

Chapter 2

Basic Facts

Abstract This chapter provides an overview of the long-term trends in the Japanese manufacturing labor market focusing on wage inequality between skilled and unskilled labor, and analyzes how the recent changes in Japan's trade structure contributed to the widening wage inequality. The relative wage of skilled labor to unskilled labor, represented by nonproduction to production workers and college graduates to high school graduates in the manufacturing industry, has been steadily increasing since the 1980s accompanied by an increase in the relative employment of skilled labor to unskilled labor. Therefore, if we are to view these relative wages and employment in a simple supply-demand framework, it is safe to say that relative demand for skilled labor increased at least to the same extent, or more than relative supply. This chapter pays special attention to the recent changes in Japan's trade structure as one of the important factors underlying this relative demand shift, and explains the mechanism of how increased trade, especially with Asian countries, widens wage inequality in Japan in a theoretical framework of the HOS model.

Keywords Wage inequality • Skilled labor and unskilled labor • Supply-demand framework • Trade structure • HOS model

2.1 Wage Inequality Trends in Japanese Manufacturing

In what follows, I use two categories of skills to represent skilled and unskilled labor. One is occupation through which labor is classified as nonproduction and production workers. The other is education, which is used to classify labor as

college graduates and high school graduates. The treatment is generally common in this type of literature.¹

2.1.1 *Wage Inequality by Occupation*

Let us first look at occupational wage inequality. Figure 2.1 shows long-term trends of relative wages of nonproduction to production workers in the manufacturing sector since the 1960s, based on data from the “Basic Survey on Wage Structure” published by Japan Ministry of Health, Labour and Welfare. I use scheduled cash earnings as wages here.^{2,3}

Production workers are directly involved in the production of goods at manufacturing establishments. Nonproduction workers include supervisors, technical employees and other office workers who are engaged in sales, advertising, and clerical functions, at the office and manufacturing establishments. It is assumed that production workers correspond to unskilled labor and nonproduction workers correspond to skilled labor.

The relative wage of nonproduction to production workers for males decreased from 1970 to 1975, moderately increased in the 1980s and 1990s, and increased again after 2000. The relative wage for females increased from 1970 to 1975, stayed in the 1980s and 1990s, and increased rapidly after 2000.⁴ The relative wage for total labor decreased slightly in the 1990s and increased rapidly after 2000.

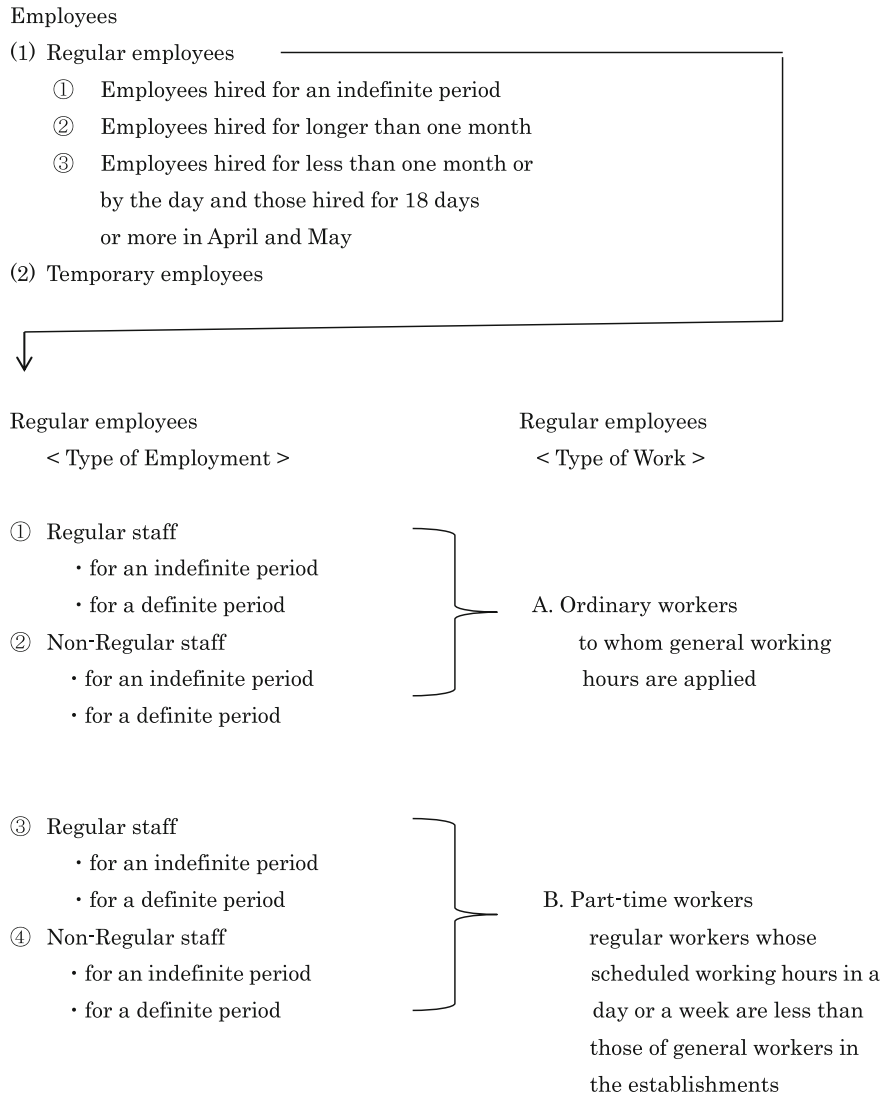
¹Previous studies utilized the same categories. For example, see Berman et al. (1994), Sachs and Shatz (1994). This treatment can be reasonably justified by a high correlation between occupational distribution and educational distribution of workers. In 1990, for example, 41.5% of nonproduction workers had at least a four-year college degree, while only 3.2% of production workers had one, indicating a close correspondence between the two kinds of classifications of skills. In 2015, these figures stood at 49.8 and 10.4%, respectively. This correspondence is similar to that in the US. According to the estimation reported by Berman et al. (1998), in 1990, 46% of nonproduction workers in the US manufacturing sector had a four-year college degree or higher education, while 8% of production workers had the same level of education.

²As labor ordinary workers are used, who are defined as regular employees for whom general working hours are applied, including regular staff and non-regular staff. See Appendix Table 2.1 for classification of labor in the “Basic Survey on Wage Structure.”

³We could use other kinds of wages such as hourly scheduled cash earnings, contractual cash earnings including overtime allowance, annual earnings including bonus and so forth. However, they largely show similar trends.

⁴It is often claimed that the relative wage of nonproduction to production workers tends to increase under the so-called “Japanese seniority wage system” as aging proceeds to a greater extent in nonproduction workers than in production workers. Therefore, as a reference, counterfactual relative wages for male and female with age distribution fixed at 1990 are presented in Appendix Fig. 2.10. It should be noted that these counterfactual relative wages tend to be underestimated because changes in supply-demand conditions due to aging are not considered under the counterfactual situation. We should also note that Japanese companies began to reform this kind of seniority wage system since the late 1990s in order to reduce total labor costs under long-term stagnation of the Japanese economy.

Table 2.1 Classification of labor in “Basic Survey on Wage Structure”



Source Ministry of Health, Labour and Welfare, Japan, “Basic Survey on Wage Structure”

Figure 2.2 shows number of nonproduction and production workers, and the relative employment of nonproduction to production workers from the same data source as above. We can see from this figure that the number of nonproduction workers (both male and female) peaked in 1995 and then decreased as a trend while

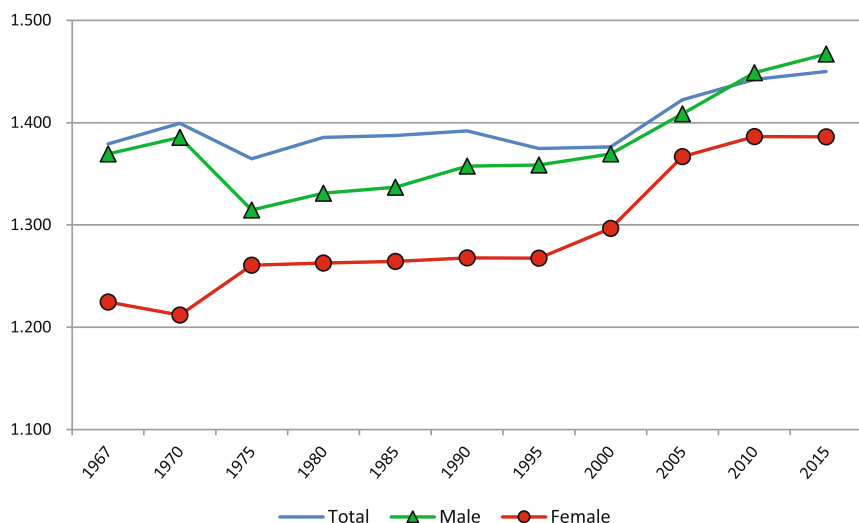


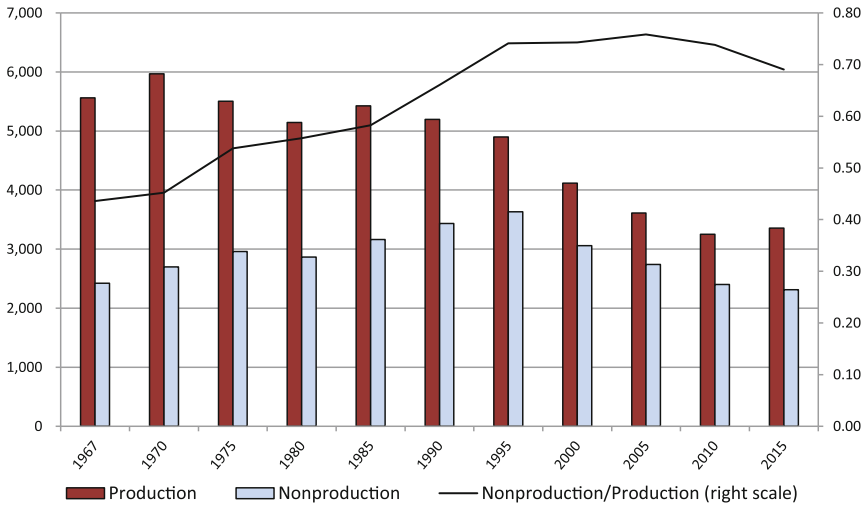
Fig. 2.1 Relative wages of nonproduction to production workers in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

the number of production workers continued to decline toward 2010 since the 1970s.⁵ The reduction in production workers was much more rapid in female workers than in male workers. As a result, relative employment of male nonproduction to production workers increased toward 1995, sustained at the same level and then marginally decreased after 2005. In contrast, relative employment for females continued to increase toward 2015, although there were some fluctuations in the pace of growth. Similarly, relative employment for total workers increased toward 1995, sustained at almost the same level and declined marginally after 2005.

Based on these trends in relative wages and relative employment, we can infer that in the long term both relative wage and the relative employment of nonproduction to production workers showed a steady and a moderate upward trend toward 2010, with fluctuations in the pace of their growth depending on gender and time. As shown below, this fact suggests that in a supply-demand framework relative demand for nonproduction workers increased more than the relative supply.

⁵We can identify the following macroeconomic and demographic factors behind these movements. First, number of workers in the manufacturing sector has been decreasing since the 1980s due to secular changes in the industrial structure and productivity increases. Second, working-age population, which is defined as population aged 15–64, peaked in 1995 and began to decrease as a trend due to low birth rates. Third, the Japanese economy entered into a prolonged recession after the economic bubble burst in 1991. Fourth, a small increase in production workers from 2010 to 2015 reflected a recovery from the recession triggered by the “Lehman Shock” in September 2008.

(1) Total



(2) Male

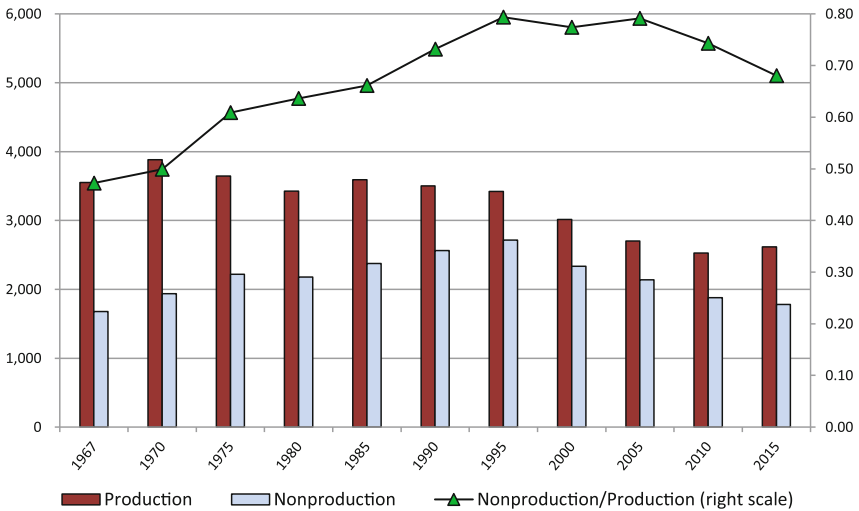


Fig. 2.2 Relative employment of nonproduction to production workers in manufacturing. *Notes* (1) Relative employment = nonproduction/production workers. (2) Unit of left scale is thousands. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

2.1.2 Wage Inequality by Education

Next, let us consider educational wage inequality. Figure 2.3 shows long-term trends of relative wages of college graduates to high school graduates since 1975, based on

(3) Female

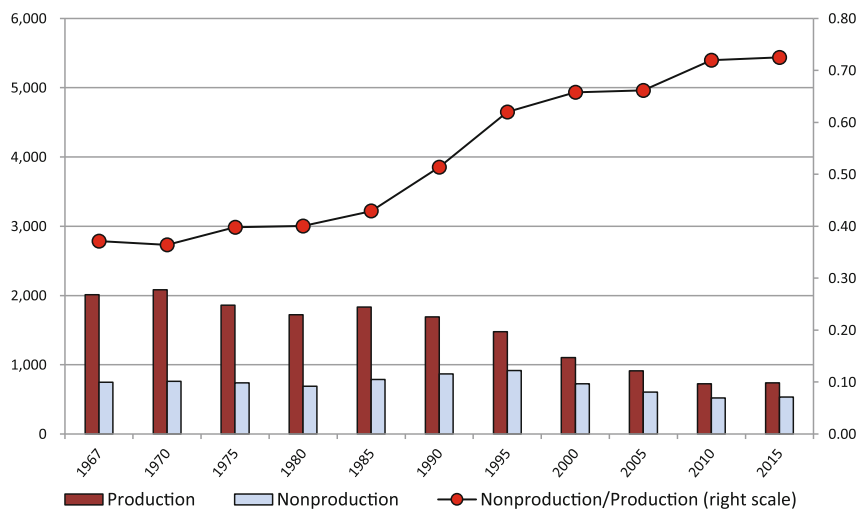


Fig. 2.2 (continued)

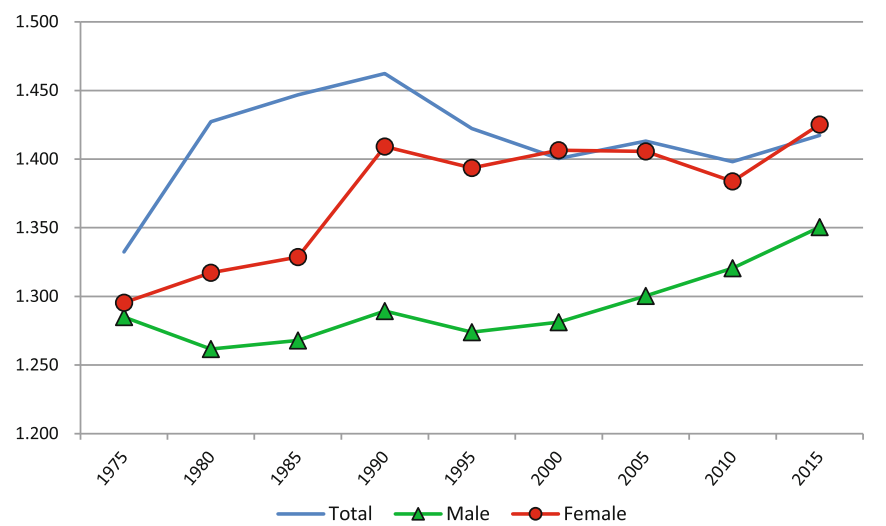


Fig. 2.3 Relative wages of college graduates to high school graduates in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

data from the “Basic Survey on Wage Structure.” College graduates are defined as employees with at least a four-year college degree. Scheduled cash earnings are used as wages, as is the case above. The relative wage for males gradually increased in the

1980s, sustained at almost the same level in the 1990s, and rapidly increased after 2000. The relative wage for females increased rapidly in the 1980s, sustained during the 1990s, and then increased slightly after 2010.⁶ A jump from 1985 to 1990 may have reflected the institutional change that the “Gender Equality in Employment Act” was enacted in 1985. The relative wage for total workers increased in the 1980s, decreased in the 1990, and sustained at that level there after 2000.

Figure 2.4 shows number of college graduates and high school graduates, and the relative employment of college graduates to high school graduates from the same data source. As for males, both college graduates and high school graduates peaked in numbers in 1995 and then began to decrease after 1995, but the declining rate is much greater in high school graduates, leading to a steady increase in the relative employment of college graduates. As for females, high school graduates began to rapidly decrease after 1995, while college graduates steadily increased throughout the 1995–2005 period, leading to a rapid growth in the relative employment of college graduates after 1995, even though the level is still much lower than that of male workers.

Based on the figures of relative wages and employment of male and female college graduates to high school graduates, we can say that both relative wage and employment steadily increased in the long term, and the relative employment for females increased much more rapidly than for males. This rapid increase in relative employment for females may have exerted a downward pressure on the relative wages of college graduates from the supply side. Summarizing, in the long term, these facts suggest that the relative demand for male and female college graduates increased at least to the same extent, or more than relative supply in a simple supply-demand framework, as explained below.

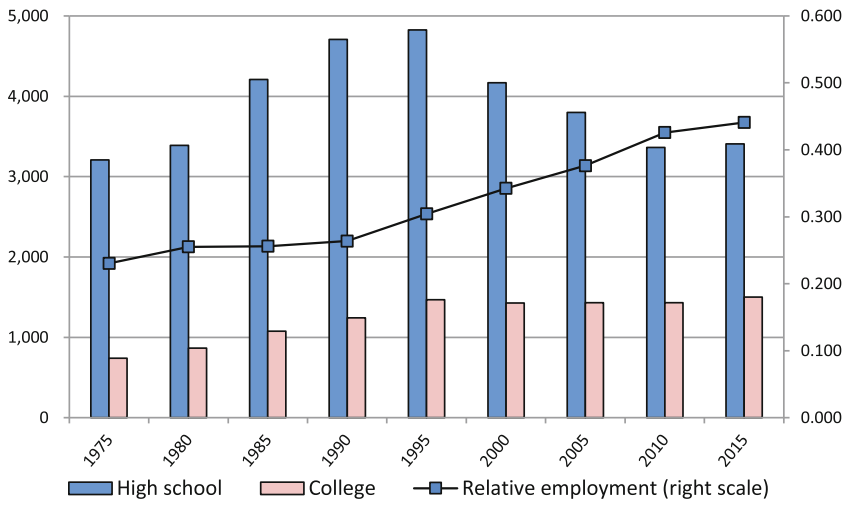
2.2 Supply-Demand Framework

The previous section reviewed the recent developments in the Japanese manufacturing labor market, which experienced an increase in relative wage with increased relative employment of skilled labor to unskilled labor. If we view these movements in a simple supply-demand framework, an interpretation consistent with the facts is that relative demand for skilled labor increased more than relative supply, as illustrated in Fig. 2.5.

Taking labor market by education as an example, if relative demand had been constant, an increase in the relative supply of college graduates would have caused a decline in the relative wage of college graduates. However, this did not happen

⁶Counterfactual relative wages for males and females with age distribution fixed at 1990 are shown in Appendix Fig. 2.11. See also footnote 6.

(1) Total



(2) Male

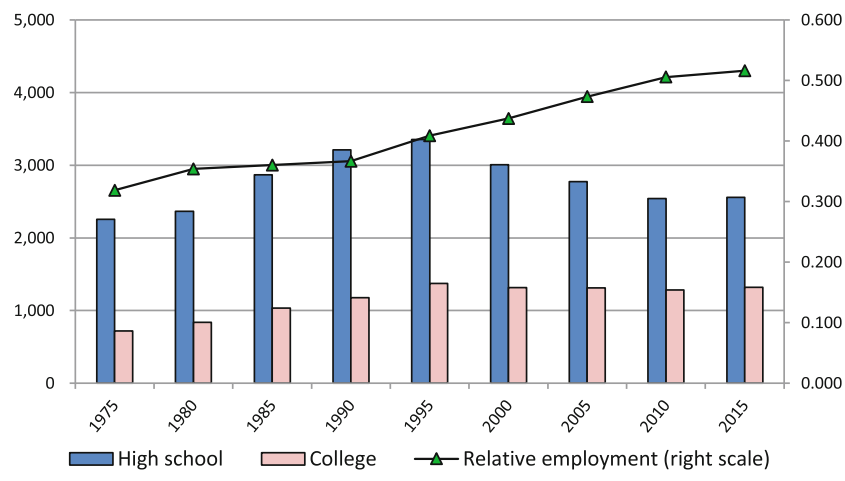


Fig. 2.4 Relative employment of college graduates to high school graduates in manufacturing. *Note* Unit of left scale is thousands. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

except for the period between 2005 and 2010 for females. Therefore, it is reasonable to assert that the relative demand for college graduates increased at least to the same extent, or more than the relative supply, as shown in Fig. 2.5. This interpretation is consistent with the observed facts. As for the period from 2005 to 2010 for females, it would be possible to interpret that an increase in the relative supply of female college graduates was large enough to reduce relative wage slightly.

(3) Female

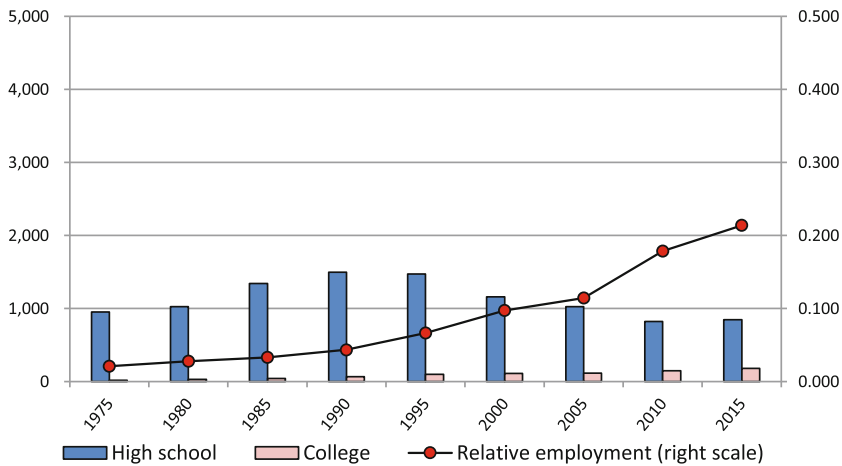


Fig. 2.4 (continued)

It is well known from the existing body of literature that under a reasonable production function, relative demand shift toward skilled labor can be approximated by a change in the skilled labor's share of the wage bill.⁷ Figures 2.6 and 2.7 show the share of nonproduction workers and college graduates in the total wage bill and employment, respectively. Wages are scheduled cash earnings. We can see from these Figs. 2.6 and 2.7 that the wage bill share of male nonproduction workers increased rapidly until 1995 and then reduced its increasing pace, while the wage bill share of female nonproduction workers increased more rapidly throughout the period. As for wage share by education, the wage bill share of college graduates increased constantly throughout the period 1995–2005 for both males and females, while the wage bill share of high school graduates stagnated after 1990 for both males and females. These data suggest that there was a relative demand shift toward skilled labor, represented by nonproduction workers and college graduates in the manufacturing labor market.

⁷Assuming that the economy is on the labor demand curve, which is derived from a constant elasticity of substitution (CES) production function with two kinds of inputs, namely skilled labor and unskilled labor, a relative demand shift can be approximated by a change in the wage share of skilled labor under the assumption that an elasticity of substitution between two inputs is close to one. For example, assuming a production function $Y_t = (a_t L_{st}^\rho + b_t L_{ut}^\rho)^{1/\rho}$, with skilled labor L_s , and unskilled labor L_u as inputs, a relative demand shift toward skilled labor can be shown by $D_t = \log(w_{st} L_{st} / w_{ut} L_{ut}) + (\sigma - 1) \log(w_{st} / w_{ut})$, where an elasticity of substitution is $\sigma = 1/(1 - \rho)$, and w_s and w_u are the wages of skilled and unskilled labor, respectively. For example, see Autor et al. (1998).

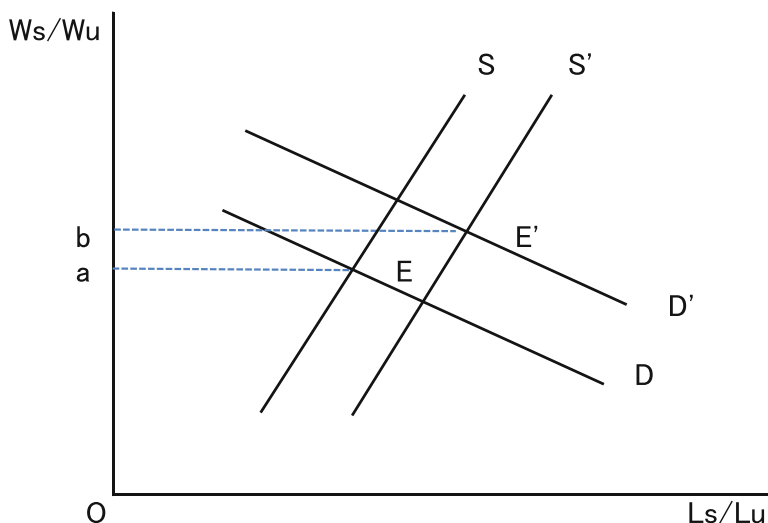


Fig. 2.5 Supply-Demand Framework. *Notes* W_s/W_u is relative wage of skilled labor to unskilled labor. L_s/L_u is relative employment of skilled labor to unskilled labor

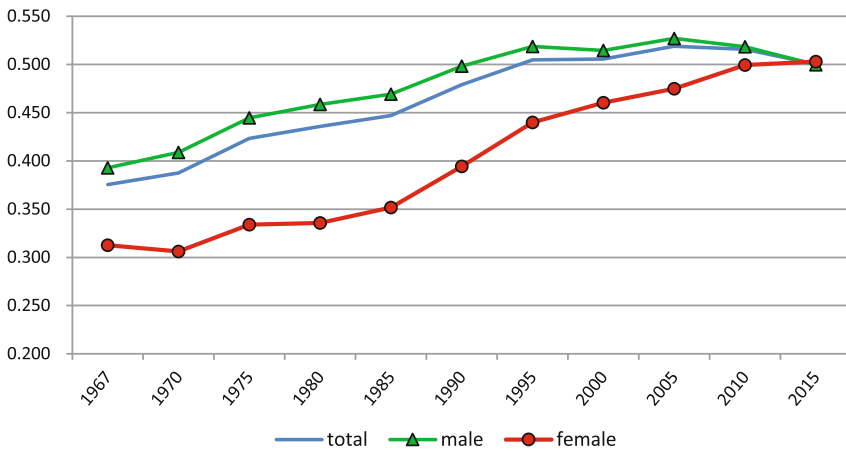
Many studies have been done to identify the factors that caused this demand shift toward skilled labor in the US and European countries, and to reach a broad consensus that skill-biased technological change (SBTC) and globalization play important roles. The next section will deal with international trade, which is a major driving force of globalization, and examine how the recent changes in the Japanese trade structure are related to the widening wage inequality in Japan, based on the theoretical mechanism of the HOS model.

2.3 Recent Changes in Japan's Trade Structure

Figure 2.8 shows a time series of the share of the US, China, and Asian countries including China in Japan's export and import of goods during the period 1985–2012. It is striking that the share of Asian countries has been increasing since around 1990 in both exports and imports, with China contributing largely. China exceeded the US in the share of imports in 2002 and in exports in 2009, and has now become Japan's largest trade partner.

Since China is still abundant in unskilled labor in factor endowments, increasing trade with Asian countries including China was in line with the HOS model in

(1) Wage bill share



(2) Employment share

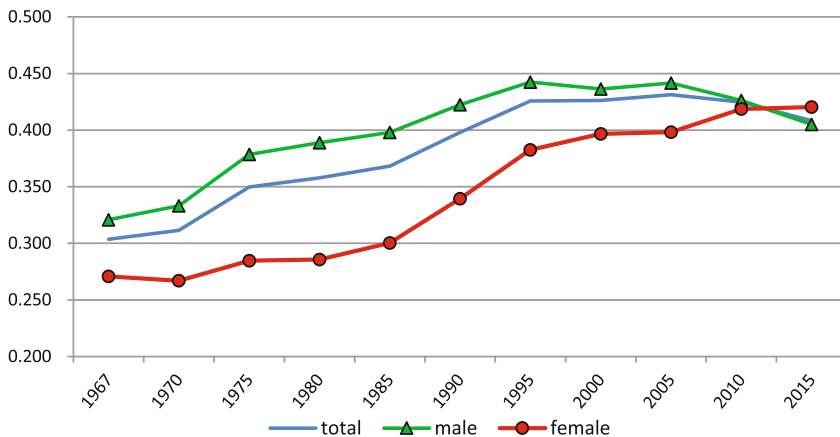


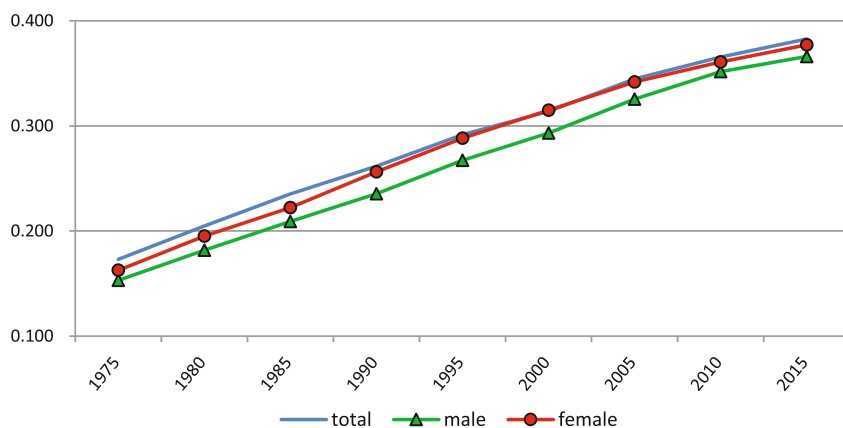
Fig. 2.6 Wage bill share and employment share of nonproduction workers in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

which trade is driven by differences in factor endowments between trade partners.⁸ The HOS model shows how international trade with developing countries widens wage inequality in the labor markets of advanced countries. The mechanism is as

⁸Although we do not go into details here, Appendix Table 3.4 shows that Japan's trade in 1995–2005 was consistent with the HOS model. Namely, regression analysis based on 55 manufacturing industries revealed that the import ratio increased more in production worker-intensive industries while the export ratio increased more in technical worker-intensive industries.

1. Wage bill share

(1) College graduates



(2) High school graduates

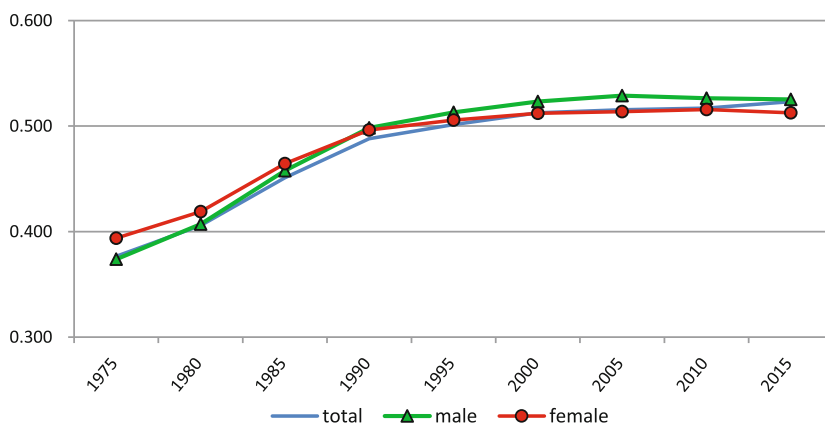
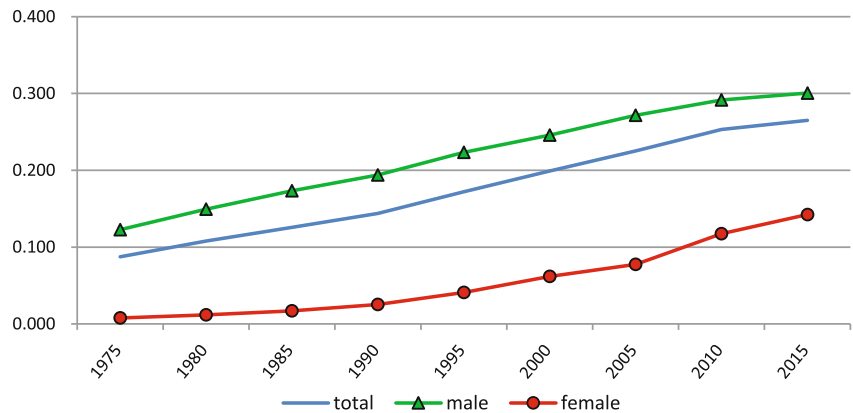


Fig. 2.7 Wage bill share and employment share of college and high school graduates in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

follows. Assume a standard HOS model of two countries = two goods = two factors, with Japan being a home country and China being a foreign country. Japan is assumed to have a comparative advantage in skilled labor-intensive goods such as “electronic equipment” (goods Y) while China is assumed to have a comparative advantage in unskilled labor-intensive goods such as “wearing apparel” (goods X).

2. Employment share
(1) College graduates



(2) High school graduates

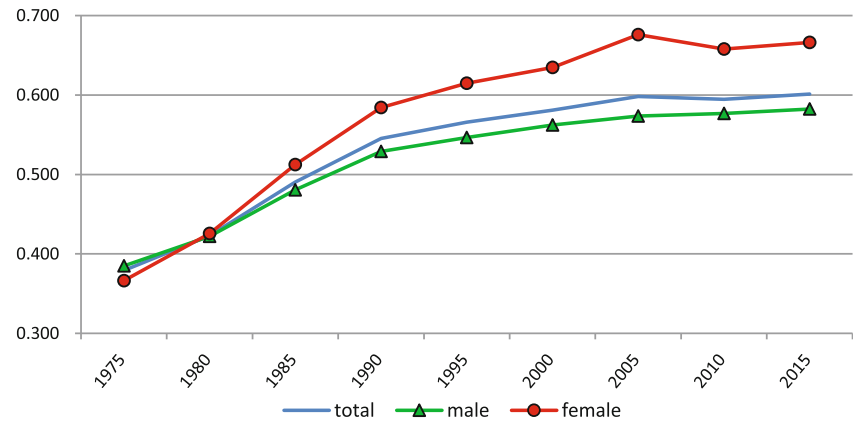
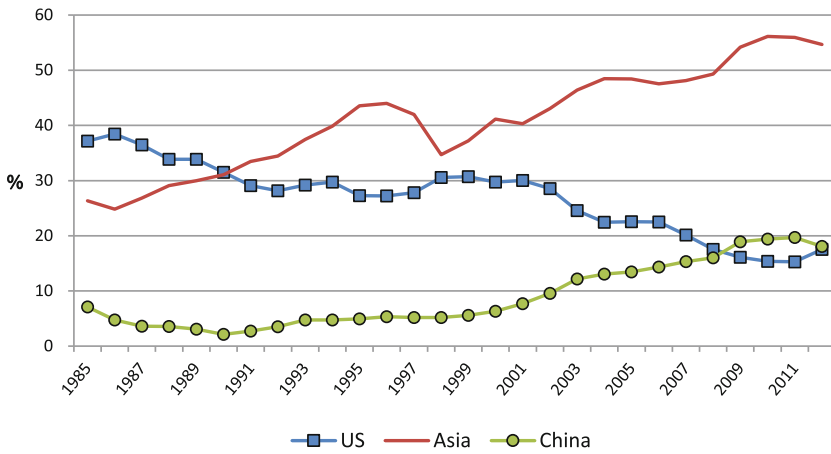


Fig. 2.7 (continued)

Suppose industrialization takes place in China, and the export prices of “wearing apparel” decline due to increased productivity, thereby leading to a reduction in the relative prices of goods X to Y in the international markets. Then, an optimal production point on the production possibility frontier of Japan shifts from O_1 to O_2 , leading to an increase in exports and the production of “electronic equipment” on one hand and to an increase in imports and a decrease in the production of “wearing apparel” on the other (Fig. 2.9a). Since the “electronic equipment”

(1) Exports



(2) Imports

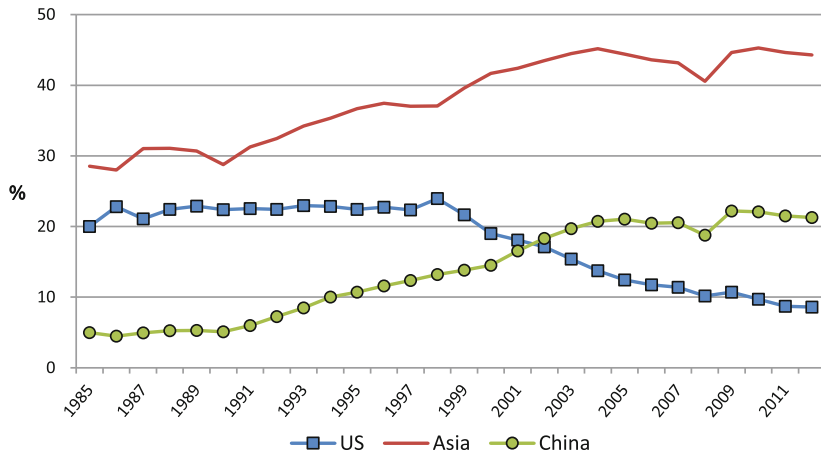
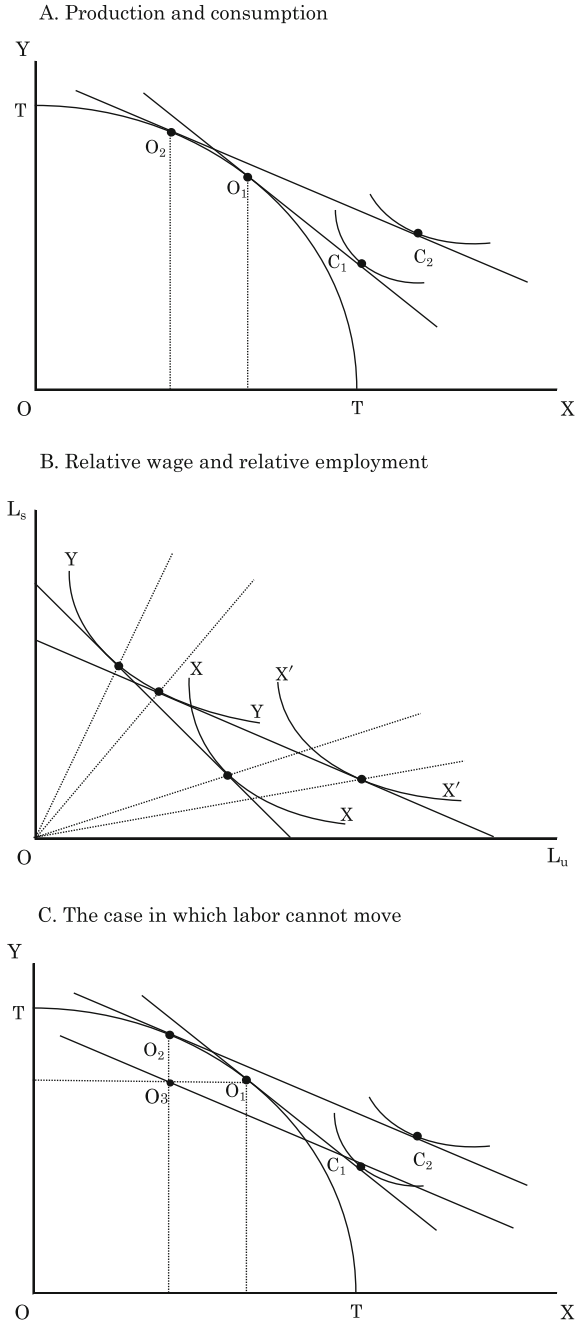


Fig. 2.8 Share of the US, China and Asia in Japan’s exports and imports (1985–2012). *Note* Hong Kong is not included in China. *Source* “The summary report on trade of Japan,” published by the Japan Tariff Association

industry is skilled labor-intensive and the “wearing apparel” industry is unskilled labor-intensive, these production changes will bring about an increase in the relative demand for skilled labor, leading to a rise in the relative wages of skilled labor.⁹

⁹The relationship between goods prices and factor prices along with these changes is called the Stolper-Samuelson theorem, which is one of the important theorems of the HOS model. This theorem states that a rise in the price of a product will increase the real wage of the factor used intensively in the sector and decrease the real wage of the other factor.

Fig. 2.9 Widening wage inequality in the HOS model



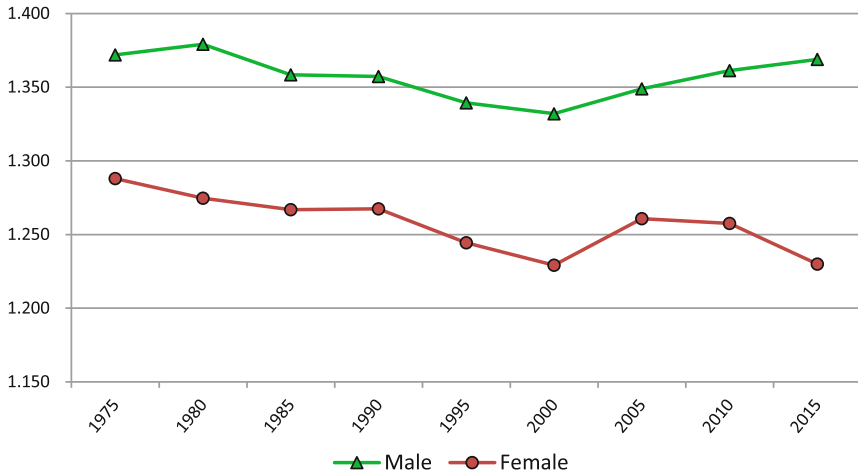


Fig. 2.10 Relative wages of nonproduction workers with age distribution fixed at 1990 in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

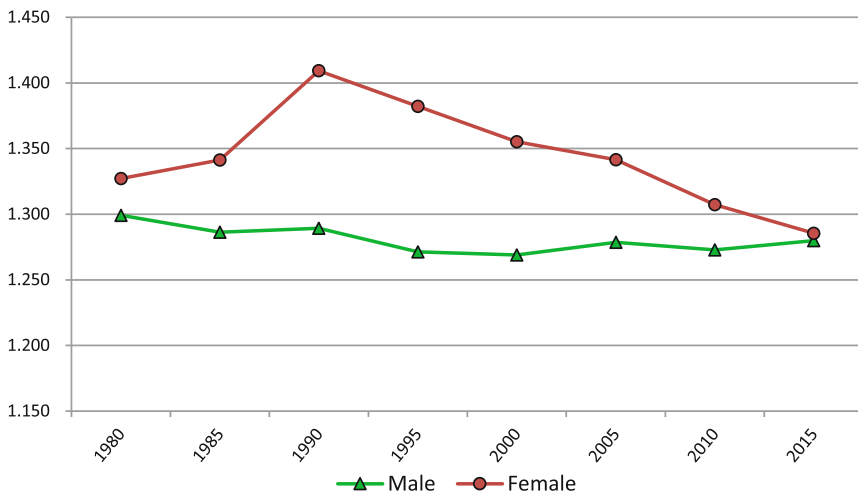


Fig. 2.11 Relative wages of college to high school graduates with age distribution fixed at 1990 in manufacturing. *Note* Wages are scheduled cash earnings. *Source* Ministry of Health, Labour and Welfare, “Basic Survey on Wage Structure”

These changes in the labor market are illustrated in Fig. 2.9b. When a unit-value isoquant curve of goods X shifts outward ($XX \rightarrow X'X'$) due to a drop in its international price, an equilibrium relative wage of skilled labor to unskilled labor increases in Japan’s labor market. If we assume here that skilled labor and unskilled

labor are substitutes, the relative employment of skilled labor to unskilled labor will decrease due to the substitution effect under the condition that supply of skilled labor is fixed. However, as shown in Figs. 2.2 and 2.4, the relative employment of skilled labor increased in reality. This means that the supply of skilled labor actually increased, which is not assumed in Fig. 2.9b.

When we apply the HOS model to the actual economy, it should be noted that two countries are assumed to have the same technology, which may not be very realistic, and that the actual economy is not necessarily in a static equilibrium. For example, if labor cannot move from X industry to Y industry, which often happens in the real world, the production point would shift from O_1 to O_3 and stay there, leading to lower economic welfare in terms of consumption levels, as illustrated in Fig. 2.9c.¹⁰

However, the HOS model provides a useful theoretical framework in which we can analyze how increasing international trade with developing countries, whose factor endowments are different from Japan, causes a relative demand shift toward skilled labor in Japan. Based on this theory, Chaps. 3 and 4 analyze statistically the effect of increased trade on employment and wages in Japanese manufacturing industries.

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¹⁰This case corresponds to the so-called “hollowing of industries.” This tends to happen in rural areas in Japan where labor mobility is low.

Trade and the Labor Market

Effect on Wage Inequality in Japan

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