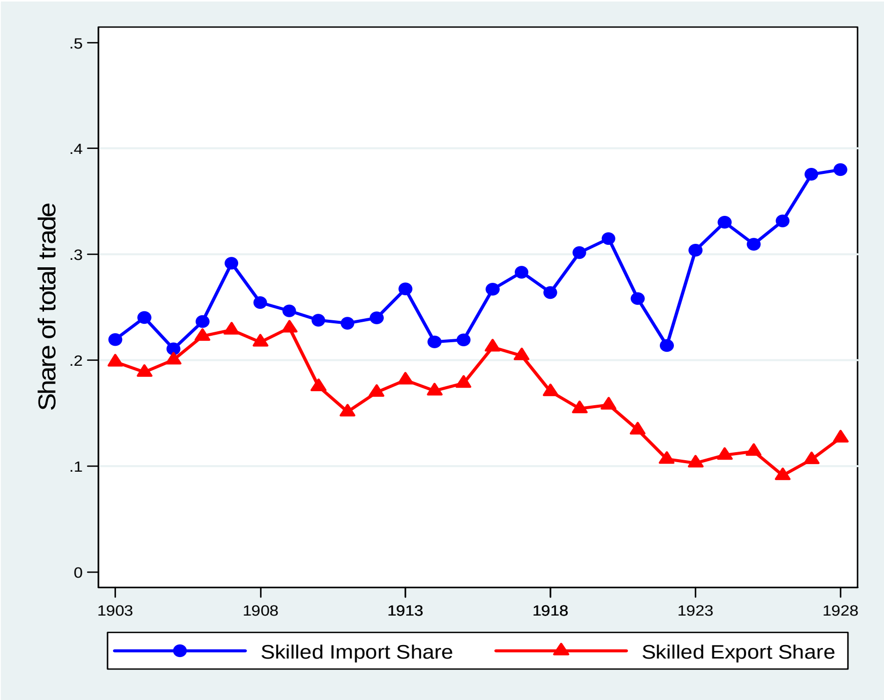
Notes: Authors' calculations based on data from the 1940 US census. See the text for a description of the educational attainment and average wages.

Figure 5. Skilled Export and Import Shares, 1903-1928

Panel A: classified by educational attainment



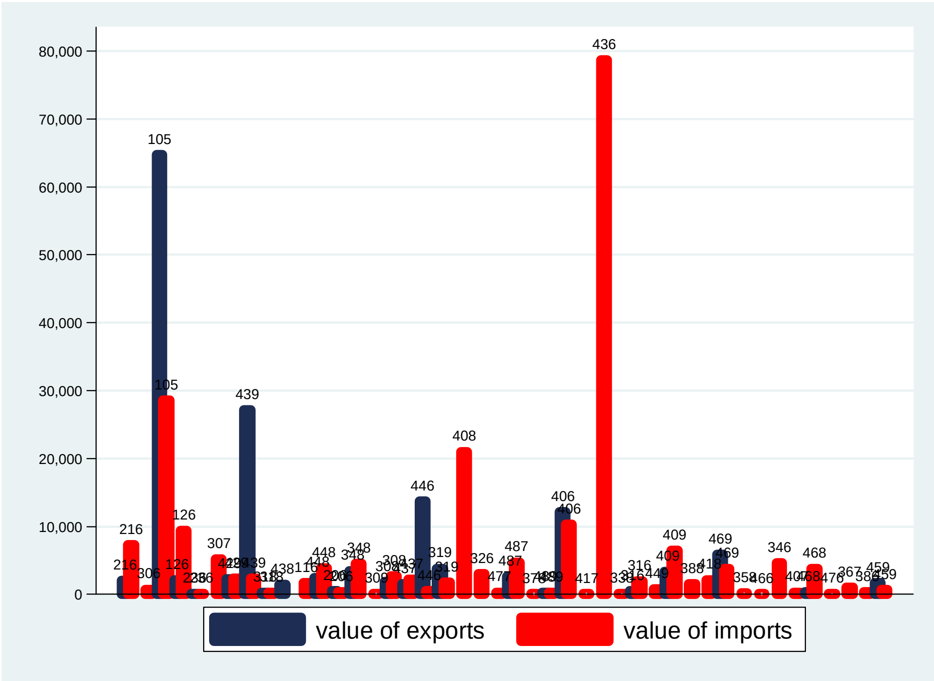
Panel B: classified by log wage



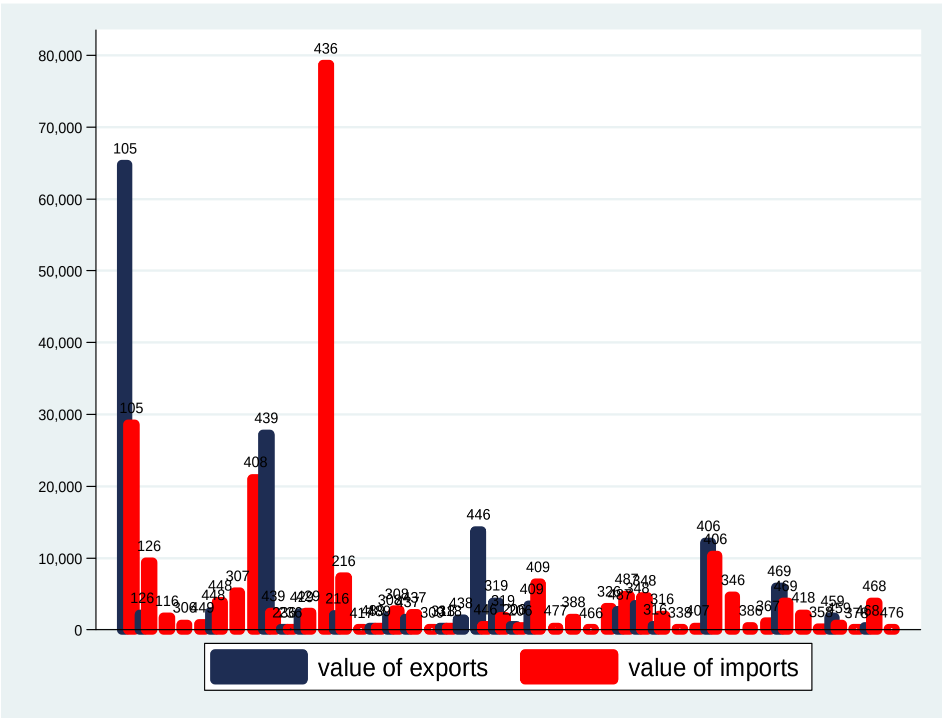
Notes: Authors' calculations are based on data from US 1940 census. See the text for the description of educational attainment and average wages.

Figure 6. Value of Exports and Imports by Skill Intensity, 1903

Panel A: classified by educational attainment Unit: thousand Haikwan Tael



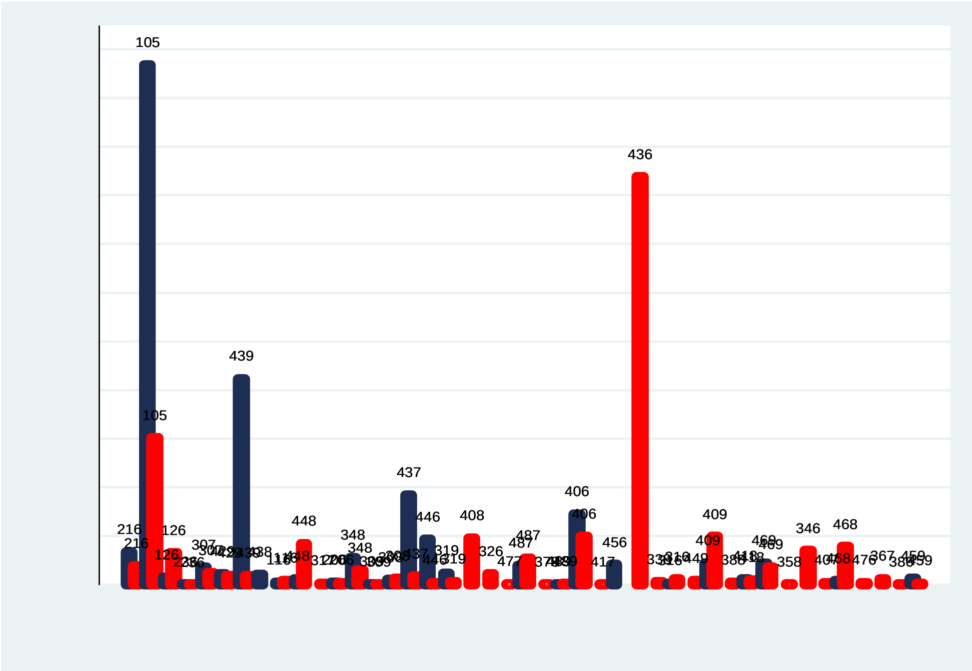
Panel B: classified by log wage Unit: thousand Haikwan Tael



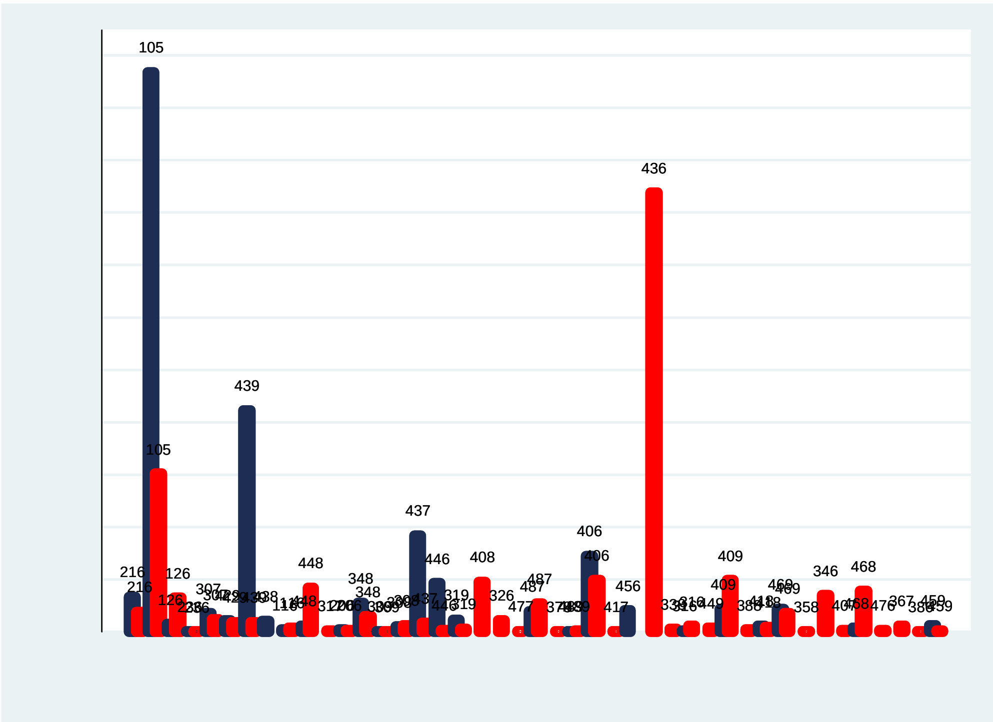
Source: Authors' calculation as described in the text. Numbers on individual bars correspond to industry codes listed in Tables 1 and 2.

Figure 7. Value of Exports and Imports by Skill Intensity, 1913

Panel A: classified by educational attainment Unit: thousand Haikwan Tael



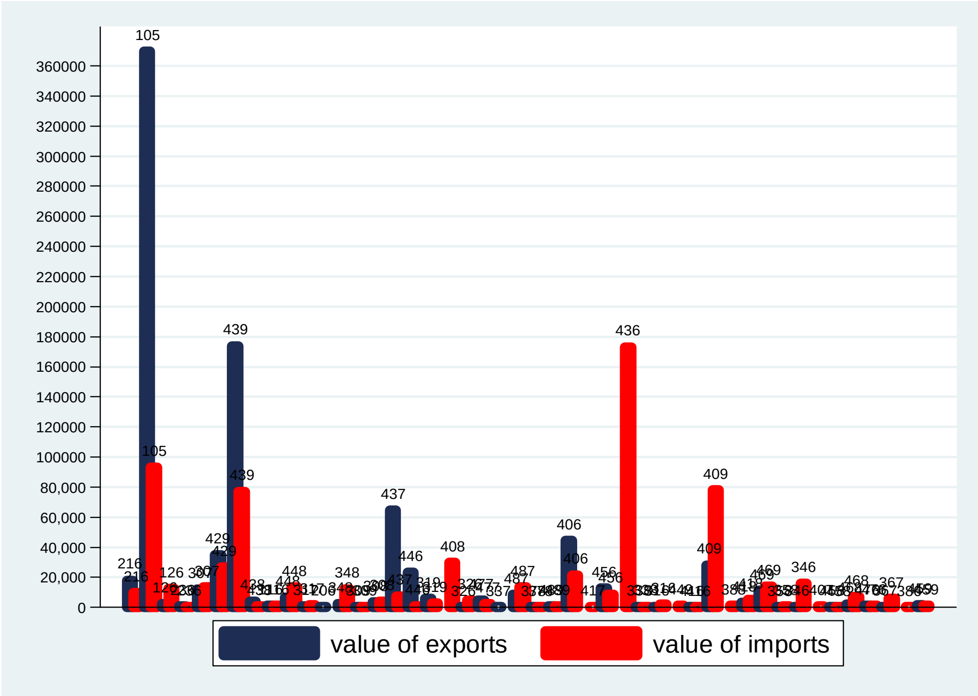
Panel B: classified by log wage Unit: thousand Haikwan Tael



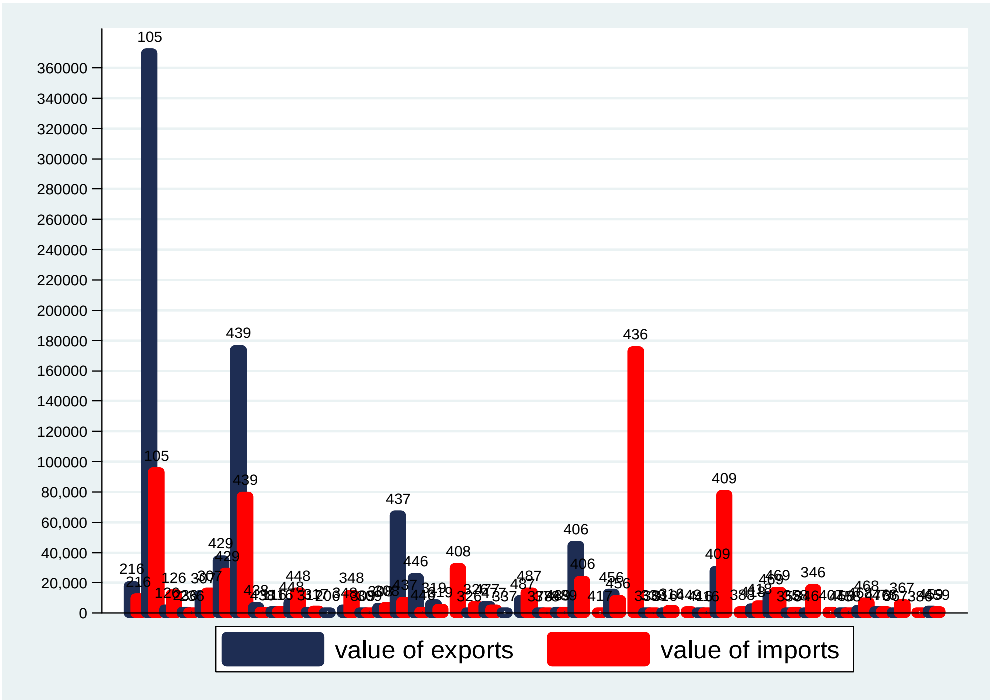
Source: Authors' calculation as described in the text. Numbers on individual bars correspond to industry codes listed in Tables 1 and 2.

Figure 8. Value of Exports and Imports by Skill Intensity, 1919

Panel A: classified by educational attainment   Unit: thousand Haikwan Tael



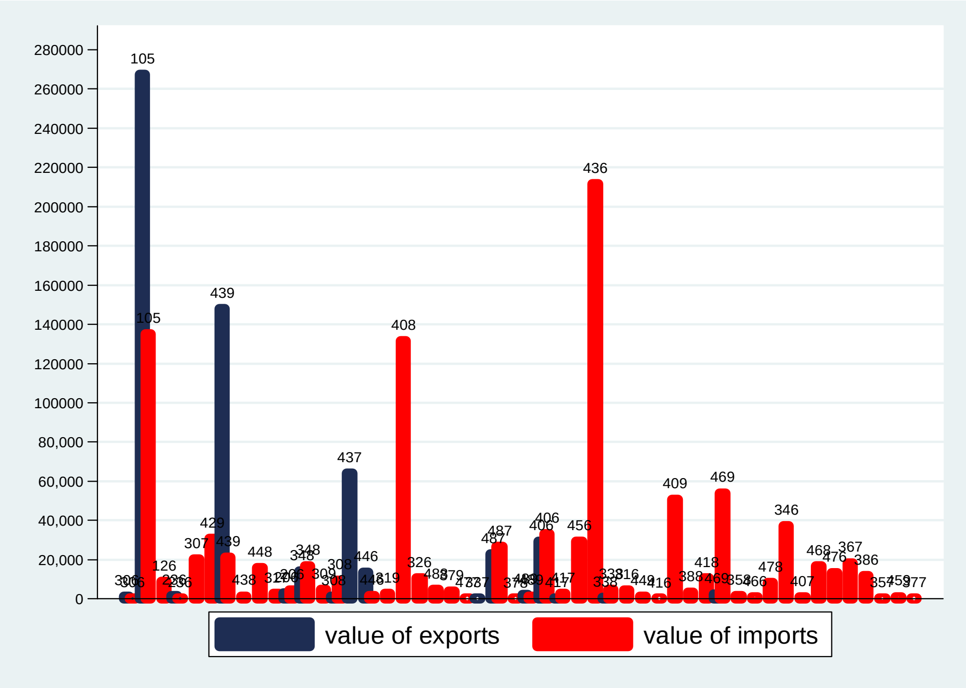
Panel B: classified by log wage   Unit: thousand Haikwan Tael



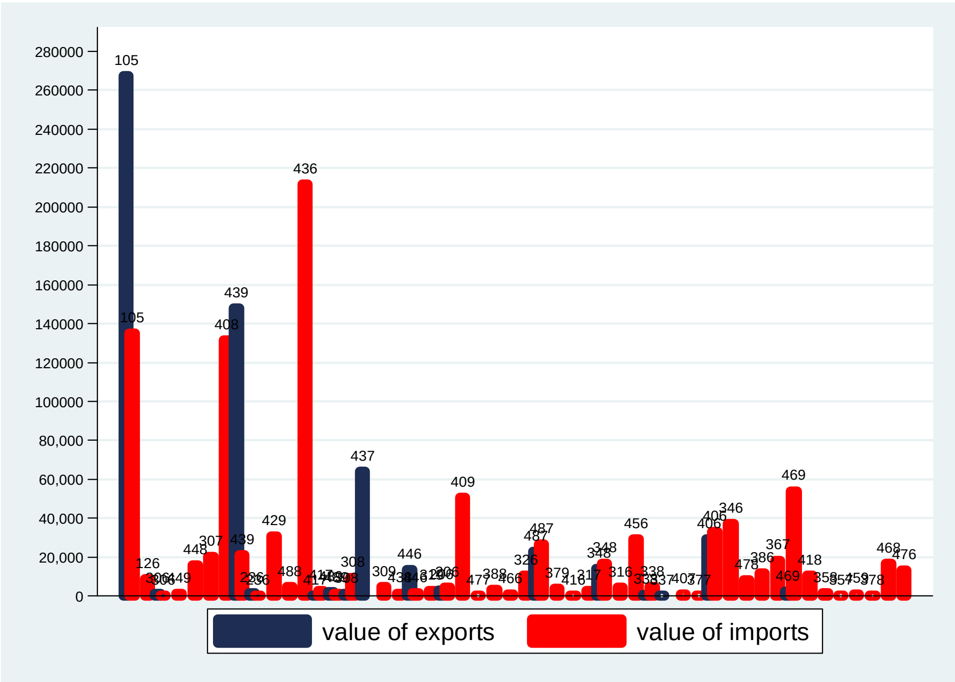
Source: Authors' calculation as described in the text. Numbers on individual bars correspond to industry codes listed in Tables 1 and 2.

Figure 9. Value of Exports and Imports by Skill Intensity, 1928

Panel A: classified by educational attainment Unit: thousand Haikwan Tael



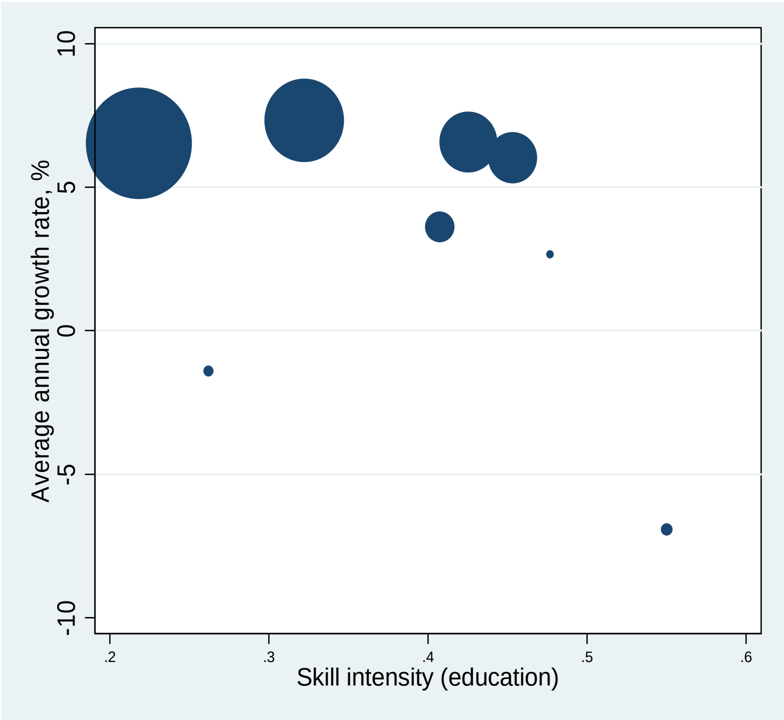
Panel B: classified by log wage Unit: thousand Haikwan Tael



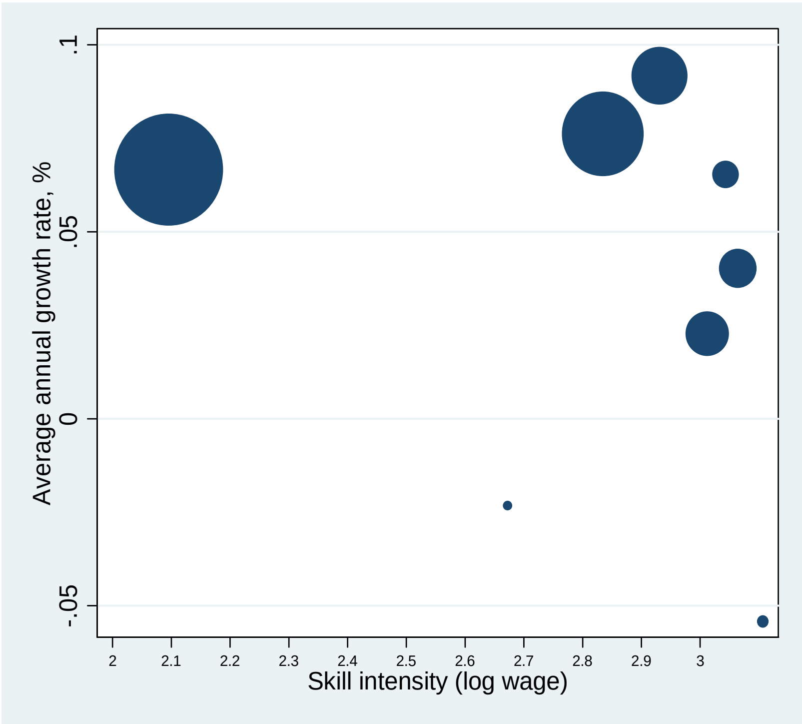
Source: Authors' calculation as described in the text. Numbers on individual bars correspond to industry codes listed in Tables 1 and 2.

Figure 10. Skill Intensity and the Growth Rate of Exports from 1903 to 1928

Panel A: classified by educational attainment



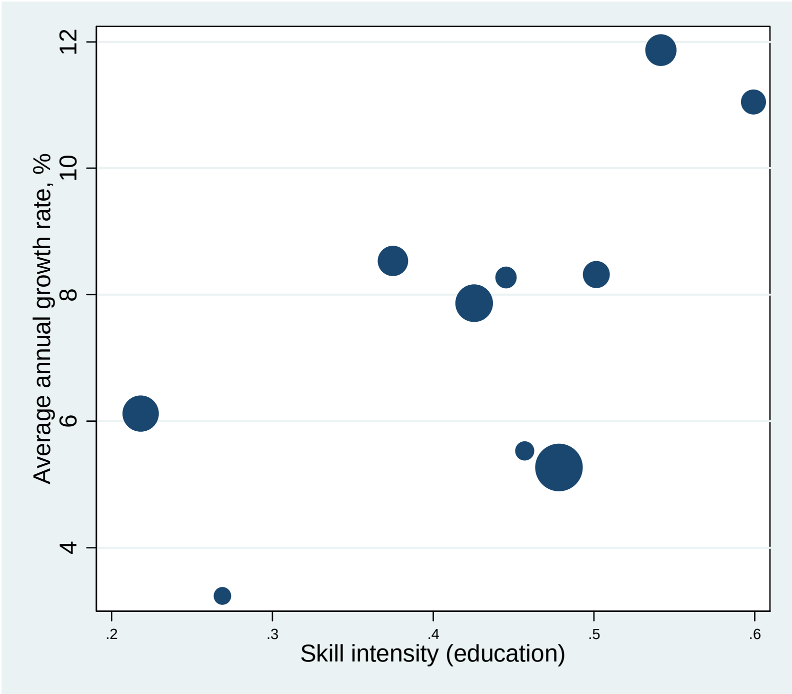
Panel B: classified by log wage



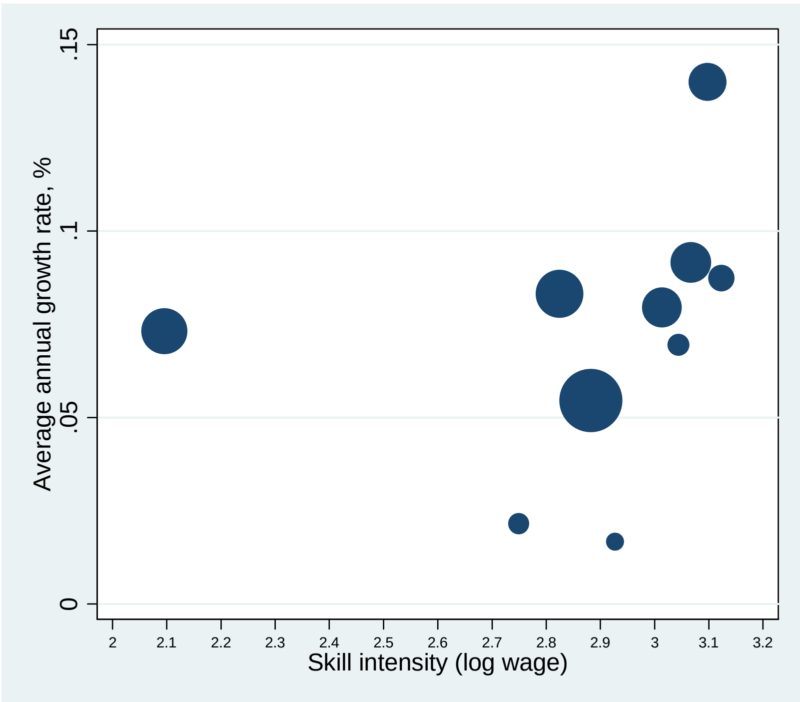
Source: Authors' calculation as described in the text. Skill intensity based on data from the 1940 US census.

Figure 11. Skill Intensity and the Growth Rate of Imports from 1903 to 1928

Panel A: classified by educational attainment

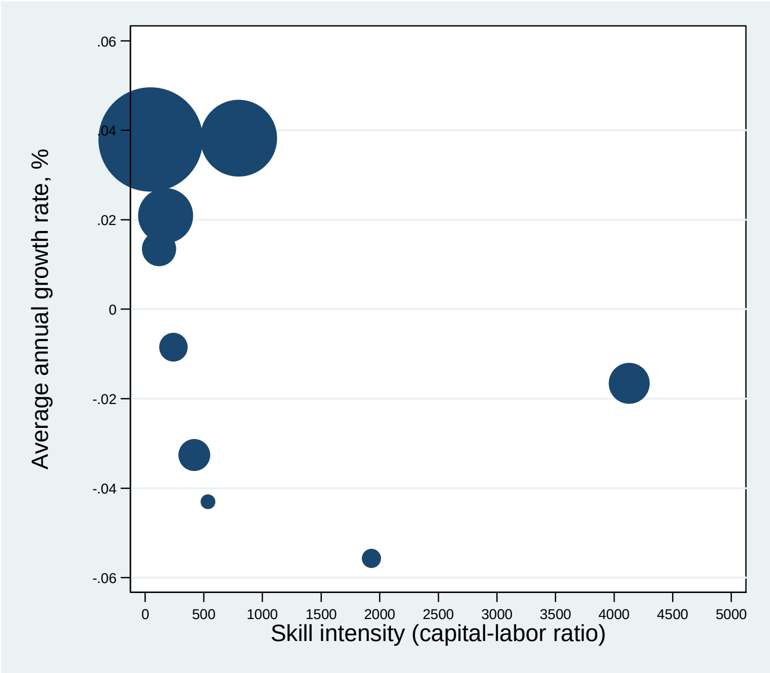


Panel B: classified by log wage



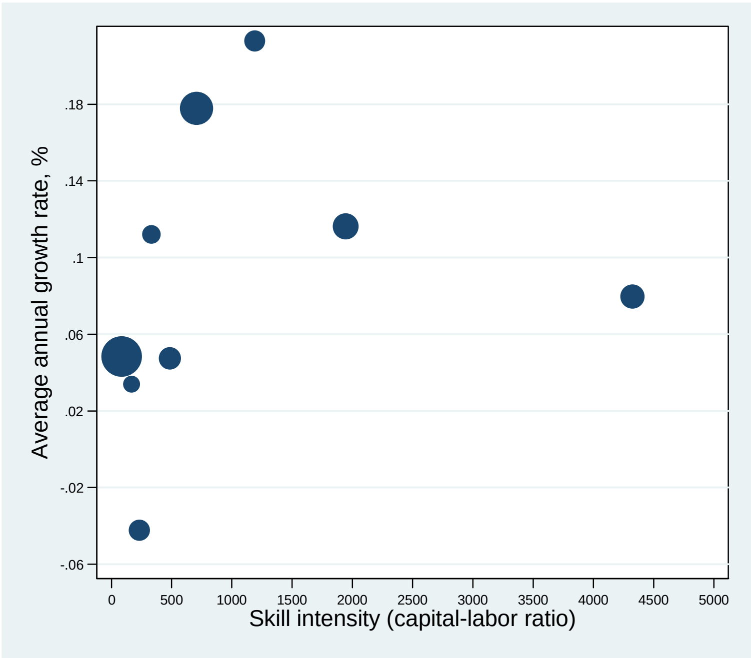
Source: Authors' calculation as described in the text. Skill intensity based on data from the 1940 US census.

Figure 12. Skill Intensity and the Growth Rate of Exports from 1903 to 1928



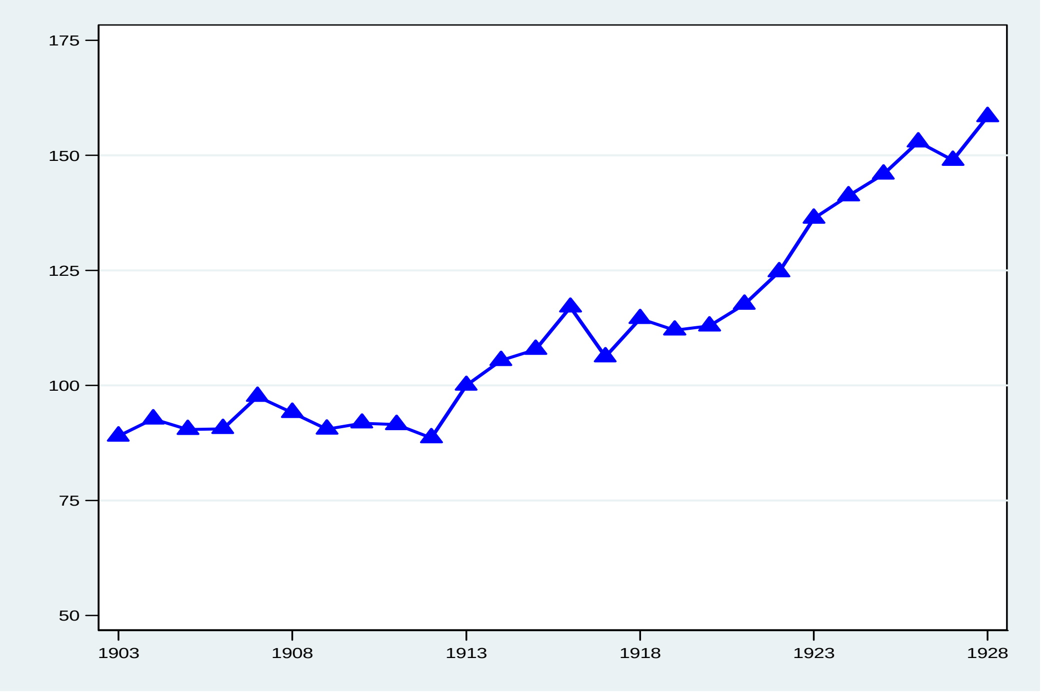
Source: Authors' calculation as described in the text. Skill intensity based on data from the 1928 Shanghai Survey

Figure 13. Skill Intensity and the Growth Rate of Imports from 1903 to 1928



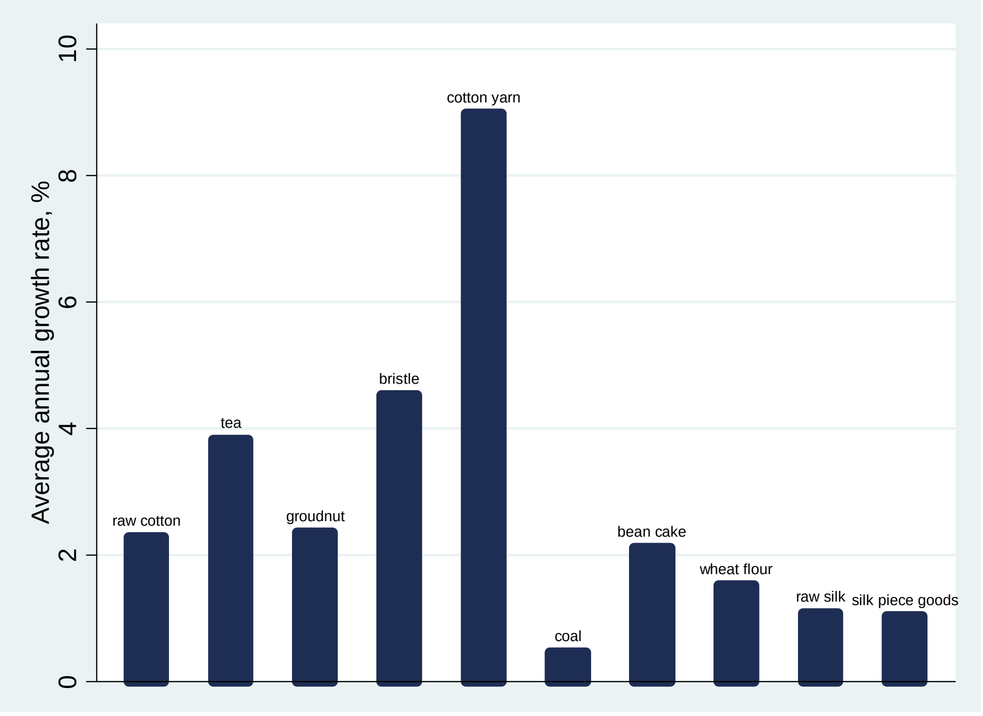
Source: Authors' calculation as described in the text. Skill intensity based on data from the 1928 Shanghai Survey.

Figure 14. Price Index of Chinese Exports, 1903 to 1928



Source: Hsiao (1974)

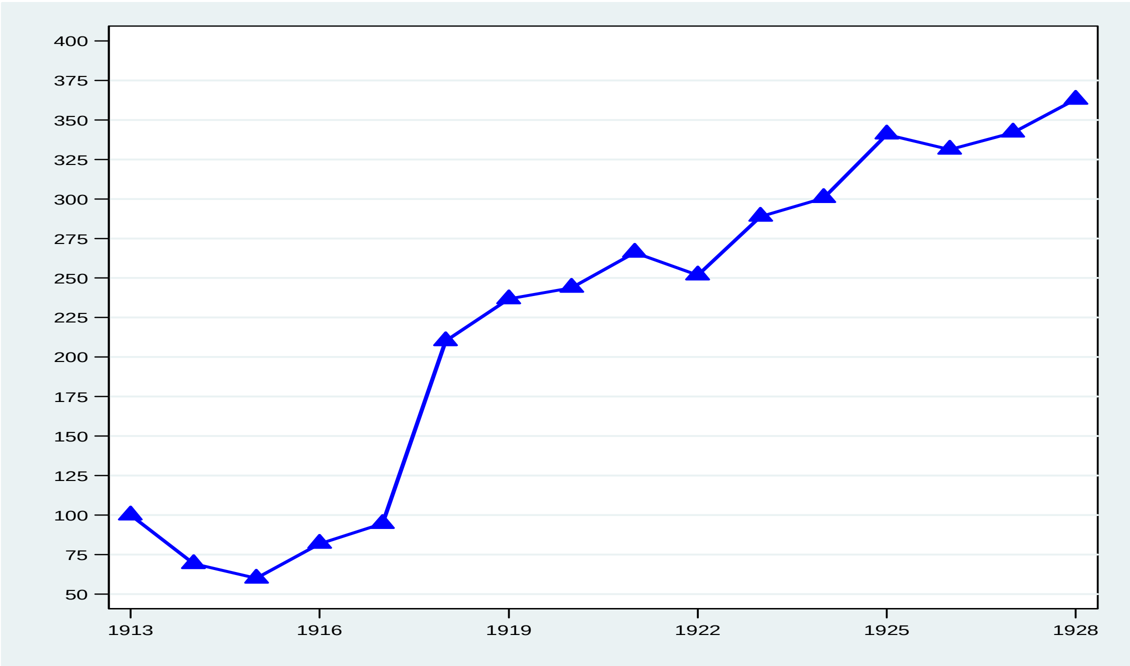
Figure 15. Growth Rates in Prices for Major Export Commodities, 1903 to 1928



Source: Authors' calculations using data from the CMC's annual trade publications

Figure 16. Export Price of Cotton Yarn

Index of unit value: 1913=100



Source: CMC annual trade publications.