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Chapter Author: Gail Honda

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7 Differential Structure, Differential Health: Industrialization in Japan, 1868–1940

Gail Honda

7.1 Introduction

The most arresting characteristics of Japan's industrialization through the mid-twentieth century are its strongly military character and the development of a differential structure between traditional and modern sectors. The beginning of Japan's modern economic growth is often associated with the Meiji Ishin, a political, social, and economic upheaval that took place over several decades in the late nineteenth century. During this time, the *bakuhau* regime, which had been in power since 1600, was overthrown in numerous coups d'état. In its place, a government was created in 1868 that restored authority to the emperor.¹ In order to stave off the encroaching colonization they observed around them in Asia, the new leaders concentrated their efforts on building a "rich country and strong army" (*fukoku kyōhei*). To this end they promulgated a constitution in 1889 that granted power to the bureaucracy and military, established compulsory education and conscription, and promoted industry by importing technology and scientific knowledge from the West.

During the initial decades of the Meiji period (1868–1926) the government established a national banking system and standardized currency issued by the central Bank of Japan. The development of extensive sea transportation and railroad networks followed, which facilitated the integration of national markets. The financial and transportation infrastructure speeded the expansion of the mining and textile industries, as the government sold its initial interests in technology imported from Europe and the United States to private concerns.

Gail Honda is director of the Program in Applied Quantitative Research and a research associate of the Department of Sociology at the University of Chicago.

This paper is dedicated to the memory of Ted Shay, who was a Ph.D. candidate in the Department of Economics at Harvard University when he passed away in 1989.

1. Meiji is the name of the emperor at the time, hence the name Meiji Ishin, which can be translated as Meiji Restoration.

Then the boom of World War I ushered in a period of increased production, a rise in employment in secondary industries, and the development of heavy and chemical industries spurred by the harnessing and generation of electric power. Japan's industrial activities were largely concentrated in a narrow urban belt extending from Tōkyō on the eastern half of the main island of Honshū, through Nagoya and Ōsaka in western Honshū, to Fukuoka in the northern section of Kyūshū.

By 1940 Japan had built a colonial empire that included Taiwan, Korea, and Manchuria, and an economic infrastructure large enough to wage serious war with the Western allies and extend its control through north China, Burma, Indonesia, the Philippines, and the Solomon Islands. Japan's imperialist drive through Asia began in the Meiji period with the Taiwan expedition in 1874 and ended with the staggering blows that the United States dealt Japan finally to end the Pacific War. For all the excitement generated during the Meiji period over building a new state founded on principles of civilization, enlightenment, and human rights, for all the effort channeled into creating a new kind of emperor—a spiritual and timeless head of a divine people united by a pure and native soul—for all the capital, financial and human, invested in the drive to industrialize, Japan's modern economic growth led not to a liberal democratic society but to an unfree people governed by an expansionist military regime and ruled by an absolutist imperial system.

Closely linked to military expansion was the development of large-scale industry in communication, transportation, banking, trade, arms, chemicals, and metallurgy. Many of these industries were the cornerstones of enormous conglomerates (*zaibatsu*) such as Sumitomo (Bank, Metals, Rubber, Construction) and Mitsubishi (Bank, Heavy Industries, Motor, Petrochemical, and Trading). Because these industries served the needs of the state, powerful bureaucracies—Ministry of Posts and Telecommunications, Ministry of Munitions, Ministry of Transportation—were established to facilitate financing and manage output to meet national goals. Capital investment in plant and facilities, research and development, and rationalization of operations greatly boosted the productivity of these so-called modern industries relative to agriculture and traditional or small-scale industries. Real wage differentials between employees of the modern sector and those of the agricultural and traditional sectors reflected the productivity differentials. The industrial boom of World War I and the ensuing agricultural depression of the 1920s created a skilled labor shortage in the modern sector and excess labor in the traditional, which further widened productivity and real wage differentials. In addition, monopolistic positions held by the *zaibatsu* enabled them to take advantage of lower wages by subcontracting work to small-scale firms. By the mid-1930s the widening differentials in productivity and real wages between the modern and traditional sectors (hereafter referred to as the “differential structure”) had become a pronounced characteristic of the Japanese economy, to the detriment of agriculture and the traditional sector.

The purpose of this paper is to examine the effects of militarization and formation of the differential structure on the health and well-being of the Japanese people during the period of industrialization from the *Meiji Ishin* through the Pacific War. The hypotheses driving the analysis are (1) investment in the military diverted funds that would otherwise have gone into improving the health of the people, such as investment in social welfare, public health technology, and sanitation, which resulted in poorer health, and (2) just as real wages reflected the gaps in technology between the modern and traditional sectors, so gaps in measures of health—nutritional status, mortality, and fertility—reflected gaps in real wages, leading to the formation of a differential structure in health.

The remainder of the paper proceeds as follows: section 7.2 discusses the health and welfare of the Japanese people before industrialization; section 7.3 introduces the foundation of modern economic growth and its attendant wars and epidemics; section 7.4 looks at the relationship between industrialization and nutritional status with respect to stature, diet and nutrition, and child growth; section 7.5 analyzes differential health; and section 7.6 concludes with a discussion of the results in the light of the proposed hypotheses.

7.2 Health and Welfare before Industrialization, 1600–1868

7.2.1 *Bakuhan* Political Economy

Though the first power looms that arrived from England in the 1880s might be interpreted as the seeds of Japan's industrial revolution, factors that eased the transition from an agricultural to an industrial society had long been developing during the Tokugawa period (1600–1868).² The *bakuhan* government in power during the Tokugawa period was characterized by a decentralized system of roughly 150 feudal lords (*daimyō*) who controlled their respective fiefs (*han*), collected taxes from the peasants residing in their domains, and paid them to the military seat of power (*bakufu*). In turn, to offset the autonomy granted to the *daimyō* and to minimize risk of collusion among them, the *bakufu* required them to reside for six months out of the year in the capital city of Edo (now Tōkyō) and often kept their families there as hostages. Accompanied by an entourage of servants, vassals, and flagbearers (the greater the entourage, the greater the perceived status), the *daimyō*, in their conspicuous consumption during the biannual treks to and from their *han*, contributed to the development of a mobile population and sophisticated commercial economy by the mid-nineteenth century.

Ogyū Sorai (1666–1728), counsel to the *bakufu* and arguably the most influential intellectual of the eighteenth century, caustically observed that the

2. This period is named after Tokugawa Ieyasu, the legendary warrior who subdued his rivals and unified the entire country in 1600.

constant transit of the *daimyō* was turning the entire samurai class into permanent hotel guests, so that “even a single chopstick had to be paid for.”³ The inns, restaurants, teahouses, and shops selling provisions that sprang up along the well-trodden routes leading to Edo were run or financed by the merchants, considered the lowest of all four classes (samurai-farmer-artisan-merchant) because of their association with money and profit. Moreover, since samurai lived on fixed stipends decreed by the *bakufu* they could afford their extravagant lifestyles only by incurring large debts with the merchant class. Thus, though merchants were ostensibly at the bottom of the social ladder, they in fact held the greatest economic power, fostered close ties with the *bakufu*, and were extremely sophisticated in their thinking on monetary and fiscal policy.⁴

7.2.2 Capital Formation

It was the Tokugawa peasants, however, who created the capital surplus that enabled the Meiji government to self-finance the initial steps of industrialization and infrastructure development.⁵ Increased productivity and development of arable land led to a rise in agricultural output during this period, while periodic famine, increasing age at marriage, and decreasing marital fertility stemmed population growth.⁶ This led to a rise in per capita agricultural output from around 1720 through the mid-nineteenth century. Changes in population growth, area of arable land, grain output, and corresponding per capita figures are given in table 7.1.

The numbers show rapid population growth from 1600 to 1720, then very little through 1850. Grain output, on the other hand, grew by 50 percent during the period of no population growth. This meant an increase of about 40 percent in per capita grain output during the latter half of the Tokugawa period. Due to the scattered nature of economic data from the Tokugawa period, no GDP figures exist. However, grain output serves as a reasonable proxy for demonstrating growth trends in GDP. This is because grain production accounted for at least two-thirds of agricultural production, which in turn occupied at least 80 percent of the labor force. Moreover, rice was the standard currency of exchange in which wages and taxes were paid.

If per capita grain output (GDP) was increasing, did this lead to an improved standard of living for the Tokugawa population? The evidence for the answer to this question is even sketchier, but the overall conclusion appears to be that

3. For more of Ogyū's incisive comments on Tokugawa economy and society, see Maruyama (1974).

4. For an exposition of the critical role Tokugawa merchants played in laying the intellectual foundations of the country's political economy, see Najita (1987).

5. For an international comparison of the “legacy of seclusion” that resulted in levels of capital adequate for self-financed industrialization, see Rosovsky (1961, 55–104).

6. For an analysis of age at marriage, see Hayami (1968, 1978). A synopsis of why marital fertility decreased can be found in Saitō (1992a). The discrepancy between agricultural output and population growth and its contribution to economic growth is discussed in Hanley and Yamamura (1977).

Table 7.1 Changes in Various Economic Measures, 1600–1872

Period	Population (<i>N</i>)	Arable Land (<i>R</i>)	Grain Output (<i>Y</i>)	<i>R/N</i>	<i>Y/N</i>	<i>Y/R</i>
1600	12,000	2,065	19,731	0.1721	1.644	9.55
1650	17,180	2,354	23,133	0.1370	1.346	9.83
1700	27,690	2,841	30,630	0.1026	1.106	10.78
1720	31,280	2,927	32,034	0.0936	1.024	10.94
1730	32,080	2,971	32,736	0.0926	1.020	11.02
1750	31,100	2,991	34,140	0.0962	1.098	11.41
1800	30,650	3,032	37,650	0.0989	1.228	12.42
1850	32,280	3,170	41,160	0.0982	1.275	12.98
1872	33,110	3,234	46,812	0.0977	1.414	14.47

Source: Hayami and Miyamoto (1988).

Note: Units are *N* in 1,000; *R* in 1,000 *chō* (1 *chō* = 2.45 acres); *Y* in 1,000 *koku* (1 *koku* = 180 liters).

if one “survived” abortion, infanticide, epidemics, and famine, one could enjoy a reasonably favorable standard of living. Stories of abortion and infanticide are legion, though quantitative evidence indicates that these forms of birth control were not used primarily to reduce family size in times of poverty, but were practiced by rich and poor alike as a form of family planning.⁷ Also, while per capita grain output was increasing on a countrywide level, these numbers do not take into account regional and intervillage differences in yield and climate. Occasional crop failures and cold, wet climatic conditions led to periodic famines and outbreaks of infectious diseases that razed certain village populations and held the country’s population growth in check (see Jannetta 1992).

7.2.3 Self-Help and Community Aid as Social Welfare

Periodic surges in mortality due to subsistence crises, when per capita surpluses in grain were increasing, suggest that the *bakuhau* government failed to effect an efficient countrywide food distribution system and adequate welfare measures for those in need. In keeping with Confucian ethics, which emphasize diligence and thrift, relief for the destitute took the form of assisting only victims of disaster and those physically unable to work. Also, the Confucian hierarchy of human relationships stressed the benevolent rule of the *daimyō* over his subjects and called for a more personal rather than institutional form of aid. In the farm villages in times of crop failure, richer neighbors and relatives were called upon to help their poorer counterparts. In the cities, poor-

7. This was the startling finding in Smith (1977). Smith writes, “Large landholders practiced it as well as small, and registered births were as numerous in bad as in good growing years. Also, infanticide seems to have been used to control the sex sequence and spacing of births and the sexual composition and final size of families. In short, it gives the impression of a kind of family planning” (147).

houses and workhouses were established to feed and shelter vagrants, but their main purpose was to get able-bodied vagabonds back to work again through training programs and moral suasion. This is in contrast to England and Germany, which had more institutionalized and ongoing forms of welfare.⁸

In theory, the purpose of government should be the economic well-being of society, according to Dazai Shundai (1680–1747), a leading figure in Tokugawa intellectual and political circles. Specifically, he defined political economy as *keisei saimin*, which means “gauging actual economic conditions and rendering aid to the people for general social order and well-being.” Economic well-being and the accumulation of wealth would be effected through trade among various sectors and at all levels of society. The role of government, then, would be to manage (*keiei*) from above in order to ensure optimal conditions for trade and wealth accumulation. The enduring legacy of Dazai’s theories can be observed in Japanese political economy today: its “managed economy,” trade surpluses, and the modern Japanese word for economics, *keizai*, an elision of *keisei saimin*.⁹

Government aid in Dazai’s sense could thus be described as encouraging self-sufficiency and intersocietal trade. Most commoners organized themselves into communal associations called *kō* that arranged loans, mutual assistance in times of emergency, and life and health insurance among other forms of aid for its members. The ubiquitous nature of *kō* and the degree to which people relied on them rather than the state are evident in the observation that every single village in Japan has at least one *kō*. One government survey in the late nineteenth century put the number of *kō* in Japan at around 350,000.¹⁰ Thus, in the absence of statewide provisions for social welfare, commoners created their own forms of insurance and credit at the local level. The existence of periodic famines and epidemics does not mean that *kō* and stopgap forms of assistance were ineffectual; only that they had their limits in reducing mortality in times of disaster.

7.2.4 Longevity and Nutritional Status

Nevertheless, those who survived enjoyed relatively long and healthy lives. Life expectancy at birth as shown in table 7.2 varied widely over place and time but was comparable to, if not better than, life expectancy in England and Wales during the same period. This evidence refutes the long-held view of preindustrial Japan as a backward, impoverished society of starving people dying early and killing their newborn to limit family size. Life expectancy in Tokugawa Japan was bolstered by the absence of war and relative lack of pestilence. Whereas much of preindustrial Europe was ravaged by bloody military campaigns, there were no wars in Japan from 1600 through the mid-nineteenth

8. This discussion of Japanese and Western welfare measures is from an exposition by Garon (1994).

9. For the theoretical underpinnings of Japan’s political economy in the thought of Dazai Shundai, see Najita (1972).

10. For the intellectual origins and various manifestations of *kō*, see Najita (1988).

Table 7.2 Life Expectancy at Birth in Japan and in England and Wales, 1700–1854

Japan		England and Wales			
Period	Region	Male	Female	Period	Both Sexes
1700–1824	Chikuzen	44.7	43.3	1700–1725	35.1
1716–1872	Iwashiro	37.8	38.6		
1717–1830	Mino	43.2	43.2		
1720–1870	Iwashiro	37.7	36.4	1725–50	33.8
1773–1830	Mino	38.6	39.1		
1776–1875	Hida	32.3	32.0	1750–75	36.3
1782–96	Mikawa	34.9	55.0		
1800–1835	Bizen	41.1	44.9	1775–1800	37.0
1812–15	Shinano	36.8	36.5		
1819–54	Echizen	26.3	24.1		

Sources: Japan, Saitō (1992b); England and Wales, Fogel (1986).

Note: For England and Wales, life expectancy is for both sexes by birth cohort.

century. Also, although almost everyone in Tokugawa Japan contracted smallpox and some succumbed to measles and dysentery, the major killer diseases in premodern Europe—plague and typhus—did not appear in Japan before industrialization.¹¹

When major famines did strike, the famine mortality rates were higher for males than they were for females. This phenomenon in which females exhibit greater resistance than males under conditions of environmental stress has been observed and documented in many studies from Bengal to Greece, during famines and during wartime. It may be attributable to the larger stores of body fat in women (see Jannetta 1992, 437; Eveleth and Tanner 1990, 200). Of the three major famines in the Tokugawa period—the Kyōhō famine (1722–33), the Tenmei famine (1783–87), and the Tenpō famine (1833–37)—the Tenmei famine was the most severe in terms of population loss and recovery time. The relatively short period of data available for the Mikawa sample in Japan shown in table 7.2, and the coincidence of the data years with the Tenmei famine, may account for most of the large difference in life expectancy between males and females. To a lesser extent the Bizen sample also exhibits a sex difference, which may be attributed to the effect of the Tenpō famine. Differences in estimated life expectancy among samples in table 7.2 may arise not only from actual regional differences but also from differences in the kinds of data sources.¹²

11. This is probably due to Japan's geographic isolation and very limited contact with foreign cultures. Trade was restricted to a single port at the southern tip of the island of Kyūshū for 250 years. See Jannetta (1987).

12. Buddhist temple registers (*kakochō*), from which the Chikuzen and Hida data are taken, record all deaths, infant as well as adult. Population registers (*shūmon aratame chō*), from which all other data in table 7.2 were retrieved, record only those who survived from birth to the subsequent compilation. See Jannetta and Preston (1991, 419–20) and Cornell and Hayami (1986, 321).

Table 7.3 Estimation of Height Based on Length of Right Femur 600 B.C. to A.D. 1900

Name	Period Years	Female		Male	
		<i>N</i>	Mean (m)	<i>N</i>	Mean (m)
Jōmon	600–200 B.C.	9	1.480	11	1.591
Yayoi	200 B.C. to A.D. 250	14	1.505	12	1.614
Kofun/Nara/Heian	250–1185	9	1.515	22	1.631
Kamakura	1185–1333	5	1.449	17	1.590
Muromachi/Momoyama	1333–1600	17	1.466	26	1.568
Tokugawa	1600–1868	45	1.456	95	1.571
Early Meiji	1868–1900	43	1.448	43	1.553

Source: Hiramoto (1972).

The nutritional status of Tokugawa society also appears to have been fairly high and above subsistence level. Engel's coefficient for food has been estimated at 0.6–0.8, but income elasticity for food was in the 0.3–0.4 range as additional income was spent not on more or better food, but on entertainment, travel, and capital investments.¹³ Diet seems to have been nutritious though low in animal protein and showed little variation across income levels and over time. It consisted primarily of rice—usually mixed with other grains like barley, millet, and buckwheat—which was served at every meal. Supplementing the grains would be soybean products like tofu or miso (soybean paste), greens and root vegetables, pickled condiments, and dried seafood products. One of the standard measures of nutritional status, height, has been estimated for the Tokugawa period based on measurements of the maximum length of the right femur. These estimates are given in table 7.3 along with those for the other major periods in Japanese history dating back to 600 B.C.

The Tokugawa bone samples were dug up at a construction site in Tōkyō proper and are thought to be from commoners' graves. Bone samples from the early Meiji period were also unearthed from within Tōkyō proper and are thought to be those of common laborers who died from illness or execution. Thus, the two samples may be considered comparable with respect to socio-economic class. Since anyone in Japan who could afford a proper funeral and burial would have been cremated, it is safe to assume that both samples are from the remains of the poor or indigent. Although the sample sizes are small, these estimates show that the average Tokugawa female was almost 1 cm taller than her early Meiji counterpart; the Tokugawa male nearly 2 cm taller than his. With 95 percent confidence intervals of 4 cm, these numbers must be used with caution. Nevertheless, they suggest at least that, among the lower socio-

13. This is based on an analysis of budgets for a Tokugawa carpenter, farmer, and samurai in Hanley (1983).

economic classes, Japanese nutritional status during the Tokugawa period was no worse than that during the period of early industrialization.

7.2.5 Summary: Tokugawa Health and Welfare

The health and welfare of the Japanese people during the 250 years prior to industrialization were good relative to that of the population of contemporary Europe and early industrial Japan. Population size held steady from 1720 to 1872 at about 32 million due to a combination of increasing age at marriage, lower marital fertility rates, use of birth control, occasional crises of subsistence, and outbreaks of infectious diseases. Improved agricultural technology and better land development resulted in rising per capita grain output. A proxy for per capita GDP, it increased 40 percent over the same period, which suggests an increasing standard of living.

The effect of government policy that had as its goal the economic well-being of the people and of a welfare system that stressed self-help and communal assistance over institutional forms of aid is more difficult to measure. During times of the most severe famine, there were significant crises of subsistence and surges in mortality. This is evidence of a flawed distribution system and a sign that perhaps more institutional forms of welfare were needed. Nevertheless, Tokugawa commoners managed to provide insurance and loans and other forms of aid to one another through communal *kō*, in times both good and bad.

There were no epidemics on the scale witnessed in premodern Europe and in Japan during the later period of industrialization. In addition, there were no wars in Japan from 1600 until the mid-nineteenth century. This relative absence of calamitous events resulted in a life expectancy at birth that varied widely with time and place but was comparable to, if not better than, life expectancy in eighteenth- and nineteenth-century England and Wales. The Japanese diet, virtually unchanged until the mid-twentieth century, was nutritious. The low income elasticity for food suggests that more income did not mean people bought more or better food. Estimates of the average height of Tokugawa commoners show that their nutritional status was no worse, and perhaps better, than that of commoners in the early period of industrialization that followed.

7.3 Foundations of Modern Economic Growth

7.3.1 Building a Rich Country and Strong Army

Meiji Ishin is the name given to the political, economic, and social revolution waged by self-proclaimed emperor loyalists (*shishi*) who overthrew military (*shōgun*) rule in the name of Emperor Meiji. The new government officials opened Japan's ports to foreign trade and engaged in cultural exchange after more than 250 years of seclusion from the rest of the world. Those who embarked on diplomatic missions to the West were amazed by the scientific and industrial achievements of Great Britain, Germany, and the United States. Us-

ing Western models gleaned from abroad, Meiji state architects instituted national conscription, compulsory elementary education, and land tax reform. Japan was set on a rapid course of industrialization and economic expansion in a quest to build a “rich country and strong army” (*fukoku kyōhei*) and maintain national independence.

The four pillars of the *shokusan kōgyō* (“increase production, promote enterprise”) policy set forth in the 1870s were (1) establishment of a national banking system, (2) development of transportation and communication networks, (3) creation and subsequent sale of public sector factories, and (4) loans to private firms. The *han* system of *daimyō* rule was dismantled and the prefectural system established. Many reforms were enacted which liberalized social relationships and economic transactions. The class system (samurai-farmer-artisan-merchant) was abolished, and restrictions on occupational mobility and buying and selling of land were lifted. Japan became, by all appearances, a modern state.

Beneath the facade of a budding liberal democratic society, however, lay the foundations of an absolutist military regime unwilling to relinquish power to the people. The parliament (Diet), which opened in 1890, was originally voted in only by those who could afford the high price of a ballot, that is, wealthy industrialists and landlords. The military character of and impetus to economic growth remained a constant force from its well-intentioned origins to the insidious takeover of the economy in the 1930s. With state-run arms production a major industry, one of the greatest stimulants to economic growth during the early period of industrialization was war: the Sino-Japanese War (1894–95) and the Russo-Japanese War (1904–5). Though Japan was not a direct participant, World War I (1914–18) was a boon to exports as Japan supplied markets normally served by European countries then occupied with the war. Indeed, growth rates of GNP rose to 4–7 percent in the late 1890s, 11 percent in 1904, and 6–9 percent during World War I (calculated from Ohkawa et al. 1974).

Overall, the Japanese growth rate from 1868 to 1940 is estimated at somewhere between 3 and 4 percent. During the Meiji period (1868–1912), new monetary and national banking systems were developed, and the foundations of modern industry established. Once sea and rail transportation networks were in place, coal and metal mining developed to the extent that copper was Japan's fifth most important export in 1900. The textile industries, notably silk reeling and cotton spinning, followed mining to become a leading component of Japan's exports. World War I ushered in the boom age of heavy industries such as chemicals, metals, and machinery, fueled by newly harnessed electric power. Then the economy suffered a number of blows: namely, the panic of 1920, the agricultural depression of the 1920s, the great Kantō earthquake of 1923, the financial panic of 1927, and the downturn of the 1930s due to the worldwide depression. By 1940, the War with China had broken out, and the Japanese were on the verge of war with the United States. The final decade of

Table 7.4 **Employed Population by Sector, 1872–1940**

Year	Primary	Secondary	Tertiary	Unclassified	Total
1872	15,525 (72.6)	n.a.	5,846 (27.4)	n.a.	21,371 (100)
1885	15,654 (70.1)	n.a.	6,685 (29.9)	n.a.	22,339 (100)
1890	15,637 (67.8)	n.a.	7,405 (32.2)	n.a.	23,042 (100)
1895	15,482 (65.3)	n.a.	8,242 (34.7)	n.a.	23,724 (100)
1900	15,853 (65.0)	n.a.	8,525 (35.0)	n.a.	24,378 (100)
1905	16,707 (69.5)	3,729 (15.5)	3,618 (15.0)	1,007 (0)	25,061 (100)
1910	16,383 (67.1)	4,089 (16.8)	3,943 (16.1)	1,060 (0)	25,475 (100)
1915	14,615 (62.5)	4,884 (19.5)	4,501 (18.0)	1,305 (0)	26,305 (100)
1920	14,388 (55.3)	6,274 (24.1)	5,355 (20.6)	1,243 (0)	27,260 (100)
1925	14,056 (52.4)	6,324 (23.6)	6,432 (24.0)	1,293 (0)	28,105 (100)
1930	14,648 (52.1)	6,151 (21.0)	7,331 (26.1)	1,488 (0)	29,619 (100)
1935	14,450 (48.7)	6,811 (23.0)	8,410 (28.3)	1,540 (0)	31,211 (100)
1940	14,523 (47.7)	8,212 (27.0)	7,728 (25.3)	2,037 (0)	32,500 (100)

Source: Nakamura (1983, 21).

Note: Population in thousands (by percentage in parentheses). Primary sector = agriculture, forestry, and fisheries. Secondary sector = mining, manufacturing, and construction. Tertiary sector = transportation, communication, utilities, commerce, services, and public administration.

the period was characterized by heavy industrialization to support the military.¹⁴

The changing composition of the economy as indicated by labor force participation in various sectors is shown in table 7.4. The percentage engaged in the primary sector declined by one-third, from 73 percent to 48 percent. Losses in the primary sector beginning in the early twentieth century fed directly into the other two sectors, both of which showed steady increases until 1940. The percentage of the total population attributed to the secondary sector nearly doubled from 15 percent to 27 percent between 1905 and 1940. Most of the increase occurred in manufacturing. Commercial activities, followed by com-

14. For more detailed analyses of the Japanese prewar economy, see Nakamura (1983) or Ohkawa and Rosovsky (1973).

Table 7.5 Growth of Japanese Urban Population, 1891–1940

Year	Urban Population (thousands)	Total Population (thousands)	Percentage Urban ^a
1891	3,812	40,719	9.36
1898	5,518	43,764	12.61
1903	6,748	46,732	14.44
1908	8,227	49,589	16.60
1913	8,920	53,363	16.71
1920	10,020	55,963	17.90
1925	12,823	59,737	21.47
1930	15,363	64,450	23.84
1935	22,582	69,254	32.61
1940	27,494	73,114	37.60

Source: Wilkinson (1965, 45).

^aUrban = population in incorporated cities (*shi*).

munications and transportation, accounted for most of the increase in the tertiary sector. The initial high percentage of tertiary workers in the nineteenth century is attributed to the large portion of the population engaged in traditional services such as domestic servitude, entertainment, retail trade, and small commercial proprietorships.

The transition of Japan from a largely agricultural society to one in which over half of the population was engaged in nonagricultural activities was accompanied by a redistribution of the labor force from rural to urban areas. The absolute and proportionate growth of the population in incorporated cities (*shi*) from 1891 to 1940 is shown in table 7.5. From 1891 to 1940, the percentage of Japan's total population living in cities of 20,000 or more jumped from 9.4 percent to 37.6 percent. In other words, in 50 years, the proportion of the population living in cities of 20,000 or more went from less than one-tenth to over one-third. Comparable increases in the percentages of urban population took 80 years (1780–1860) in England and Wales and 75 years (1850–1925) in the United States (Wilkinson 1965, 37).

The rapid urbanization witnessed in Japan was initially spurred by the sudden opening of the country to the rest of the world in the late nineteenth century and the expansion of international trade. Though there were well over 400 incorporated cities by 1920, six great metropolitan centers accounted for one-half to two-thirds of the urban population of the prewar period. Of these six—Tōkyō, Yokohama, Nagoya, Ōsaka, Kōbe, and Kyōtō—only Kyōtō, the ancient capital and cultural center of Japan, was not a major port city or closely associated with an export center. The later wave of urbanization in the 1930s resulted from the agricultural depression of the 1920s and the collapse of the silk market due to the worldwide depression in the 1930s. Displaced laborers flocked

Table 7.6 Estimated Literacy Rates for Various Groups, 1897–1941

Year	Sample Population	Estimated Percentage Literate
1897	Ōsaka factory workers	21.5
1902	Ōsaka conscripts	53.1
1907	Ōsaka conscripts	66.1
1912	Ōsaka conscripts	74.8
1925	All conscripts	88.7
1933	All conscripts	95.8
1941	All conscripts	98.5

Source: Taira (1971, 378–81).

Note: Percentage of sample with at least a lower elementary school education (four years of school, six years from 1907 on) used as proxy for literacy. The 1897 sample = factory workers in Ōsaka; 1902–12 sample = conscripts in Ōsaka; 1925–41 sample = conscripts in all of Japan.

to the major industrial centers for jobs in the burgeoning military industries of chemicals, oil, shipbuilding, and munitions (Wilkinson 1965, 44–50).

The use of increasingly sophisticated technology in Japan's science-based industries and the growth of white-collar service industries in the early twentieth century required a trained, disciplined, and literate workforce. National compulsory education of four years (increased to six years in 1907) was promulgated in 1872, though several decades elapsed before virtual universal education was achieved. In 1873 the elementary school enrollment rate for both boys and girls was reported to be 28.1 percent. By 1883 it was 51.0 percent, and not until 1910 was 98 percent enrollment reported. Precise figures on literacy can at best be roughly estimated for the prewar period because of the difficulty in defining literacy for the Japanese population. While the ability to sign one's name is often interpreted as an indication of literacy in Western countries, knowledge of at least 2,000 Chinese characters in addition to two 50-character alphabets is required for functional literacy in the Japanese language.¹⁵ Moreover, enrollment in elementary school is not equivalent to completion and certainly not to literacy. For example, the 98 percent enrollment rate in 1910 disguises the estimated elementary school completion rate among those in employable age brackets at the time: 40.6 percent of males and 22.6 percent of females (Ohkawa 1968, 136).

Table 7.6 is a compilation of some of the best estimates of literacy rates for the prewar period. Rates of completion of elementary school were used as a proxy because it was assumed that four to five years of schooling were necessary for minimum literacy, and six for functional literacy, "the ability to read,

15. Excellent analyses and discussions of this topic can be found in Taira (1971) and Japan National Commission for UNESCO (1966).

write, and reckon intelligently for one's own practical needs" (Taira 1971, 376–77). The 1897 estimate is from a study of Ōsaka factory workers in cotton spinning; weaving; manufacture of glass, tiles, matches, brushes, blinds, or machinery; shipbuilding; clock and watchmaking, chemical and drug production, and printing. Although the overall percentage of graduates is 21.5, there was much variation among the groups. For example, only 9.8 percent of male workers in glass and tile manufacturing completed elementary education, as compared to 78.7 percent of male workers in printing. The figures for 1902, 1907, and 1912 were taken from military conscript records from the prefecture of Ōsaka, which might be expected to be higher than the national average because of the prefecture's high urban concentration. Indeed, urban conscripts of Ōsaka had a literacy rate of 87 percent; rural conscripts 70 percent (Taira 1971, 379). It was not until the 1920s that near universal literacy as envisioned by nineteenth-century architects of the Japanese modern state was attained.¹⁶

Thus, in labor force composition, urbanization, and literacy, Japan had by 1940 attained levels characteristic of a modern state. The composition of the labor force was significantly altered as the percentage of the population in agriculture dropped from 75 to 50. The modern industries of the secondary sector included mining and textiles initially, followed by the heavy industries of machinery, metal, oil, and chemicals. The modern industries of the tertiary sector, which accounted for 25 percent of the labor force in 1940, were primarily banking and finance, transportation, and commercial trade. To accommodate the growing nonagricultural workforce, the urban population of Japan went from less than 10 percent of the total population in the late nineteenth century to nearly 40 percent in 50 years, a phenomenon that required 80 years in England and Wales and 75 in the United States at comparables stages of industrialization. The increasing sophistication of modern industries in manufacturing and services required a disciplined and literate workforce. Literacy rates, estimated by rates of completion of four to six years of elementary school, suggest that by the eve of the Pacific War near universal literacy in Japan had been achieved. Industrialization, however, also ushered in a new era of health and welfare for the Japanese population, one that introduced new diseases and stratified society into various levels of physical well-being.

7.3.2 The Age of Epidemics

As discussed in section 7.2, no wars were fought during the Tokugawa period until the mid-nineteenth century, when the *bakufu* government was first attacked by disgruntled *han* armies from the southern island of Kyūshū. Life expectancy during the Tokugawa period was also bolstered relative to preindustrial Europe by the absence of plague and typhus, and by the limited spread

16. The 88.7 percent rate for all male conscripts reported for Japan in 1925 surpasses estimated literacy rates in 1990 for China, India, and Indonesia. The rate for Japan when females are included would be less than 88.7 percent.

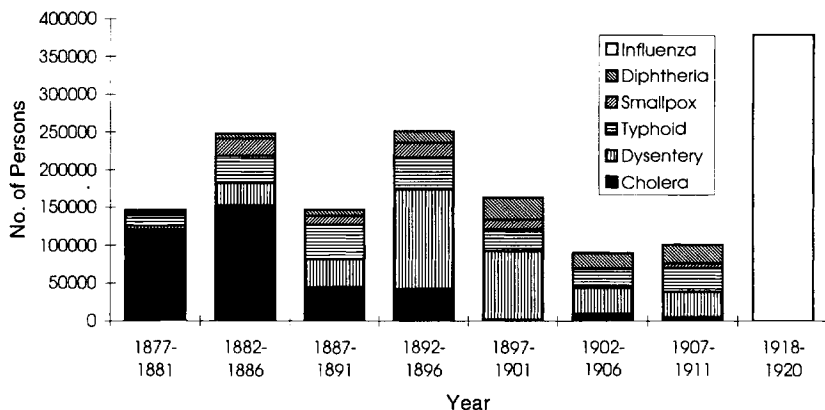


Fig. 7.1 Deaths by infectious diseases, 1877–1920

Sources: 1877–1911 calculated from Itō (1991); 1918–20 from *Kōseishō imu kyoku hen* (1976).

of measles, dysentery, and cholera. In contrast, once ports were opened to trade, early industrializing Japan was swept by wave after wave of cholera, smallpox, dysentery, and Spanish influenza. Figure 7.1 depicts the enormity of epidemic mortality figures of acute infectious diseases.

The worst of the cholera epidemics took place just after Japan opened its ports to foreign trade in the years of turmoil just preceding and during the Meiji Ishin. Many hundreds of thousands died in these initial outbreaks until the Central Sanitary Bureau was able to curb the spread of cholera through isolation of the ill, public education, and sanitation measures. While smallpox was the major killer disease of the Tokugawa period, by the Meiji period smallpox deaths were reduced to several tens of thousands as the result of widespread efforts to vaccinate all children. The influenza epidemic of 1918–20 in Japan killed twice as many people as the great Kantō earthquake of 1923 and was part of the worldwide influenza pandemic that claimed 25–30 million lives.¹⁷

Tuberculosis, while not listed as an epidemic disease, was claiming mortality rates of about 0.16 percent of the population around the turn of the century. This rate was comparable to that of Western Europe. Rates in Western industrial countries declined over the first half of the mid-twentieth century, dropping to well below 0.10 percent by 1940. Japan's tuberculosis mortality rate, however, remained high, fluctuating between a low of 0.18 percent in 1932 and a high of 0.28 percent in 1945 (see Hunter 1993). It was a well-documented killer of young women in textile factories in early industrializing Japan, and one of the leading causes of death throughout the prewar period along with pneumonia and gastrointestinal diseases.

17. For a detailed exposé of the Japanese influenza pandemic, see Rice and Palmer (1993).

War and epidemics have been discussed at some length to delineate prominent exogenous factors that distinguish Japan's preindustrial from its early industrial period. They also have significant bearing on the economy and serve to illustrate the quality and magnitude of the welfare policy that the government enacted to maintain or improve the health of its people. Despite major reforms in economic policy and development instituted by the Meiji government, welfare and health care during this period became only slightly more institutionalized. There was still a heavy reliance on ad hoc measures typical of the Tokugawa period of "mutual fellowship among the people," that is, dependence on the family and community for assistance. The people responded by drawing on the firmly established institution of communal *kō* from the Tokugawa period. Commoners in industrializing Japan—in villages and cities alike—organized themselves into larger insurance and medical co-ops. These were called *mujin kaisha*, literally "unlimited resource companies," and provided loans and other forms of assistance. Unable to rely on the state for health care and welfare, the Japanese people pooled resources among themselves to construct enduring institutions that continue today as important sources of credit in the form of *sōgō ginkō*, or "mutual trust bank."¹⁸

New forms of poverty created by industrialization and urbanization, however, prompted the passage of the Relief Regulations (Jukkyū Kisoku) in 1874, the only institutionalized poor law for 55 years. Though the Relief Regulations were passed in emulation of German social policy and English poor laws, government expenditures in reality were minimal and inconsistent. Medical care for the poor was offered and retracted at will. Moreover, it was largely financed by contributions solicited from the private sector and donated by the imperial household. For all the Home Ministry's rhetoric to promote the health and welfare of the people, it failed to support its words with the necessary capital.¹⁹

7.3.3 Military Expansion at the Expense of Social Welfare

Welfare, health care, epidemics, and war intersect in peculiar ways in early industrializing Japan. First, there appears to be a trade-off between government investment in the military and in social welfare. Following Japan's victory in the Russo-Japanese War, the government in 1908 cut the poor relief budget to finance military expansion. This act was part of an effort to increase Japan's world power by "creating a people who worked selflessly for national prosperity while making few demands on the state." Minimizing relief to the poor fitted in well with the centuries-old exhortation to encourage self-reliance and to use moral suasion to get people back into the productive labor force (Garon 1994, 82). Seen from the government's point of view, to build a "wealthy coun-

18. Najita (1993) brings to light these forms of insurance, health care, and credit in a discussion of commoner participation in and contribution to the industrial revolution.

19. This attitude toward poor relief was not unique to Japan. For a broader discussion of Japanese welfare in historical perspective, see Garon (1994).

try and strong army” the return on investment was far greater in the military sector than in social welfare.

Second, the government invested very little in public health technology so that it could instead boost its burgeoning military-industrial complex. For example, widespread measures were taken to bring cholera epidemics of the late nineteenth century under control, but these measures consisted primarily of vaccination and promoting sanitation through education and propaganda, rather than more capital-intensive efforts such as hospital and sanatorium construction, modern sewer systems, and piped water. Channeling of funds into the military and away from public health may have been a major factor in the failure of Japanese life expectancy to keep up with that of contemporary Western Europe in the first half of the twentieth century (Mosk and Johansson 1986, 430–32).

Finally, with heavy investment in the military, it is not surprising that Japan’s major contribution to public health was in the field of military medicine. In the Sino-Japanese War Japan lost four times as many men to infectious diseases spread in camps as it did to battlefield wounds, a classic historical ratio of causes of death in war. By the Russo-Japanese War a decade later, it had managed to reduce mortality by infectious diseases in the war to one-fourth of all war deaths. This was accomplished through major investments in field hospitals and laboratories, the latest medicine and equipment, first aid handbooks for all soldiers, and a healthy military diet (Johansson and Mosk 1987, 221–22). Japan’s advances in military medicine have been called “the real triumph of Japan” by an American officer, though the praise rings hollow when the diversion of funds from public health and the ensuing costs are considered.

7.4 Industrialization and Nutritional Status

7.4.1 Income and Height

The positive relationship between income and height as a proxy for nutritional status has been documented in many studies. These include both analyses of secular trends and comparisons among socioeconomic groups (see Fogel 1993; Floud, Wachter, and Gregory 1990; Eveleth and Tanner 1990; Steckel 1983). Thus it comes as no surprise that average heights of 20-year-old recruits in Japan increased during industrialization along with per capita GDP. Figure 7.2 captures these trends. From 1892 to 1937 there was a fairly steady increase in height, from 156.1 cm to 160.3 cm, or an average of 0.91 cm per decade.²⁰ As a point of comparison, the average height of 160.3 cm for Japanese recruits attained in the mid-twentieth century was still a good 3–8 cm shorter than

20. Because 20-year-old men in the nineteenth century had several more years of growing left, the increase in heights shown in fig. 7.2 is probably overstated. If adjusted for estimated further growth in nineteenth-century recruits, the increase in height over the period would be 3.3 cm, or an average of 0.7 cm per decade (Shay 1986).

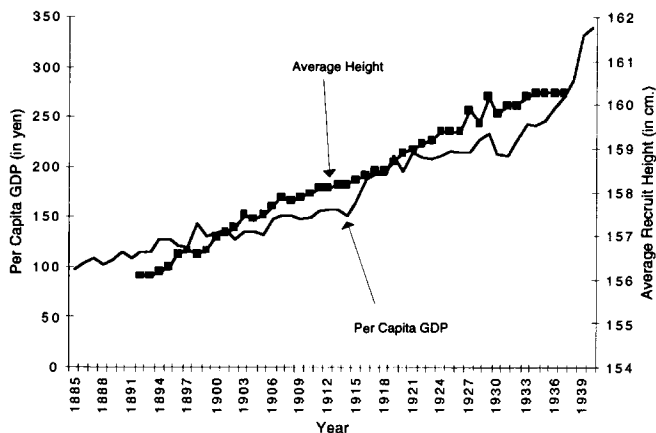


Fig. 7.2 Per capita GDP and average height of 20-year-old military recruits, 1886–1940

Sources: Per capita GDP in 1934–36 prices calculated from Ohkawa et al. (1974, 227) for GDP and Umemura et al. (1988, 169–71) for population. Average recruit height from Shay (1986, appendix).

Note: Year is year of measurement for recruits.

full-grown men in Great Britain, Norway, Sweden, and Hungary in the mid-eighteenth century.²¹

This difference has been largely attributed to the genetic pool, but rapid increases in heights of Japanese men and women born after World War II have narrowed the gap. Interestingly, nearly all of the secular trend is due to an increase in leg length. Thus, although Japanese adult height is still one standard deviation below that of North Europeans, their trunk-leg proportions are more similar (see Tanner et al. 1982). Reasons for the postwar secular increase include better nutrition and greater consumption of animal protein and dairy products, though one study emphasizes urbanization and a decreasing Engel's coefficient over nutrition (Matsumoto 1982).

Increases in height during industrialization through 1937 were uneven, with higher rates of growth (0.4 percent) in 1892–97 and 1917–27, and lower rates of growth (0.1–0.2 percent) in 1907–12 and 1927–37.²² This leveling off of

21. For European comparisons, see Fogel (1994). Body mass index, or BMI = weight/height² (in kg/m²), is another predictor of health but is difficult to obtain unless one has individual height and weight data. These are not available for Japan on a national scale, but another study shows that average BMI for recruits in an agricultural village in Shizuoka prefecture increased from 20 in 1913 to 21.5 in the mid-1930s, then became erratic in wartime with a downward trend from 1937 to 1943. It never rose above 21.5, however, which suggests that early-twentieth-century Japanese recruits were slightly more wasted than American men in 1910, who had an average BMI of 22.6. See Honda (1996) for Japanese recruits, Kim (1993) for American men.

22. This change in height trends in the 1930s has also been observed in microlevel studies of rural Japan, where average height of 20-year-old recruits tended to decrease in the 1930s (see Honda 1995).

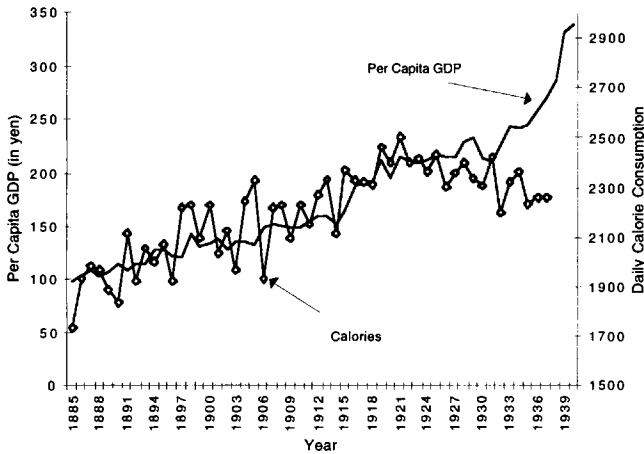


Fig. 7.3 Per capita GDP and daily caloric intake, 1886–1940

Sources: Per capita GDP in 1934–36 prices, as in fig. 7.2. Daily caloric intake from Mosk (1978, 279).

increases in the 1930s might reflect the decline in daily calorie consumption beginning in the early 1920s shown in figure 7.3. The decline is particularly pronounced against the backdrop of rising per capita GDP in the late 1930s due to military expansion. Why this drop occurred is unclear, though, based on the calculations from which the numbers are derived, it may have been due to a change in consumption patterns, a decrease in the total food supply of a particular food used in the calculations, or an increase in the population.²³

7.4.2 Income, Diet, and Nutrition

A closer look at diet composition in table 7.7 reveals that most of the calories lost in the 1930s were from starchy staple consumption.²⁴ These declines were only partially offset by increases in animal protein consumption. Still, grains, noodles, and potatoes accounted for 83.3 percent of the Japanese diet through the mid-twentieth century. An estimated 72 calories per day in animal protein is scant; most of it probably came from fish and other marine products, which have long been a mainstay of the Japanese diet.

With estimated average caloric intake between 2,000 and 2,100 (or according to the graph's estimates, between 2,200 and 2,500) and declining from the 1920s, and with estimated caloric intake for various occupational categories as shown in table 7.8, it is remarkable that heights increased at all during

23. Caloric intake in fig. 7.3 was derived by calculating total nutrients consumed by food type and then dividing through by estimates of total population. Twenty-two food types were used. See the appendix in Mosk (1978).

24. These calorie estimates by Shinohara were derived differently from those shown in fig. 7.3, which were from Mosk (1978). See Kaneda (1970) for an explanation of Shinohara's estimates.

Table 7.7 Daily Calories per Capita by Major Food Group, 1911–35

Years	Starchy Staples (kcal)	Animal Proteins (kcal)	Other (kcal)	Total (kcal)
1911–15	1,765 (86.6)	40 (2.0)	232 (11.4)	2,037 (100.0)
1921–25	1,807 (85.1)	47 (2.2)	269 (12.7)	2,123 (100.0)
1931–35	1,711 (83.3)	72 (3.5)	272 (13.2)	2,055 (100.0)

Source: Kaneda (1970, 409).

Note: Starchy staples include rice, barley, naked barley, other cereals, sweet potatoes, white potatoes, wheat flour, starch, and noodles. Animal proteins include meat, milk, eggs, fish, shellfish, and other marine products. Estimates exclude canned and bottled foods and beverages. Figures in parentheses are percentages of total calories.

Table 7.8 Caloric Intake by Occupational Class, 1926–36

Occupational Class	Caloric Intake (kcal)
Nonfarm household	2,578
Salaried worker	2,506
Laborer	2,614
Farm household	3,265
Owner or owner-tenant	3,279
Tenant	3,233

Source: Saitō (1989, 349).

this period. Small wonder that the final adult height for males in the mid-twentieth century was far below that of Western industrialized countries. Furthermore, it seems that those who required the most energy (farmers) were also the most economically disadvantaged. As will be shown in section 7.5.2, evidence indicates that the combination of lower income and higher energy requirements gave rise to one of the shortest occupational classes in industrializing Japan.

Until the 1920s, however, caloric intake rose along with per capita GDP. This does not mean that Japanese spent more on food as their incomes rose. In fact, income elasticities for food have been estimated at 0.3 or 0.4 from 1878 to 1940, which suggests that despite increasing exposure to Western lifestyles during the first half of the twentieth century, people's food consumption patterns changed very slowly during the prewar period. This also means that as incomes rose, most people still preferred the less expensive starch-based traditional Japanese meals to the more expensive Western-style meat-based fare, though there was certainly some increase in consumption of animal proteins.

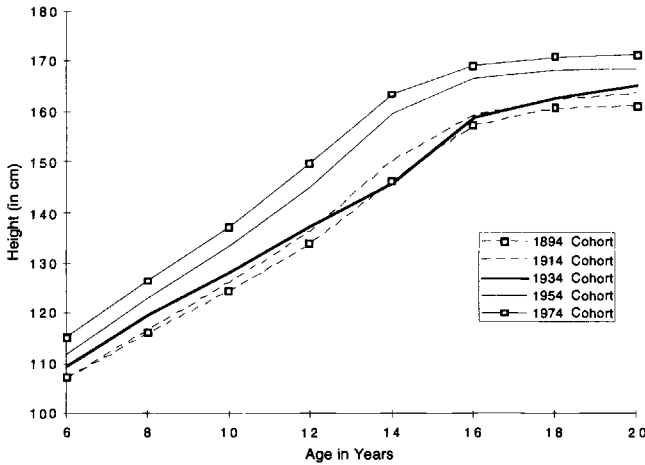


Fig. 7.4 Growth of schoolboys by birth cohort, 1894–1974

Sources: Calculated from Monbushō (1990, 270–71) and Umemura (1988, 14–15).

Another dietary switch that occurred as incomes rose was that from “inferior” starches, such as barley and naked barley, to the highly prized polished white rice (see Kaneda 1970). Consistently low levels of animal protein in the diet may have prevented greater increases in height such as those observed in the postwar period: spurts only came once the dietary habits of the Japanese incorporated greater proportions of meats and dairy products.

7.4.3 Nutritional Status and Growth of Schoolchildren

While final adult height represents one’s nutritional status from birth through age at final height, the tempo of human growth measures one’s physiological maturity at given ages. Two people may have the same final height, but they may mature at different times, depending on genetics, nutrition, and infection. Japanese children tend to mature earlier than European children, though they are on average shorter at full maturity. Acute, episodic malnutrition may temporarily stunt a child’s growth, but full recovery can be expected if malnutrition is not protracted. Infectious diseases can prevent the body from absorbing vital nutrients even though nutrition is adequate, which can also stunt a child’s development.²⁵

The tempo of growth of Japanese schoolboys and schoolgirls is depicted in figures 7.4 and 7.5. The data are taken from annual reports published by the Ministry of Education on the physique and exercise skills of schoolchildren from 1900 through the year of publication. Mandatory education during the prewar years was six years. Thus heights recorded after age 12 are probably

25. This discussion of tempo of growth is from Tanner (1990, chaps. 6 and 9).

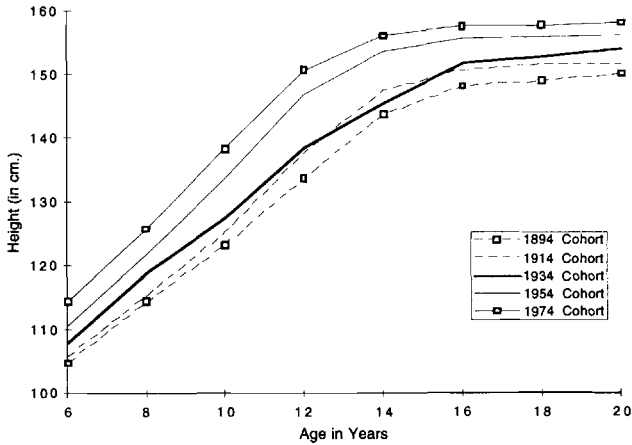


Fig. 7.5 Growth of schoolgirls by birth cohort, 1894–1974

Sources: As in fig. 7.4.

overstating the national average, as those children who could afford to remain in school were more likely to come from higher socioeconomic levels and thus be taller. Enrollment rates for mandatory elementary school were very high, even at the turn of the century. For 1901–5 they were 96.2 percent for boys and 88.6 percent for girls. By 1911–15 they were about 98 percent for each (*Nihon chōki tōkei sōran* 1978, 5:212–31).

The most useful information to be extracted from these graphs comes from comparisons between birth cohorts separated by 20-year intervals. For boys, between 1894 and 1914, the early phase of industrialization, differences in height do not appear until age 9, and they are then maintained at about 2–3 cm from age 12 until full maturity. Between 1914 and 1934, the later phase of industrialization, differences are quite discernible from age 6. Then the advantage of the later born begins to decline at around age 9 (with the onset of the Pacific War), and average height drops precipitously until 15-year-olds born in 1934 were no taller than 15-year-olds born in 1894. This reflects severe wartime and immediate postwar deprivation and malnutrition. By age 18, the 1934 cohort has begun to recover from the stunting, and by age 20 it has almost attained its expected height.

The 1954 and 1974 cohorts are used as a point of comparison for all prewar cohorts. Tempo of growth was much greater beginning at age 6 but was most prominent during the ages of puberty, between 12 and 15. The rate of increase in height is noticeably greater in the postwar cohorts beginning as early as age 10; it peaks at around age 13. Little growth is observed after age 16. Early maturation in the postwar period in comparison with the prewar period has been attributed to several reasons. Nutritional reasons include a doubling of

animal protein intake in the six years following the end of the Pacific War (Mitchell 1962), an increase in milk consumption (Takahashi 1966), and changes in intake of fat, vitamin B2, and eggs (Matsumoto 1982). Socioeconomic reasons such as increasing urbanization, decreasing family size, and a decreasing Engel's coefficient have also been suggested (Matsumoto 1982).

Growth of schoolgirls presents a different picture of physiological maturity. While final height is a good 7–10 cm shorter than that of boys, this is due to genetic differences rather than nutritional disadvantages.²⁶ The difference between the 1894 and 1914 cohorts is apparent at age 6 and is much more pronounced than that of boys. This is consistent with the observation that girls experienced a greater degree of change in average height and experienced it earlier than did boys during the first half of the twentieth century (Wall 1993, table 7). It is interesting to note, too, that the 1934 girl cohort appeared to have weathered the war deprivations much better than its boy counterpart, at least relative to growth of earlier cohorts. Stunting of growth was less severe and seems to have been corrected by age 16. In general, environmental effects are more marked in the growth of boys than in that of girls, as one study on the effects of the atomic bombing at Hiroshima has shown (Greulich, Giswan, and Turner 1953). The difference in rates of increase in height between the prewar and postwar cohorts is evident at age 8, two years earlier for girls than for boys. Also, girls of the postwar cohorts exhibit little increase in height after age 16, whereas boys continued to grow until age 18.

The differences in tempo of growth among same-sex birth cohorts and between girls and boys highlight one of the most interesting problems in the relationship between industrialization and health, that is, examining differences among subgroups of the population to see whether one group benefited more or less than the others in the overall process of economic growth. The following section traces out the development of the differential structure in the Japanese economy and probes the demographic impact of productivity and wage gaps between the modern and traditional sectors.

7.5 Formation of the Differential Structure

7.5.1 Gaps in Productivity and Real Income

As World War I fueled the growth of Japanese industries such as arms, chemicals, and metals, modern large-scale industry for the first time experienced a skilled labor shortage. As a result, manufacturing processes became rationalized for maximum efficiency, which greatly increased not only the pro-

26. A comparable height gap appears between British boys and girls in the 1960s in Tanner (1990). An analysis of nutritional status of Japanese boys and girls in the early twentieth century shows little evidence of a female disadvantage with respect to nutritional resources. See Wall (1993).

Table 7.9 Real Per Capita GDP by Sector, 1907–40

Year	Primary	Secondary	Tertiary	Year	Primary	Secondary	Tertiary
1907	154	425	568	1924	191	765	682
1908	156	419	565	1925	210	811	642
1909	158	436	544	1926	194	852	632
1910	150	457	559	1927	205	872	614
1911	159	469	591	1928	200	944	682
1912	158	490	616	1929	203	1,031	656
1913	160	517	597	1930	213	1,052	474
1914	174	545	483	1931	186	1,094	495
1915	178	545	555	1932	220	1,097	586
1916	195	578	685	1933	242	1,156	628
1917	189	577	743	1934	193	1,214	614
1918	190	574	703	1935	203	1,273	548
1919	205	607	807	1936	217	1,323	584
1920	203	587	676	1937	227	1,261	648
1921	182	696	795	1938	224	1,392	642
1922	188	740	712	1939	243	1,510	786
1923	191	681	690	1940	237	1,531	783

Sources: Calculated from Ohkawa et al. (1974, 227) and Umemura et al. (1988, 204–15).

Note: GDP in yen, 1934–36 prices.

ductivity of the modern industrial sector relative to the agricultural and traditional manufacturing sectors, but its real wages as well. The productivity and wage gaps widened during the 1920s and 1930s, which led to what is commonly known as the formation of the differential structure.²⁷

In table 7.9 it is clear that productivity by sector—as measured in real GDP per gainful worker²⁸—increased at varying rates. Only the secondary sector witnessed large and steady gains over the first four decades of the twentieth century. In the primary sector, which includes agriculture, forestry, fishing, and salt making, per capita real income grew very slowly and stagnated during the 1920s, the period of agricultural recession. The tertiary sector, which includes many small-scale traditional services, also experienced little growth during this period. Thus the differences arose from both rapid growth in large-scale manufacturing and little growth in agriculture and traditional industries.²⁹ As will be shown in this section, these gaps extended to the health and welfare of the people as well.

27. This gap between modern and traditional sectors is also referred to as the “dual structure” or “dual economy,” more literal translations of *nijū kōzō*. I prefer to use “differential structure,” coined by Ohkawa and Rosovsky (1965), since it is more general and acknowledges more complexity than a simple modern-traditional dichotomy in economic growth.

28. May include part-time workers. See Ohkawa (1957, 142).

29. Analysis by sector serves only as a proxy for the true differential structure that emerges between so-called modern and traditional industries. Modern industry comprises goods and services introduced after the Meiji Ishin and those dependent on foreign technology (e.g., banking, communications, transportation, arms, and medicine). Traditional industry includes old traditional

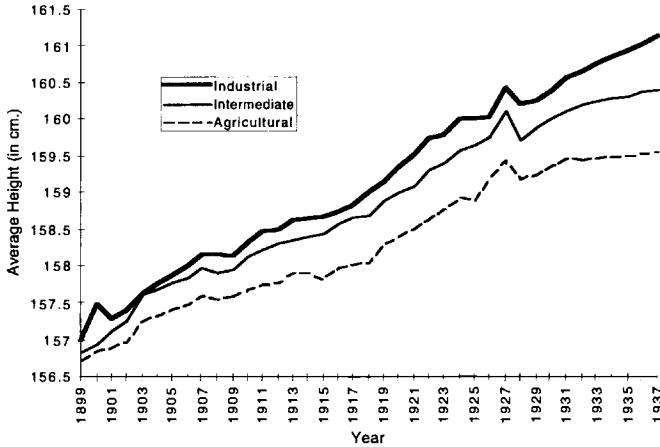


Fig. 7.6 Average height of 20-year-old recruits by prefectural type, 1899–1937

Source: Calculated from Shay (1986, appendix).

Note: Year is year of measurement. Industrial = less than 40 percent of labor force in agriculture in 1930; intermediate = 40–60 percent of labor force in agriculture in 1930; agricultural = more than 60 percent of labor force in agriculture in 1930. See Taeuber (1958, 88).

7.5.2 Differential Height

To determine whether the gaps in real wages between the traditional and modern sectors are manifested in the heights of those employed in the respective sectors, national recruit height data were divided into categories that would come closest to representing those sectors. Recruit height data were available by prefecture, so prefectures were divided into three categories: industrial, intermediate, and agricultural (according to Taeuber 1958, 88). Industrial prefectures had less than 40 percent of their labor force in agriculture; intermediate, between 40 and 60 percent; and agricultural, over 60 percent. The number of prefectures of different types totaled 7, 20, and 20, respectively.

The results are shown in figure 7.6. With clarity and consistency, recruits from industrial prefectures are tallest, those from agricultural prefectures shortest, and those from intermediate prefectures somewhere in between, but closer to those from industrial prefectures. Moreover, the gaps are increasing over time so that on the eve of the War with China, industrial recruits were on average close to 2 cm taller than agricultural recruits. At the turn of the century,

goods and services that existed before the Meiji Ishin (e.g., stonecutting, carpentry, food production, ricksha driving, and geisha) and new traditional goods and services that were originally introduced from the West but retained a traditional organizational structure (e.g., textile manufacture, tinsmithing, shoemaking, and painting). Modern and traditional industries can also be characterized by firm size. Though many exceptions exist, modern industry almost always refers to large-scale firms, while traditional industry, both old and new, has a strong association with small-scale, especially “midget” (one to three worker) enterprises. See Nakamura (1983, 27–28) and Ohkawa and Rosovsky (1973, 37–39).



Fig. 7.7 Crude death rate by prefectural type, 1896–1937

Source: Calculated from *Nihon teikoku tōkei nenkan* (1899–1906, 1929–37).

Note: Number of deaths per 1,000 population. Definitions of industrial, intermediate, and agricultural prefectures as in fig. 7.6.

40 years earlier, there was virtually no difference between any of the heights. Thus total gains in average height over the period of industrialization for industrial, intermediate, and agricultural recruits were 4.1, 3.6, and 2.8 cm. Since recruitment physical examinations took place in the village, town, or city of birth, heights would be fairly accurate in measuring one's nutritional status and environmental effects from birth through recruitment in one's hometown. There may have been some migration in the later teen years as young men sought employment, but they would return to their place of birth for recruitment registration, so migration effects are minimized.

7.5.3 Differential Mortality

The same process of dividing prefectures into industrial, intermediate, and agricultural categories was performed on national statistics from the Cabinet Statistical Bureau, which covers the entire population, not just recruits. These are the so-called official statistics, which many have cautioned against using since they tend to underreport certain measurements. Since this analysis is more concerned with relative intersectoral differences than with absolute changes over time, using the official statistics may not be problematic. Figure 7.7 depicts crude death rates for each prefectural type (statistics for the years 1907–28 were unavailable). It appears that industrialization had a positive effect on mortality, as crude death rates for industrial prefectures were reduced from a high of 23 per 1,000 at the turn of the century to 15 by the late 1930s. Crude death rates in agricultural and intermediate prefectures showed only

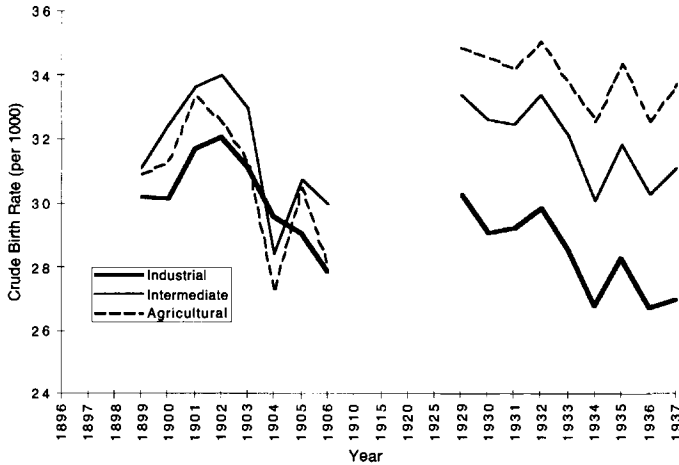


Fig. 7.8 Crude birthrate by prefectural type, 1899–1937

Source: Calculated from *Nihon teikoku tōkei nenkan* (1899–1906, 1929–37).

Note: Number of recorded births per 1,000 population. Definitions of industrial, intermediate, and agricultural prefectures as in fig. 7.6.

slight declines so that the high-to-low gradient from industrial to agricultural mortality was virtually reversed by the late 1920s. The reasons for this reversal include better medical care and public health measures in the cities in the later stages of industrialization, which mitigate the overcrowding and spread of infectious diseases characteristic of urban areas in the early stages of industrialization (see Mosk and Johansson 1986).

7.5.4 Differential Fertility

In crude birthrate, as shown in figure 7.8, there is little difference among the three prefectural types in the early stages of industrialization. By the late 1920s, the differences are pronounced and consistent. Agricultural birthrates are the highest, fluctuating between 32 and 35 per 1,000 population; intermediate, next highest, between 30 and 34; and urban, the lowest, between 26 and 30. Decline in birthrates is a much noted phenomenon of the so-called demographic transition from a traditional, agriculture-based society to a modern, industrial society. Urbanization and its attendant crowded living conditions in particular tend to reduce the number of children that people feel they can comfortably have, both financially and with regard to living space. Better education, which generally accompanies modern, industrial life, leads people to prefer “quality” of children over quantity. They prefer to invest available resources in more human capital for fewer children. In Japan birthrates on average do not appear to have declined very much over time, but the cross-sectional differences among sectors are significant.

In stillbirth rate per live births, shown in figure 7.9, agricultural prefectures

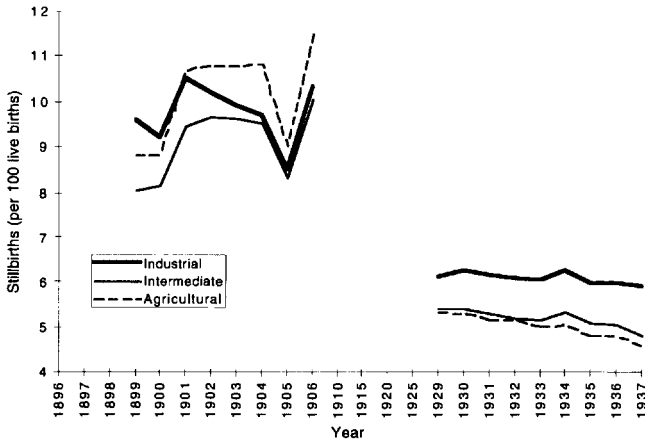


Fig. 7.9 Stillbirth rate by prefectural type, 1899–1937

Source: Calculated from *Nihon teikoku tōkei nenkan* (1899–1906, 1929–37).

Note: Number of recorded stillbirths per 100 live births. Definitions of industrial, intermediate, and agricultural prefectures as in fig. 7.6.

seem to be at a slight disadvantage in the early phases of industrialization. The situation is reversed by the late 1920s, with industrial prefectures showing on average one more stillbirth than the other prefectural types. This is consistent with another study, which showed that there was a high-to-low gradient in stillbirth rate from coastal to valley to mountain villages (representing decreasing levels of industrialization) in Shizuoka prefecture (Honda 1995). While causes of natural stillbirth are still largely unexplained, ones commonly cited are hypertension, antepartum hemorrhage and small-for-gestational-age fetuses (Herschel et al. 1994). Since these causes relate to prenatal care and maternal health, the reversal in figure 7.9 suggests that prenatal stress was higher for women in industrial prefectures. Intersectoral differences aside, the large drop in all sectors of the stillbirth rate indicate an overall improvement in the lives of women in their childbearing years.

While improved prenatal care and maternal health can account for some of the decline in natural stillbirths, they cannot account for the dramatic drop in stillbirth rates for all types of prefectures between 1910 and 1930. There appears to have been a change in reporting methods or a large decline in the rate of unnatural stillbirths. The precise definition of stillbirth used in this data set is unclear, since abortion, infanticide, natural losses, and deaths of infants up to one month old were often combined in a single category. Since no change in reporting methods has been documented, it might be hypothesized that much of the decline occurred among unnatural stillbirths, that is, abortion and infanticide. When stillbirths are divided into legitimate and illegitimate categories, the stillbirth rate for illegitimate births was on the order of 5 to 10 times

higher than that for legitimate births from the 1920s through the 1940s. For example, in 1930 the stillbirth rate in large cities was 53 per 1,000 live births for legitimate children and 558 per 1,000 live births for illegitimate children. Outside the cities, the respective rates were 48 and 314 (Taeuber 1958, 270–71).

Also, stillbirth rates were higher among mothers of marginal childbearing ages (below 20 and over 40 years) in the prewar period. The high stillbirth rate among mothers below 20 years of age is undoubtedly linked to the high stillbirth rate among illegitimate births. There was also social stigma attached to older women giving birth, as though being old and pregnant was shameful or inappropriate.³⁰ Hence, if the larger part of the decline occurred among induced stillbirths, it must have occurred mostly among illegitimate births and births among women of marginal childbearing ages. In other words, there must have been a decline in abortion and infanticide among mothers to whose pregnancies some social stigma was attached. A possible explanation for this is the loosening of social ties and weakening of social mores that accompanied massive migration during industrialization. It was far easier for a woman to take her illegitimate pregnancy to term if she was living in a city away from the tight social nexus of her family and village.

7.6 Conclusion

The formation of the differential structure between modern and traditional sectors during industrialization was manifested in the health of the Japanese people. Average heights of 20-year-old recruits, when segregated into industrial, intermediate, and agricultural prefectures, displayed increasing differentials from 1899 to 1937. This is in accord with higher real income for nonagricultural workers in large-scale industries and lower real income for agricultural workers, which were characteristic of the differential structure. In addition, agricultural workers had much higher caloric requirements, which dealt a double blow to nutritional status: lower income and higher intake. The results are as expected: beginning with virtually no average height differences in 1899, industrial recruits grew an average of 4.1 cm, intermediate recruits 3.6 cm, and agricultural recruits 2.8 cm.

Mortality differentials, derived from national statistics for the entire population, were reversed over time. In the early phases of industrialization, industrial prefectures had the highest rates of mortality; agricultural, the lowest. By the late 1920s, the gradient was reversed, with the death rate of agricultural prefectures 2–4 points higher than that of industrial prefectures. Reasons for the reversal include better medical care and public health measures in the cities in

30. "In those days it was considered a great disgrace to have a baby after the age of forty—they were usually either aborted or killed at birth. A middle-aged woman only had to look tired or slack off from work and tongues would start wagging" (Saga 1987, 210).

the later stages of industrialization, which mitigated the effects of the overcrowding and spread of infectious diseases characteristic of urban areas in the early stages of industrialization.

Crude birthrates of different areas were virtually indistinguishable in the first decade of the twentieth century, but by the 1930s, patterns were clear and consistent. Agricultural birthrates were highest, fluctuating between 32 and 34 (per 1,000 population); intermediate, between 30 and 34; industrial, between 26 and 30. Industrialization and its attendant urbanization tend to reduce the number of children that people feel they can comfortably have. In addition, better education, which generally accompanies modern, industrial life, leads people to prefer “quality” of children over quantity. In stillbirth rates, which are inversely related to quality prenatal care and maternal health, industrial prefectures were at a slight disadvantage. Overall, however, the large drop in stillbirth rates for all sectors suggests a general improvement in the lives of women in their childbearing years.

Military expansion and war were major stimulants to the Japanese economy and contributed to the rise in per capita GDP during the period of industrialization. For example, although Japan was not a direct participant in it, World War I spurred the GNP to growth rates of 6–9 percent. Another positive effect was the breakthrough in military medicine and hygiene through research and education. This greatly reduced the number of deaths due to infectious diseases in battle camps between the Sino-Japanese War (1894–95) and the Russo-Japanese War (1904–5).

On the other hand, in the effort to meet the state objective of building a rich country and strong army (*fukoku kyōhei*), the government heavily favored amassing a formidable military-industrial complex over investing in social welfare, health care, public health technology, sanitation, and insurance.³¹ The people’s response was to draw on the centuries-old institution of communal associations (*kō*) and to form their own co-ops and companies that provided insurance, credit, and health care. Nevertheless, lack of major capital investments in public health on the part of the state may have delayed the control of epidemics in the early stages of industrialization and contributed to the stagnation of life expectancy throughout the period of industrialization.

Direct effects of war on the health of the people can be observed in the growth of schoolboys and schoolgirls. Birth cohorts of 1934, who would have reached puberty during the final years of the Pacific War and its devastating aftermath, showed significant stunting in both sexes. The effect on boys was more severe and protracted, as signs of stunting can be observed from ages 10 to 19, and 1934 birth cohorts at age 15 were no taller than their 1894 counterparts at age 15. Girls recovered more quickly, and the effects they suffered

31. See Honda (1995, table 6.1), in which it is shown that the Japanese government spent anywhere from 10 to 1,000 times more on defense than on public welfare each year from 1868 to 1942.

were less severe. They showed signs of stunting from ages 10 to 16, and their heights did not drop to 1894 cohort levels.

While increases in per capita income can lead to some benefits for an industrializing society, per capita income is not well correlated with all measures of health. In the case of Japan, height as a proxy for nutritional status increased with per capita income, but leveled off in the 1930s even though per capita GDP rose rapidly. The leveling-off reflected a decrease in caloric intake, which in turn may have been due to the distribution of a limited amount of resources to a burgeoning population. Mortality rates and income are somewhat correlated over time and across occupational class, though reduction in mortality in higher income, industrial areas only occurred in the later stages of industrialization. Fertility rates and income are negatively correlated, but once again, only in the later stages of industrialization. In the early stages, industrial and agricultural birthrates are virtually indistinguishable. Thus, the relationship between industrialization and health is not a simple one: in addition to income, it is critical to consider the stage of industrialization and where the additional resources from higher income are being channeled.

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