
How Godzilla Ate Pittsburgh: The Long Rise of the Japanese Iron and Steel Industry, 1900–1973

Bernard ELBAUM*

From the 1890s to as late as 1960, industrial policy provided vital aid to the development of the Japanese iron and steel industry. Japanese industrial policy proved successful in steel even though public support was much prolonged, subject to political influence, and based on limited forecasting power *ex ante*, particularly with regard to recurrent raw material problems. Policy success in steel within different time periods suggests that specific targeting mechanisms were less important than the prevalence of market failures within a context of underdevelopment, broad support for industry, and dedicated and capable governmental bureaucracy. By implication, industrial policy in recent years faced greater difficulties insofar as it attempted narrower targeting and operated in a more mature economy.

I. Introduction

As of the mid 1970s, the Japanese iron and steel industry led the world in production, exports and efficiency and posed enough of a competitive menace to companies and jobs in the Europe and the US to provoke protectionist measures. Public inquiries then held in the US found little evidence of differential government aid (cf. US Federal Trade Commission, Bureau of Economics 1977: 324–332). But from a long-term, historical perspective, extensive and recurrent public support, extending from the 1890s through the 1950s, made a sizable contribution to the rise of Japan's steel industry.

The Japanese government provided recurrent support for the steel industry even though it lacked a strong basis for optimism regarding industry prospects *ex ante*. Upon founding modern Japanese steelmaking in the 1890s, the government underestimated the difficulty of assimilating Western technology and overestimated domestic sources of iron ore. At subsequent policy junctures in the 1920s and 1950s, the industry was far better established, with investments in physical and human capital worth preserving, a record of considerable accomplishment and private actors willing to invest their

Bernard ELBAUM is an Associate Professor specializing in economic history at the Economics Department of the University of California, Santa Cruz. His previous publications on the steel industry of Britain and the US include: 'The Steel Industry before W.W.I.' in Bernard Elbaum and William Lazonick, eds., *The Decline of the British Economy* (Oxford University Press, 1986); 'The Making and Shaping of Job and Pay Structure in the Iron and Steel Industry,' in Paul Osterman, ed., *Internal Labor Markets* (Cambridge: MIT Press, 1984); and co-author with Frank Wilkinson of 'Industrial Relations and Uneven Development: A Comparative Study of the British and American Steel Industries,' *Cambridge Journal of Economics* (September 1979), pp. 275–304. His previous papers bearing on trade specialization and industrial policy more generally include: 'Cumulative or Comparative Advantage? British Competitiveness in the Early Twentieth Century,' *World Development* (September 1990), pp. 1255–1272; and co-author with William Lazonick of 'The Decline of the British Economy: An Institutional Perspective,' *Journal of Economic History* (June 1984), pp. 567–584. He can be reached by e-mail at lbaum@ucsc.edu.

*I would like to acknowledge the valuable comments I received on earlier drafts from William Lazonick, Tetsuji Okazaki, the editors of *Social Science Japan Journal* and three anonymous referees. I also benefited from comments at an All-University of California economic history conference, particularly by my discussant Linda Cohen, and at a Business History Conference, particularly by my discussants Robert Forrant and David Kirsch. I should further acknowledge research assistance by Yuki Sakasai and translation services by Takeshi X. Shimatani. Any remaining errors are unfortunately my own responsibility.

own funds if the government came to their aid. But at each policy juncture, industry prospects were highly uncertain, with raw materials posing the main risk, as informed assessments of comparative advantage took a dim view of making iron and steel in a nation so poorly endowed as Japan in coking coal and iron ore (Warren 1975; Allen 1981: 212; 100–101; Yonekura 1994: 33).

Within the wider debate over Japanese industrial policy, the gap between results *ex post* and the basis for public decision making *ex ante* constitutes the main divide between ‘interventionists’ and their neoclassical critics. Interventionists can and do cite striking instances of apparent success, steel among them, for Japanese industrial policy *ex post*. Neoclassical critics question whether and how public policy can improve upon market outcomes given information and incentive problems *ex ante*.¹

The current paper scrutinizes and tries to narrow that divide. Exploiting what is by now extensive English-language historiographies on both Japanese industrial policy and the steel industry of different nations, the present paper asks the following questions: what basis was there for intervention *ex ante*? Did the Japanese iron and steel industry develop more rapidly and yield greater social returns than likely in the absence of government support? How does the case of Japanese steel bear on more general debates over the merits of industrial policy?

The nature of the questions and evidence admit no stronger set of answers than provided by interpretative historical judgment, with all its attending qualifications. Although much ink has been spilled on Japanese industrial policy in general and its steel industry in particular, most previous literature focuses more narrowly on the postwar era. The main distinction of the present paper is its attempt to place industrial policy debate in new light by assessing the arguments against the long-term, comparative record.

With the 1970s as endpoint, the present paper can make only passing mention of the contribution of industrial policy intervention to more recent, serious problems of excess capacity and economic stagnation. Its contribution to the Japanese economic miracle seems a question large and weighty enough for one paper. Hopefully, better understanding of industrial policy may help reduce the costs attending policy intervention.

2. Pre-World War I Origins

The establishment of the Japanese iron and steel industry was mainly the work of the government. Meiji central and local governments had inherited a tax regime that put at their disposal a fraction of national output that was unusually high for a pre-industrial society, an average during the late Tokugawa period of some 20%. From 1880 to 1920, central and local government expenditures took 14% of GDP, the largest single component going to the military, which in the three successive decades after 1890, absorbed 34%, 48% and 41% of total government outlays respectively (Crawcour 1997: 109–110). The satisfaction of military demand through domestic production, desired on security grounds, involved public promotion of industry, a policy justified under the oft-quoted slogan, ‘rich nation, strong army’.

The government maintained only a few public enterprises and in 1912 directly employed only some 12% of the workforce. But from 1880 until World War I (WWI), most of gross national investment

1. The best known general historical accounts favorable to industrial policy are those of Johnson (1982), Amsden (1989) and Wade (1990). The general case for skepticism as grounded in neoclassical theory is developed at length by Matsuyama (1997). Yamamura (1993: 12–13) provides a reference to surveys of the literature.

came from public expenditures (Ohkawa and Rosovsky 1997: 218). The government concentrated its spending in heavy industries, including militarily strategic sectors and infrastructure, particularly shipping and railroads. Iron and steel was, of course, a vital input both for infrastructure and military hardware.

For iron and steel, as for many other industries, the first attempts at modern factory production came during an early phase of Meiji public policy. Between 1868 and 1881, the government established enterprises in a wide variety of industrial sectors—including cotton, silk, mining, shipping, shipbuilding, engineering, cement and chemicals, as well as iron and steel—most of which proved unprofitable and were ultimately sold at bargain prices to private interests. Arguably, despite their unprofitability, many government enterprises of the early Meiji era more than paid their way by the learning gained from demonstration of new production methods (Smith 1955: 103). At one such enterprise, the Kamaishi iron works, attempts at coke-fired blast furnace operation foundered as the government followed the advice of foreign engineers despite warnings by Japanese expert Oshima Takato of peculiarities of Japanese raw materials (Iida 1980: 40–44).

In 1891, the Japanese government submitted a bill before the Diet for the establishment of its own steelworks. A prime motivation was the perception that iron and steelmaking was a critical gateway into metallurgy and metal-using industries, with forward linkages critical to military strength (Hanami 1987: 42, 79–80; Yonekura 1994: 33–35). An accompanying statement underlined that private steel ventures would be unprofitable until exploration uncovered a viable domestic source of iron ore. It expressed confidence that a public venture would realize external economies and benefit other industries. The Diet rejected the bill repeatedly, the opposition voicing concern over public finances and the adequacy of domestic raw materials.² Out of legislative defeat came a proposal for an investigation committee, for which funding was also initially rejected, but restored through the direct intervention, on national security grounds, of the Emperor Meiji. Serving on the investigation committee was metallurgical engineer Kageyoshi Noro, who in 1894, at the Kamaishi works, by then privately owned, oversaw an innovative technique of coal blending which for the first time enabled Japanese coke to fuel blast furnaces.

Noro had also authored an earlier research report for the government that echoed voluminous Japanese writings of the time on the relationship between iron and steel and the development of modern civilization. It began, ‘Steel is the mother of industry, and the basis for national security. Without steel, there can be no industry . . . for it is recognized that the steel industry determines the destiny of a nation . . .’ (quoted in Nishida 1973: 15).

In the early 1890s, domestic steel supply failed to expand significantly, despite a boom in steel demand fed by railroad construction and the ongoing military build-up. In the immediate aftermath of the Sino–Japanese War, amid intense patriotic fervor, the government legislated large subsidies to foster Japanese shipping and shipbuilding, and by overwhelming majority established a state-owned iron and steel works on the coast at Yawata. The first detailed blueprints for Yawata were drawn up by Kageyoshi Noro.

Coastal location left open the possibility of importing raw materials, particularly from China, which was known to be a potential source.³ Since mining was a labor-intensive sector, China, and Asia more

2. Much of the detail here and below is from Yonekura (1994), which contains the most extended account of the Japanese iron and steel industry before WWII in English.

3. I am indebted to an anonymous referee for this point. The point is also made by Johnson (1982: 86).

broadly, also offered potential for low raw material costs, though neither the extent nor cost could be gauged well in the 1890s, when iron ore and coal mining in Asia was still a small-scale affair.

Founded with military purposes foremost in mind, Yawata was to include an arsenal to meet specialized navy needs. Despite navy objections, the arsenal was never built, falling victim to an upsurge in civilian demand that created competing priorities, and a budget-minded decision by the Ministry of Agriculture and Commerce. Upon completion, the bulk of Yawata's output went for civilian purposes, with its principal product—rails—going to the nationalized railway.

Without its Yawata arsenal, the navy turned to the private sector for military production. Before WWI, the bulk of private steel output came from four firms that catered to Japan's nationalized rail system and navy. The navy provided firms with technical assistance and was willing to pay high prices, especially in wartime.

Demonstrating the decentralized character, at this early date, of Japanese industrial policy, the navy encouraged joint investment by Hokkaido Coal Mining and Vickers Armstrong—a British manufacturer of armaments and steel—to form Nippon Steelworks, which supplied the navy with ordnance and equipment, and became by 1913 second only to Yawata in steelmaking capacity. The navy also rescued the Kobe works from the brink of financial failure in 1909 by designating it a special supplier. Thereafter, the chance of failure was remote, given navy policy of increasing the Japanese content of its hardware, and navy assurances of orders at five to six times prime cost. 'This and other plants became virtual auxiliaries of the navy arsenals' (Crawcour 1997: 96).

How successful were the governmental interventions? In all, by 1913, imports still accounted for over half of pig iron and two-thirds of steel consumption. Yawata produced about three-fourths of the domestic pig iron and steel output. About half of Yawata's output went to the government railway or military.

At Yawata, initial plans were for a works of modest scale. The aim was to limit the initial capital investment, begin production quickly and postpone expansion until Japan itself learned how to produce needed machinery and how to adapt foreign technology to domestic resources. But as work proceeded, the Ministry of Agriculture and Commerce changed its lead engineer and its plans. Designed by German engineers, the Yawata steelworks began production in 1901 with imported German equipment in a large-scale plant that approached the capacity of leading foreign facilities.

There followed unforeseen difficulties with administration and operation. At the time of its founding in 1901, Yawata was the largest enterprise in Japan and its status as a government enterprise imposed inflexibility. Enterprise expenditures required Diet approval as part of the national budget. A prime goal was commercial profitability. But Yawata was also supposed to deliver import substitution and military self-sufficiency, which imposed uneconomical manufacture of a wide range of specialized products (Yonekura 1994: 32–59).

Contrary to optimistic scenarios, raw materials at first posed another difficulty. In the early 20th century, iron and steel production was materials intensive, with raw materials comprising the greater part of costs.⁴ The European and US industries had grown up on ore and coalfields. No country had ever before ventured into steelmaking so resource poor as Japan.

Yawata was founded with captive ownership of the Futase coalmines, which could provide some 50–60% of its coal consumption (Kawasaki 1985: 397). Initial plans to supply the Yawata works with

4. Raw materials comprised some 60% of costs for the British steel industry. The figure is unlikely to have been very different for Japan, whose low wages largely offset low labor productivity.

domestic iron ore failed to come to fruition. Instead, the works was supplied mainly by imports of iron ore, as well as substantial quantities of pig iron and coal, from China and Korea, imports which bound the enterprise inseparably to Japanese imperialism.

Plans were for Yawata to have a capital cost of 10.56 million yen and a capacity of 90,000 tons of crude steel, which would double within a few years. Yawata's steel output, however, fell far below expectations: 1,700 tons in 1901, just 63,000 tons in 1906 and finally reaching 170,000 tons only in 1911. By 1909, total capital costs stood at 36.9 million yen; by 1910, accumulated operating losses were 11.1 million yen. The main problems were an initial lack of coking facilities and the time it took to learn imported steelmaking techniques and adapt them to a distinctive raw material supply (Yonekura 1994: 35–56). The government at first repeated the error it previously made at Kamaishi of trusting in foreign advisors rather than Japanese engineers, and had to call Noro in to remedy matters (Iida 1980: 47–48).

In short, public undertaking of iron and steel production was marred by serious mismanagement and miscalculation. Still, intervention yielded upward-trending benefits that promised, if trends persisted, to outweigh its costs.

For all its difficulties, Yawata provided a model for Japanese business management. The top management of Yawata was bureaucrats and technocrats from government ministries appointed by the Ministry of Agriculture and Commerce. From the first, management drew upon its public bureaucratic experience to give the enterprise a well-functioning, multi-functional departmental organization. Notwithstanding recurrent state subsidy, Yawata operated under pressure to perform from constraints on the public purse and import competition (Yonekura 1994: 35–56, 74). In other developing nations in later years, nationalized enterprise, established in the name of infant-industry promotion, usually produced a bounty of corruption and inefficiency. By comparison, Yawata stands out for the relatively high quality of public management and entrepreneurship.

Backed by unmatched financial resources, Yawata was the technological leader of the industry. Engineers and skilled workers from the Yawata works went on to crucial positions in private sector steel firms. Additional externalities were generated by a demand and training stimulus to such related sectors as mining, transport, cement, brick and machine manufacture.

In the absence of state support, the record suggests that domestic iron and steel output in 1913 would have been a fraction of what it was. An oft-cited constraint on the establishment of a steel industry in poor countries is a domestic market too small to accommodate economies of scale. In Japan, although the domestic market afforded room for sizable entry by private producers, imports supplied the bulk of the rails for the railway network and might have supplied virtually all but for Japanese government intervention. Private entrepreneurs were able to meet foreign competition only in small market niches. Had the state refrained from intervention, the consequence at a minimum would have been considerable delay in industry development, and quite possibly, the forgoing of first mover advantages within Asia that were instrumental to the industry's remarkable ascent. The main obstacles to private ventures appear to have been the costs of learning, accumulating a skilled work force and obtaining suitable raw material supplies, problems confronted and overcome by Yawata with the aid of public money, management and imperial power.

Yawata proved able to produce pig iron at competitive cost levels, indicating that even before WWI, contrary to prominent contemporary and historical opinion, local access to raw materials was unnecessary for comparative advantage. Nearly all of the iron ore that Yawata refined came from imports. But in 1914 the cost of iron ore for Yawata, at ¥9.2 per ton, compared favorably with costs per ton of 18.7 in Britain and 15.0 in the US. At ¥7.0 per ton, the cost of coke for Yawata also compared favorably with costs per ton of 8.8 in Britain and 8.2 in the US. At Yawata the low cost of raw materials

and labor offset low productivity, so that the cost of making pig iron was almost as low as in the Lorraine, the low-cost region worldwide, and below that in Britain or the US (Okazaki 1991: 171–173).⁵

Ex ante the Japanese could hardly have anticipated obtaining such low material costs. But a careful reading of comparative experience on the eve of WWI indicates that it was reasonable, if risky, to bet that Japan could build a steel industry of at least modest size upon imported raw materials.

The British industry was by WWI importing one-third of its ore requirements; if allowance is made for iron content, the figure would be on the order of 46%. Several of Britain's pig iron-producing areas, including the largest, the Cleveland district, were also encountering diminishing returns on their ore fields in the form of declining iron content (Carr and Taplin 1962: 190–191; Roepke 1956: 78; Elbaum 1986: 71–73). Germany's main production center in the Ruhr imported over 50% of its ore, chiefly from Sweden and Spain (Pounds 1952: 112). The US industry still possessed ample coal reserves, but reserves of high-grade iron ore were more limited and were principally located in the Great Lakes region, a location near the US industrial heartland, but distant from other important markets. Major US producers transported their domestic Great Lakes ores some 1,500 km and set new standards for mineral freight costs through investment in specially designed ore carriers, high-capacity loading equipment and heavy mineral trains. But some US producers were already seeking alternatives abroad. In 1913, for example Bethlehem Steel acquired the El Tofo ores in northern Chile to supply, via the Panama Canal, facilities in eastern Pennsylvania, over 8,000 km away (Warren 1975: 28).

For Japan, reliance on water transport to coastal plant reduced freight charges. Japan also had the advantage of drawing upon relatively untapped Asian ores and upon the cementing of vertical bonds to suppliers through imperial means.

To secure iron ore from the key Chinese supplier, Han Yeh Ping, the government secretly ordered the Industrial Bank of Japan to extend huge loans (Yonekura 1994: 53).⁶ The arrangement, by design, kept the ore beyond the reach of Western firms that were potential competitors, a strategic move in an era when steel companies sought monopolistic advantage from control over raw materials, as US Steel Corporation did, most notably, with Lake Superior ores. Subsequently, Yawata helped manage blast furnaces built by the Chinese concern, which came to supply Yawata with pig iron as well as raw

5. I report figures from Okazaki (1991: 171–173), for consistency of comparison across the different countries. Okazaki's unit cost figures, however, appear too high for the US, where data reported by vertically integrated companies, particularly US Steel Corporation, are distorted by monopolistic ownership of ore and transport, and by internal transfer pricing designed to shift profits. If instead US unit costs are calculated from estimates reported by the US Bureau of Corporations (1913: 335), which correct for the distortions, the figures would be significantly lower. The qualitative picture, however, would remain unchanged.

6. The Japanese government acted to supply the loans after learning of German interest in the ores. Additional factors in the Chinese decision to sell to Japan were a swap arrangement with Yawata of iron ore for coking coal and the progressive involvement over time of Yawata in management of the Chinese concern (Yonekura 1994: 53). The *Social Science Japan Journal* editors' comments on this paper note that a 1917 report by the Japanese Ministry of Agriculture and Commerce emphasizes as the deciding factor in securing Chinese raw materials the competitiveness of the Japanese steel industry. I find this less persuasive than the cited account by Yonekura. As I point out, the data suggest that the Japanese industry still operated under a cost handicap in the prewar years, when key long-term contracts were secured. If industry competitiveness had favored them, why would the Japanese feel compelled to offer huge loans? We would also expect the main concern of the Chinese to be the purchase terms on offer for their raw material, and here the secret government directives to supply loans provided a competitive advantage. I should note that in earlier years, Yawata contracted with Hanyang Iron Works, which later merged with other firms to form Han Yeh Ping. The text refers only to Han Yeh Ping for simplicity of nomenclature.

materials, including some 50% of its ore requirements. After Japan annexed Korea in 1910, Yawata also took control of Korea's nationalized iron ore mine. And in Manchuria, the South Manchuria Railroad Company, a semi-public corporation, undertook colonization and development of raw material and iron production for shipment back to Japan. In short, Japan overcame its raw material handicap through a combination of first mover advantages and imperial intervention that ensured that low-cost Asian resources were available exclusively to Japanese producers.

In the last years before WWI, Yawata became quite profitable. So did Japan's private steelmakers, who also started out in the red, and who benefited from imports of cheap Indian pig iron. For finished steel, Japanese manufacturing costs remained greater than in developed nations, in part because of quality problems with Bessemer steel rails, which forced the Yawata works to use a more expensive duplex process. But the cost gap narrowed considerably after 1907. Japan was also shielded by transportation costs and, after 1911, by a 15% tariff. During the wartime boom, imports from Germany and Britain were in any case foreclosed, and Yawata's profits totaled 151 million yen, more than enough to cover accumulated losses and the investments made since Yawata was founded (Nagashima 1991: 191–192; Okazaki 1991: 168–175; Crawcour 1997: 106).

The coming of WWI vindicated the government's bet on strategic military concerns as a reason for state support of industry. Economic evaluation of industrial policy involves more complex considerations.

From an historical vantage point stretching back to the 1890s, it becomes clear that the Japanese government possessed no great powers of selectivity for industrial investment. It simply targeted industry with an eye on developing modern military capabilities. Despite the orientation toward the military, targeted sectors spanned a broad spectrum, including basic infrastructure and capital goods manufacture. The government seems to have acted under the presumption that Japan was trapped on a course of slower-than-desired economic development, in which lack of international competitiveness blocked accumulation of modern industrial expertise and human capital. The government presumption was rendered plausible for iron and steel by the limited extent of private ventures. Intervention aimed overall at a scale of public investment sufficient to foster a hothouse atmosphere of rapid industrial growth.

The success or failure of this type of industrial policy depended on there being an opportunity for very large gains from public promotion in at least some basic industries. It did not depend on the ability of the government to pick individual 'winners and losers' *ex ante*. Overall social returns could be positive even if the government mainly picked losers. To have a winning portfolio, government industrial policy, like venture capital, needed only to back a certain limited number of winners *ex ante* and contain losses on losers *ex post*. Provided the growth rate of winners exceeded the social rate of discount, gains from even a handful of winners could then outweigh losses on a great many losers.

The grounds for intervention appear akin to the infant-industry argument but with significant differences. The infant-industry argument presumes that public intervention leads to an efficient outcome. But even at this early stage, Japanese industrial policy contained a strategic element. It aimed at bringing to Japan, possibly to the detriment of other nations, new capacity in strategic industries. Without industrial and imperialistic intervention by the Japanese state, Asian raw materials might have been tapped instead by European or American steel companies, an outcome that at the time, given Japanese learning costs, might have been more efficient.

If the government arrived at a winning portfolio for industrial policy support, success seems to have derived less from powers of selectivity than from a favorable institutional environment and the prevalence of low enough opportunity costs to make the potential for misallocation of resources a secondary concern. For Japan circa 1900 or even as late as the 1950s, the opportunity cost of labor, in

particular, may have been quite low, perhaps as low as that of underemployed agricultural labor. Amid underdevelopment, opportunity costs may also have been low because different industries were more likely to be complements than substitutes (Aoki *et al.* 1997: 6). The main problem, in other words, may have been less that of allocating scarce resources so as to select efficiently between such industries as coal, shipbuilding, shipping and iron and steel, than of mobilizing underemployed resources so as to expand simultaneously across such diverse complementary activities. Collectively, state interventions may have generated a ‘big push’ that helped overcome supply and demand constraints in complementary sectors that provided each other with markets, inputs, entrepreneurship and capital (Murphy *et al.* 1989: 1003–1026).

Had WWI not intervened, steel industry losses might well have been more prolonged. But even, say, by 1911, iron and steel bespoke a promise of industrial policy success. Falling costs meant that the required rate of public subsidy was declining. Industry output was growing rapidly: by some 17% per annum between 1905 and 1911.⁷ Industry jobs were human capital intensive and paid a large wage premium. Low material acquisition and labor costs indicated that one day soon Japan could gain a comparative advantage if it could only continue to narrow the productivity gap. If and when it did, given industry growth rates, the social returns would soon outweigh the earlier cost burden, a calculus that continued to apply to 1973.

3. From the First World War through to the Second

The wartime boom brought skyrocketing prices, high profits, large-scale investments, technical advance and entry by numerous small-scale private firms, as well as a few large companies. New entry allowed for greater product specialization and thereby promoted greater industry-wide efficiency. Yawata increased the scale of its steelmaking facilities to match international standards, and private firms made more extensive improvements, narrowing Yawata’s technological lead. The most important private steel enterprises were controlled by the *zaibatsu*, which took care to hold more than 50% of issued stock. Leading *zaibatsu* competed in a basically capitalist market environment, but stood out because of their political connections as well as their financial and managerial resources, and were called upon to serve as economic agents of a government committed to their success (Crawcour 1997: 113–114).

During the war, nominal wages had surged. The 1920s brought deflationary pressures from several sources: domestic and worldwide recession, overvaluation of the yen, steady decline in domestic holdings of specie and pursuit by the Japanese, as well as leading foreign governments, of gold resumption, which the Japanese only implemented in 1929 at the advent of the great depression.

High wages and an overvalued yen caused the iron and steel industry to lose cost competitiveness. Since coal mining was labor intensive, high wages had a particularly great impact on the cost of domestic coal. Steelmakers who imported their pig iron benefited enough from cheap Indian supplies

7. From 1907 to 1973, Japanese steel output in tons grew at a compound annual rate of 10.8% (Kawasaki 1985: 30, 213). An alternative measure to tonnage would employ the value of steel output deflated by a suitable price index. For earlier periods, we lack consistent price series. But for the post-WWII period, there was only a small difference in the cumulated change in the wholesale price index and steel prices, so the two measures are nearly equivalent (US Federal Trade Commission, Bureau of Economics 1977: 217–218).

to earn positive, if low profits. Integrated firms and specialized producers of pig iron incurred high raw material, as well as labor, costs and suffered losses (Okazaki 1991: 168, 179–180).

Having encouraged aggressive wartime expansion that compounded later distress, the government again came to the aid of the industry. Government rescue measures included enactment of higher tariff levies on steel (1921 and 1926) and subsidies on the production of pig iron (1926). The government also instructed banks to refinance loans to larger firms throughout the economy, with the Bank of Japan guaranteeing banks against losses and the government discounting a ‘staggering sum’ (Johnson 1982: 97).

Reducing the competitive threat from imports, protection, subsidy and debt rescheduling in effect afforded a relatively efficient domestic firm contingent rents that promised to become greater in magnitude the more the firm could reduce costs. Contingent rents replenished retained earnings and gave firms a source of equity they could use to finance a greater level of investment than would otherwise be possible. With integrated and pig iron producers facing high risk, arguably the equity so gained also reduced agency costs in bank lending—agency costs that could have been significant even within an integrated *zaibatsu* organization.⁸ Notwithstanding government aid, Japanese iron and steel firms remained under pressure to perform because of ongoing domestic and foreign competition and tightening of the budget constraint at Yawata, which in 1926 was made a quasi-private corporation, its accounting system separated from the national budget and placed on a self-paying basis.

By 1924, all pig iron and integrated producers had been acquired either by the Mitsubishi or Mitsui *zaibatsu* or by Yawata. Government measures allowed many smaller, weaker firms to fail, but saw to it that the leading firms survived. Leading firms used the resources gained to become more efficient. In particular, investments in pig iron operations introduced larger scale blast furnaces, auxiliary equipment, pretreatment of raw materials and utilization of by-product gases.

Some authors emphasize the weaknesses in performance of the interwar steel industry (O’Brien 1992: 131; Yonekura 1994: 151). But by 1930, Japan’s integrated producers—the largest and most progressive firms in the industry—had gained cost competitiveness. Their coke ratio and labor productivity approached levels in some developed countries. At Mitsui’s Kamaishi works, by the late 1920s, the cost of pig iron matched that of Yawata and of Vereinigte Stahlwerke Aktiengesellschaft in Germany (Okazaki 1991: 184–185). ‘By 1928, the Yawata works had reduced its product lines from 565 to 122, increased labor productivity by 40 percent, and raised profit per ton from 1.73 to 14.48 yen’ (Yonekura 1994: 118). In 1931 Japan abandoned gold and the yen fell some 40% in value. Thereafter, the cost of finished steel fell below that of German imports and Japanese steelmakers became highly profitable. Profits were boosted by maintenance of subsidies until 1934, ongoing tariffs, and after 1933, foreign exchange controls. But the evidence of cost efficiency implies that leading steel firms would have been profitable even in the absence of subsidies and protection (Okazaki 1991: 184–185).

Although data are insufficient for explicit calculation, the *ex ante* case for government intervention appears stronger for the 1920s than the 1890s. By 1920, the industry had made enough progress to be within reach of competitiveness. But for the macroeconomic environment, it might have required little or no further aid. It now had in place labor and capital resources that were far more productive in steelmaking than in alternative uses. Japan’s fledgling capital markets, however, would have had

8. On contingent rents and agency costs, see Hellman *et al.* (1997: 163–207).

difficulty accommodating sizable, risky losses at large firms that had yet to establish themselves as able to withstand unfettered international competition. Here intervention could find straightforward justification on infant-industry grounds, with the high wage level in steel relative to alternatives again providing a large offset to the social costs of intervention.

As before, the tally of social costs and benefits is likely dominated by returns from military build-up (if profit from military production can be regarded as a social good), which caused output to far surpass previous levels. In the latter 1930s, as Japan's military government prepared for war, aggressive industry investment in new vintage capacity further narrowed the gap in technology and scales of operation between different Japanese facilities and between Japan and the West. Once again, the central question for the industry became raw materials, as a drive for military self-sufficiency made remarkable strides, but ultimately fell short, with disastrous wartime consequences.

During the 1920s and 1930s the government introduced new measures for industry control, which veered from promoting cartelization to mandating consolidation. As early as 1925, the newly formed Ministry of Commerce and Industry had taken the lead in promoting iron and steel cartelization, touting it as a means of rationalizing productive capacity. Subsequently, cartels formed in pig iron and in a number of steel product lines. In steelmaking, it appears that cartels did promote efficiency by concentrating production of particular products at specific firms that could thereby gain scale economies. But cartel attempts at price-fixing foundered with the Shōwa depression of 1930 (Yonekura 1994: 117–130). Legislation of 1931 promoted cartelization as a means of rationalization throughout the Japanese economy, foreshadowing post-WWII industrial policy measures.

Legislation in 1934 mandated a merger between the publicly owned Yawata Steel Company and five other leading companies to form Japan Iron and Steel, a semi-public corporation, which at founding was responsible for 97% of the pig iron and 56% of the crude steel produced in Japan. In the context of rapid capacity expansion, Japan Iron and Steel was able to implement further rationalization. By late 1937, Japanese iron and steel consumption as well as production passed under control of the military government. By 1940, under the wartime New Economic Structure, annual general goals for iron and steelmaking were set by government agencies—namely by the Cabinet Planning Board and Ministry of Commerce and Industry—based on information supplied by an industry control association. In turn, the control association, staffed by managers drawn from the steel firms, developed more disaggregated and detailed plans with government approval, setting an important precedent for government–business relations in the postwar period.

4. Rebuilding from WWII

Immediately after WWII, much of Japan, including its industry, lay shattered, starved of oil and coal. Japanese real wages fell so much that living standards became comparable to those in Malaysia. Initially, the occupying authority—the Supreme Command for the Allied Powers (SCAP)—was disposed against rebuilding the industrial might of a former enemy power, and prospects for Japanese steelmaking seemed poor enough for SCAP to contemplate dismantling the industry. But after the onset of the Cold War, SCAP sought industrial revival through a priority production plan that put the crucial inputs of coal and steel atop a pecking order for allocations of materials, capital and imports. Through direct subsidy, the government massively reduced purchase prices for raw materials and consumed steel.

In late 1948, a new SCAP economic czar imposed the 'Dodge Plan', which dismantled subsidies and inflicted budgetary austerity in the name of restoring a viable market economy. Japan Steel was privatized and broken up into two concerns: Yawata and Fuji Steel.

Helping firms cope with the Dodge deflation was the first task of the new Ministry of Trade and Industry (MITI). By grafting its economic administration in general and MITI in particular onto Japanese institutions for wartime planning, SCAP helped preserve a bureaucratic, state-centered form of capitalism. MITI was ‘an institutional beneficiary of this legacy, constituting a greater centralization of economic authority than had been achieved at the peak of Japan’s mobilization for war’ (Dower 1999: 544).

5. MITI Planning: General Considerations

MITI processes of policy formulation and implementation were marked by what some authors dub ‘bureau pluralism’ and others, with more negative connotations, call ‘bureaucratic sectionalism’ (Tresize 1976: 786). Industry associations and government planning agencies made policy by conferring and bargaining with each other.

Much of the consultation, planning and consensus building went on in councils subsidiary to and established by MITI. In 1949, for example MITI founded the Industrial Rationalization Council, which assumed as its first task the rationalization of the coal and steel industries. Its decentralized structure allowed local information to flow upward to decision makers responsible for broader policy. The process was pluralistic (or sectionalist) in that it involved various private interests and government ministries (Tresize 1976: 783–805; Aoki *et al.* 1997: 31–32; Okazaki 1997: 76–81; 2001: 332–333).

A fair judgment appears to be that in notable instances MITI helped solve coordination problems, but in others incurred costs from interest group sectionalism (Okazaki 2001: 323–342). On balance, statistical evidence suggests that trade and industrial policies were based more upon economic criteria than political rent seeking by private actors (Pekkanen 2003: 107–111). Examples of costly decisions were MITI’s support for the coal and shipping industries, in keeping with a legacy of long-standing government support of these industries, and for petrochemicals, oil refining and aluminum (Ito 1996: 226).

On the positive side, MITI coordination at times facilitated provision of important public goods. An important example from the late 1950s was new infrastructure that revolutionized raw material transport in iron and steel and made a sizable contribution to industry competitiveness. MITI also shared information with firms about foreign markets and technology and plans for domestic economic expansion. MITI information sharing may have filled a gap in coordination arising from dissolution of the *zaibatsu* and disruption of financial markets. In particular, indicative planning by MITI and its councils may have helped encourage parallel, complementary investments in steel, shipbuilding, coal and machinery after 1949, shifting down their interrelated cost structures simultaneously, and thereby allowing machinery manufacture, a strategic target, to commence development of competitiveness (Okazaki 2001: 323–342).⁹ In addition, export incentives, which originated under SCAP (Sumiya 2000: 208), granted tax credits and loans at concessional rates of interest, in effect sharing with firms that helped relieve Japan’s pressing postwar balance of payments constraint some of the external pecuniary benefits. And regulation of technology licensure provided bargaining leverage that enabled Japanese firms to acquire foreign technology at relatively low cost.

9. Returns to expansion of Japanese coal capacity proved short-lived, however. Coal mining companies hardly began to implement projected plans for investment and rationalization in the 1950s as Japan’s coal deposits proved to be too poor to meet competition from foreign coal and oil (Hein 1990: 230–235).

Controversy centers on the efficacy of MITI targeting both at industry and broader levels. A sizable literature concerns the choice between light industry, favored by neoclassical arguments for static comparative advantage, and heavy industry, favored by more dynamic considerations. Although much is made of MITI's decision to promote heavy and chemical industries, in long-term perspective, the chief novelty of postwar debate was the attention newly paid to neoclassical arguments. Public policy, after all, had favored heavy industry ever since the 19th century, an emphasis that became marked with the build-up for WWII, leaving behind a legacy of massive investments in heavy industrial capacity, which survived the war largely intact, and related job training and production experience (Sumiya 2000: 170–177).

Additional antecedents for MITI promotion of heavy industry can be found in the postwar views of various governmental agencies, business associations, and even SCAP (Vestal 1993: 17; Dower 1999: 538–540). Industries selected by MITI in fact included most that were targeted during immediate postwar reconstruction—among them electric power, textiles and food processing. MITI targets embodied recommendations from different camps in policy debate, spanned light as well as heavy industries, avoided high technology in favor of more labor-intensive manufacturing sectors and exploited conventional sources of comparative advantage even while seeking modernization.¹⁰ In short, MITI targeting amalgamated past policies and experiences, rather than conforming narrowly to a particular new model of economic development (Vestal 1993: 34). If MITI was directly responsible for the postwar decision to target heavy and chemical industries, one can well imagine Japan coming to like policies through other means.

At the industry level, previous literature largely treats the merits of MITI targeting as synonymous with the question of policy efficacy, placing at the center of debate a false dichotomy.¹¹ Fuss over industry targeting neglects the point that in the 1950s Japan was committed under Bretton Woods to a fixed, overvalued exchange rate, which made some sort of resort to targeted import restrictions and exchange controls 'practically inevitable' (Ito 1996: 226). It also neglects the possibility that the Japanese government may have succeeded in promoting growth less because of skill in selecting specific industry targets than because it created a general environment of protectionism, macroeconomic expansion, and relatively easy if rationed credit—an environment conducive to nurturing infant industries in the broad sectors where a modernizing Japanese economy, by wide agreement, was likely to develop.¹² The record of iron and steel from the late 19th century suggests that a succession of different government policy regimes had success in infant-industry promotion, without the benefit of the specific modes of planning and target selection employed by MITI.

Statistical evidence suggests that MITI did not succeed in providing greater net benefits from industrial policy to industries with superior *ex post* performance. Beason and Weinstein (1996) report that between 1955 and 1990, targeted industries had relatively low productivity growth, and Weinstein (2001) reports for 1960–1985 a negative correlation between the degree of policy assistance and the

10. According to Pekkanen's (2003: 65) figures, the industry most favored by net subsidies from trade and industrial policies as of 1955, 1960 or up to 1973, was food processing.

11. The dichotomy is reflected in the literature on steel. Yonekura (1994) is skeptical of an economic contribution from industrial policy, though he does acknowledge the value of MITI coordination for the provision of infrastructure for raw material transport. At the opposite pole are O'Brien (1985) and McCraw and O'Brien (1986).

12. There is a large literature on the cost of credit in Japan. For a short survey of the evolution of postwar credit practices, see Crum and Meerscham (1986: 261–298).

amount of Japanese productivity convergence with the US. By implication even if other authors are correct in noting that Japan benefited from a high income elasticity of world demand for its exports and a low income elasticity for its imports (cf. Itoh 1991: 31–40, 75–90), one can question whether Japanese specialization was the result of MITI targeting or simply reflected the natural course of development of the economy within the broad policy environment.

On the other hand, the correlations cited by Beason and Weinstein (1996) are insufficient for concluding that industrial policy was unsuccessful. The cited cross-industry correlations may reflect government policies that targeted industries for different reasons, sometimes to promote growth and other times to avoid closures and job loss, as in agriculture, shipping and coal. Furthermore, cross-industry correlations shed no light either on gains from trade, for which a few large export sectors would likely dominate, or on net social returns, which must also be weighted by industry importance and added up case-by-case. The record suggests that industrial policy provided critical infant-industry support to a number of industries that went on to spectacular competitive success—including shipbuilding and automobiles, as well as iron and steel—and that at least through the first postwar decades, returns from miracle industries may well have swamped outcomes elsewhere.¹³ Even if MITI failed to tilt its targeting toward better performers, industrial policy may well have yielded high net social returns for much the same reasons as it had in earlier periods.¹⁴

6. MITI Planning in Iron and Steel: Beginnings

Circa 1949, in iron and steel, *ex ante* prospects were in certain ways better and the case for public support stronger than at earlier policy junctures. Although throughout its history, the industry had been more a technological imitator and adapter than innovator, its long record of efficiency gains had, by the 1930s, allowed it to attain competitive cost levels. The industry too had a long record of entrepreneurial identification and exploitation of new raw material sources and economies, within the pre-1945 empire and abroad, notably within interwar Malaysia (Nagura 1981).

Yet if promising, targeting of steel was once more a highly risky venture *ex ante* with the crucial margin of uncertainty again involving raw material costs. With the rise of communist regimes, prewar sources of iron ore and coal in China, North Korea and Manchuria were scarcely available. Japan's previous rate of utilization of iron ore from Malaysia and the Philippines was great enough to threaten those sources with depletion and limit expansion of their output (United Nations Department of Economic Affairs 1950: 19). Japan would either have to develop new sources for raw materials or import from the same First World sources as the leading global producers and bear a significant disadvantage in transport costs. Moreover, during the war and immediate postwar years, the industry had fallen behind technologically, adding further to its high competitive cost position and to prevailing uncertainties.

13. See Blumenthal (1976: 129–160) on shipbuilding and Mutoh (1988: 307–332) on automobiles. Yonezawa (1988: 425–450) presents a skeptical view of industrial policy in shipbuilding, but does not directly address the period immediately after the war, when in shipbuilding, as in steel, the need for rebuilding and renovation was great and costs were relatively high.

14. Insofar as it ascribes important economic roles to both industrial policy and market forces, the present argument resembles that of the World Bank volume *The East Asian Miracle* (1993: 79–104). But the present argument is more explicit and detailed in its accounting of their respective economic roles.

Uncertainties, initial prospective losses and renovation costs were all so great that it is hard to see who would have financed industry development, amid the disruption of Japanese financial markets, if not for public intervention. In the event, planning and debate were overtaken by the onset of the Korean War in June 1950, which rescued the Japanese economy from the Dodge deflation. By war's end in April 1951, Japanese steel prices had surged and were 50–100% higher than those of its chief foreign competitors, posing a critical handicap for the competitiveness of domestic machinery manufacture (Kawahito 1972: 23). A consensus then formed around iron and steel as a target not because of a perceived promise for exporting but rather to relieve balance of payments and cost pressures on steel-consuming industries. MITI ambitions for steel grew greater only after the industry exceeded expectations, as steel firms on their own initiative began implementing a new vision for industry development (Yonekura 1994: 207–226).

7. MITI Rationalization Plans for Steel: Mechanisms and Cumulative Results

MITI undertook three successive rationalization plans for iron and steel: from 1951 to 1955, 1956 to 1960 and 1961 to 1965. For the first and second plans, MITI drew upon several pieces of legislation that remained in effect until 1960. There were sizable tax breaks in the form of special depreciation allowances and a credit against tax linked to firm export volume. Industry imports were exempted from tariffs. MITI established an approval system for the licensing of foreign technology. It tried to coordinate investment to forestall excess capacity, and when excess capacity appeared anyway, it promoted cartels.

The steel industry also obtained allocations of cheap credit. In the first plan low interest loans from the Japan Development Bank provided 9% of the financing. By the time of the second plan, the industry was less dependent on the government as it was better able to attract market sources of finance. The Japan Development Bank then supplied 1.2% of the financing itself and forwarded another 6.8% granted from the World Bank.

But the implicit role of the government in securing finance was greater than the numbers alone indicate. Major private banks were involved in the MITI-planning process in the Fund Section of the General Branch, where they received detailed explanations of investment projects and MITI's evaluation of them (Okazaki 1997: 93). Targeted status reduced the perception of risk, increased the volume of bank lending and allowed firms to maintain a highly leveraged financial structure. The Japan Development Bank and Japan Export Bank 'did not stop at assuming the risks of private financial institutions, and the Development Bank in particular performed the function of a pilot for the funds advances of private financial institutions' (Nakamura 1995: 136). In 1952, the Ministry of Finance explicitly requested financial institutions to emphasize loans to steel among other industries (Vestal 1993: 120). The Bank of Japan also mediated efforts by city banks to organize loan consortia (Okazaki 1997: 91).

Finally, relatively high tariffs—15% for raw steel, 12.5% for ingots and 15% for rolled steel—provided effective rates of protection estimated to be as high as 24.4%, 47% and 35.1% until phased out with the Kennedy Round GATT negotiations of 1967 (Yamawaki 1988: 289, 304, n. 14; Vestal 1993: 119). Foreign exchange controls, from which industry imports could be exempted at MITI's discretion, provided further protection, until eliminated for imports of pig iron and steel in 1960–1961.

Between 1961 and 1976, the industry received little subsidy apart from lingering protection, which had minimal impact as industry prices fell below international levels. Industry growth, rapid from 1952 on, accelerated after 1960. Between 1960 and 1974 steel production increased by 438%, output

grew to rival that of the US in magnitude, and exports grew from 14% to some 40% of output. The high growth achieved during a relatively free market regime for the industry unduly colored subsequent assessments of industrial policy impact.

8. The US Federal Trade Commission Report

In a 1977 report, the US Federal Trade Commission (FTC) estimated that cumulative postwar subsidies to the Japanese industry circa 1975 amounted only to some one-fifth of 1% of the delivered price of Japanese steel to the US (US Federal Trade Commission, Bureau of Economics 1977: 367–370). But the magnitude of subsidies relative to Japanese costs, the FTC concedes, would have been far larger in the early 1950s, when ‘they improved the competitive chances of the Japanese steel industry during its formative years’ (*ibid.*: 372). The largest aid components were then the tariffs and exchange controls that limited imports to less than 3% of sales despite high domestic costs.

The FTC calculation of cumulative subsidy value involves conceptual flaws. Because it makes no calculation of the rate of effective protection, it underestimates the value of tariffs and exchange controls in the 1950s. It also treats uniform protection and export subsidy as having no impact on the pattern of comparative advantage, drawing implicitly on a symmetry theorem by Lerner (1936) to infer that the breadth of Japan’s protectionism diluted its effects. But the simple Lerner model neglects the very real potential of uniform protection for shifting an imported or non-traded good into an exportable (US Federal Trade Commission, Bureau of Economics 1977: 329; Itoh and Kiyono 1988: 173).

More fundamentally, because the FTC calculation values protection merely as a reduction in cumulative industry expenses, it is bound to find a low dollar figure for its value, given that in the early 1950s industry output was a small fraction of its later size. The FTC calculation implies that each unit of subsidy, regardless of when made, or under what circumstances, was of equal risk and return, and equal strategic significance.

From a long-term historical perspective, the 1950s rather appear as the last chapter of prolonged infant-industry sponsorship, in which the government provided recurrent venture and rescue capital of high-risk and high-potential return. The cost data also indicate that the 1950s was a key period when the Japanese industry made strategic competitive gains. By far, the greater gain in Japanese/US unit production costs came in 1951–1956 and 1956–1960, when the ratio fell from some 1.5 to 1.08 and then to 0.71, as opposed to 1960–1976, when it fell further to 0.55 (US Federal Trade Commission, Bureau of Economics 1977: 113; Kawahito 1972: 23). Until 1960 the real cost of Japanese steel fell sharply; between 1960 and 1976, it was unchanged.¹⁵

The progress made during the 1950s by the Japanese industry provided the basis for its subsequent large-scale investment and expansion. Had the Japanese government required payment in equity in return for the risk capital it implicitly provided through public subsidy and protection, there seems little doubt that it would have wound up with a sizable and ultimately extremely valuable ownership stake—a stake that would serve as a better measure of its contribution than totaling estimated subsidies through simple addition.

15. My calculation of relative Japanese/US costs is from data estimated by US Federal Trade Commission, Bureau of Economics (1977: 113) and for 1951, from Kawahito (1972: 23). To obtain an index of real costs, that data were deflated by the Japanese producer price index reported in Allen (1981: 279).

The FTC analysis must be understood by reference to its mandate, which was to investigate allegations of unfair trade practices by the Japanese. On this score, the FTC was correct in its negative findings. Sizable Japanese intervention was confined to the 1940s and 1950s, a period that preceded the advent of an international free-trade regime, when Europe as well as Japan enjoyed wide latitude for public intervention to rebuild domestic industries without violation of the rules of international commerce. The FTC also was correct in deeming retaliatory subsidy by the US as an unappealing option, for by the time the Japanese emerged as major competitors in the 1970s, they had acquired a crushing competitive advantage.

9. The First and Second Rationalization Plans: Outcomes, Analysis and Controversies

MITI goals for the first rationalization plan were based upon general goals contained in a report by the Industrial Rationalization Council and specific detailed proposals contained in a report by the coordination committee of MITI's Industrial Structure Council (Sumiya 2000: 54–55, 240–241). The emphasis of the first rationalization plan was on improvement of existing plants, especially in rolling, by rounding out, renovation and replacement of old pull-over mills with strip mill technology licensed from the US. Because new investments had to fit the proportions of existing facilities, the results could fall short of the best practice techniques abroad. Although MITI tried to ameliorate this problem through investment coordination, it also sought to maintain neutrality and inter-firm competition by preserving market shares, goals that were inconsistent with full exploitation of scale economies to minimize costs. MITI itself complained that ensuing investments were haphazard and had caused overproduction.¹⁶

Because of budgetary concerns, MITI at first demurred from the most ambitious proposal, submitted by Kawasaki, for a new integrated, greenfield facility on the coast of Chiba—a trailblazing proposal that anticipated the later course of industry development. But MITI did come round, approving the proposal in principle and later deciding along with the Bank of Japan to help fund it.¹⁷

By 1956 labor productivity remained low, and raw material costs high. But low real wages provided sufficient offset, and industry unit costs were close to US levels and trending down. Consequently, by 1956 steel should no longer be considered an infant industry. The second rationalization plan should rather be regarded as one of strategic industry promotion. The gains from strategic trade policy are generally modeled as monopoly rents arising from predominance in global markets. But far more important, once again, were investments in and returns to human capital that was a joint product with steel manufacture.

During boom-time expansions of 1953 and 1955, MITI became concerned over the contribution to the high cost of steel from scrap prices, and in the hope of price stabilization encouraged formation of a scrap iron cartel. The steel firms themselves, who initiated the second rationalization plan (MITI initiated the first), proposed large-scale introduction of the basic-oxygen process and integrated

16. MITI is credited with effective coordination by O'Brien (1985, 1987, 1992) and McCraw and O'Brien (1986). But see O'Brien (1985: 144) for MITI complaints about the outcome.

17. Yonekura (1994: 207–215) makes much of MITI's initial dissent from Kawasaki's path-breaking proposal. O'Brien (1992) and especially Okazaki (1997: 89–91) document that Kawasaki did eventually obtain MITI backing.

steelmaking, both of which would reduce dependence on scrap, shifting the industry toward greater ore consumption.

The Japanese (and contrary to some authors, not the US) became the fastest in adoption of the basic-oxygen furnace, a superior new technology that both economized on scrap and offered productive efficiencies. MITI intervention helped Japanese firms license basic-oxygen technology at low cost on terms that made it available throughout the industry.¹⁸ Overall, the record suggests that government support accelerated a firm investment program that by then would in any case have been highly entrepreneurial and aggressive, as after 1956, highly expansive markets provided the Japanese opportunities for obtaining a competitive cost advantage.¹⁹

10. Comparative Advantage and the Problem of Raw Materials

Comparative advantage in a given industry reflects a nation's real resource cost of production, relative to other tradable goods. We can accordingly decompose changes in competitiveness into shifts in comparative advantage for steel production within the US and Japan.²⁰

In the US between 1956 and 1976, while the dollar depreciated by 17.8%, the real domestic cost of producing steel grew by 37%.²¹ Although steel had historically been a materials-intensive sector, by 1956 in the US, labor and materials each accounted for about the same share of unit input costs. Each also grew in real terms by roughly the same rate from 1956 to 1976: unit labor costs by 35% and unit material costs by 38%. Each therefore made like contributions to a loss in US comparative advantage in steelmaking. The main reason for the rise in unit material costs was a 48% increase of the real price of iron ore and (with our 1976 end date falling in the aftermath of the 1973 oil price shock) a near doubling of the real price of coke.

In Japan between 1956 and 1976 the real cost of steel fell by some 39%. Although wages increased more than 10-fold, gains in labor productivity more than compensated, so that real unit labor costs fell by 16.3%, accounting for about 5 of the 39% drop in real costs. The rest of the 39% was due to a decline in unit materials and energy costs.

In Japan in 1976 steel remained very much a materials-intensive industry; the unit cost of materials was over twice that of labor. Moreover, between 1956 and 1976 real unit costs for materials declined by some 46%. The great bulk of the gain in Japanese comparative advantage in steelmaking came from that sharp reduction in unit material costs. The largest contributing component was a 57% drop in the real price of iron ore.²² Despite OPEC, the real price of coke for Japan was also up just 8%.

18. There is a sizable literature on the introduction of basic-oxygen technology. The most complete and convincing treatment is by Lynn (1982), who concludes that there was rapid adoption by Japan and relatively slow adoption by the US.

19. Barnett and Schorsch (1983) view market expansiveness as the key advantage of the Japanese industry because it allowed firms to introduce large-scale capacity of the latest and most efficient technological vintage far more rapidly than competitors.

20. See Crandall (1981) for a book-length discussion.

21. Input price and cost data are from US Federal Trade Commission, Bureau of Economics (1977, vol. 1: 113–118), which reports data only for labor and material inputs. Real data are obtained from nominal by deflating with the producer price index for all commodities in the US and the wholesale price index for Japan.

22. Between 1956 and 1976, Japanese unit scrap utilization fell by 48%, while unit iron ore consumption increased by only 10%. Since iron ore and scrap are substitutes, the data suggest that iron ore purchased was of higher grade in 1976 than in 1956 and that the 57% figure for price decline understates the cost savings considerably. The FTC data make no adjustment for grade of iron ore consumption.

The contrast between the two industries arose from different path-dependent courses of development. To cope with the depletion of its Great Lakes ranges of high-grade iron ore, US firms in the 1950s made large investments in the mining and processing of taconite ores, which contain iron within quartzite rocks. By crushing taconite and forming it into pellets, ores with as little as 25% iron could be upgraded to 65% for ease and economy in shipping and blast furnace operation. The investment of some \$2.7 billion allowed the continued use of Great Lakes ore at prices that increased modestly before the 1970s, and thereby also allowed modernization of existing inland plants, and continued reliance on established transport infrastructure.

Meanwhile in Japan, real prices fell for imported materials with the emergence of new overseas sources—notably in Australia, Latin America and Canada—and a revolution in supply logistics. The revolution involved large public investments in port facilities, combined with large private investments in giant ore and coal carriers, and collaborative public and private encouragement of foreign mining and infrastructure development. It required coordination between Japanese shipbuilding and steel firms—who otherwise faced potential delays from ‘hold-up’ problems associated with bilateral monopoly—as well as public authorities’ coordination, which MITI oversaw and helped bring to fruition in remarkably short time. In the end, new bulk carriers brought raw materials to new steel plants on deep tidewater for much the lowest assembly costs in the world. Once a cost burden, Japan’s heritage of import dependence and coastal plant location had become a decisive advantage.

11. The 1960s and Early 1970s

Between 1960 and the early 1970s, Japanese steel firms raced against each other to build new integrated facilities at greenfield coastal sites. Although various authors try, in different ways, to attribute the rapid rate of expansion to MITI policies, MITI no longer had much aid to offer and proved powerless to slow the investment expansion (Yamawaki 1988: 292–299).²³

The race by steel firms to expand likely had a natural taproot in the dynamics of oligopolistic competition. Tendencies toward over-investment may have been aggravated by the Japanese system of corporate governance, which could lead firms to put growth before profits, and by vestiges of the MITI-coordinating process, which involved sharing information about firm plans for capacity expansion (Yonekura 1994: 231). Government announcement of an income-doubling plan in 1960 may have added further momentum by inspiring firm confidence that demand would be sufficient to justify their expansion. Firms may also have been inclined toward aggressiveness rather than caution because they perceived, in the event of difficulties, an implicit commitment of government aid, which would favor as it had in the past, firms that were larger and more efficient. Although the government tried to temper the race by orchestrating a 1970 merger between the two largest firms—Yawata and Fuji Steel—to form Nippon Steel, by then expansion plans were in place that were to carry the industry to long persistent, excess capacity.

23. O’Brien (1985, 1987, 1992) and McCraw and O’Brien (1986) attribute the expansion to MITI promotion of recession cartels in steel. Yamamura (1982: 77–112) makes a general argument that recession cartels spurred aggressive firm investment behavior. But in steel, recession cartels had only temporary effects on industry prices: the data indicate that prices were highly volatile over the cycle, much more so than in the US, where firms adhered to a long-standing practice of price leadership. The effective influence of industry cartel arrangements on investment quotas lasted only from 1958 to 1962. Thereafter, firms were unrestrained in vying for market share through investment in massive new plants (Kawahito 1972; Miwa 1988: 480–485; Yamawaki 1988: 292–299).

12. Conclusions

The long-term historical record for iron and steel provides little support for the contention that MITI-planning mechanisms or selection of specific industry targets was instrumental to Japan's miraculous economic performance after WWII. The record also provides little support for the view that industrial policy was irrelevant or even harmful to Japanese economic performance.

The record rather suggests that infant-industry promotion found success after WWII for much the same reasons as it had in Japan ever since the late 19th century. Postwar industrial policy proved beneficial less because of MITI targeting than because it responded to problems of high startup costs and immature financial markets by providing an overarching umbrella of protectionism and implicitly subsidized credit across wide swathes of the Japanese economy. Under the wide span of that umbrella, certain infant industries flourished spectacularly, iron and steel among them, with market forces acting as the key selection mechanism.

Without its long record of industrial policy intervention, Japan might never have become a major steel producer, for dependence on imported raw materials meant that it had little source of comparative advantage apart from the technical expertise and capital investments gradually accumulated over a distinctive, path-dependent course of development. At the least, without state intervention, steel industry development would have been substantially delayed.

As in earlier time periods, after WWII infant-industry promotion was abetted by a macroeconomic environment of underdevelopment and by effective institutions for bureaucratic public administration—institutions that had long distinguished Japan from most other developing nations. MITI-planning mechanisms most strikingly made an additional economic contribution by coordinating provision of public goods.

An implication is that in more recent years, as Japan outgrew underdevelopment, circumstances for industrial policy would grow less propitious. Another implication is that intervention is likely to be more successful where broadly applicable rather than narrowly targeted. A sector where Japan still lags behind global leaders that policymakers have singled out in more recent years for nurturance is high technology. But here targeting of computer hardware through preferential government purchases helped induce Japanese firms both to develop hardware capabilities and to neglect software development, the latter being an unintended consequence that illustrates the potential pitfalls of narrow targeting (Shinjo 1988: 333–363).

Broader lessons suggest both promise and peril. Over the long term, implicit public commitment of aid to troubled industries may have created moral hazard problems that contributed to difficulties with excess capacity—difficulties that worsened with economic maturity and a less favorable market environment. Japanese experience suggests that interventionist regimes pose a danger of overreaching and of imposing costs that offset benefits. Hopefully, better historical understanding will help limit future costs.

Funding

University of California (Pacific Rim Mini-Grant), Grant number PRRP 03-1089.

References

- Allen, G. C. 1981. *A Short Economic History of Modern Japan*. London: Macmillan.
- Amsden, Alice. 1989. *Asia's Next Giant*. Oxford: Oxford University Press.

- Aoki, Masahiko, Kevin Murdock and Masahiro Okuno-Fujiwara. 1997. 'Beyond the East Asian Miracle: Introducing the Market-Enhancing View.' In *The Role of Government in East Asian Economic Development*, eds. Masahiko Aoki, Hyung-Ki Kim and Masahiro Okuno-Fujiwara. Oxford: Clarendon Press: 1–40.
- Barnett, Donald F. and Louis Schorsch. 1983. *Steel: Upheaval in a Basic Industry*. Cambridge, MA: Ballinger.
- Beason, Richard and David Weinstein. 1996. 'Growth, Economies of Scale, and Targeting in Japan (1955–1990).' *Review of Economics and Statistics* 78: 286–295.
- Blumenthal, Tuvia. 1976. 'The Japanese Shipbuilding Industry.' In *Industrialization and Its Social Consequences for Modern Japan*, ed. Hugh T. Patrick. Berkeley, CA: University of California Press: 129–160.
- Carr, J. C. and W. Taplin. 1962. *History of the British Steel Industry*. Cambridge, MA: Harvard University Press.
- Crum, M. Colyer and David M. Meerschwam. 1986. 'From Relationship to Price Banking: The Loss of Regulatory Control.' In *America Versus Japan*, ed. Thomas K. McCraw. Cambridge, MA: Harvard Business School Press.
- Crandall, Robert W. 1981. *The U.S. Steel Industry in Recurrent Crisis*. Washington, DC: Brookings Institution.
- Crawcour, E. Sidney. 1997. 'Industrialization and Technological Change, 1885–1920.' In *The Economic Emergence of Modern Japan*, ed. Kozo Yamamura. Cambridge: Cambridge University Press: 50–115.
- Dower, John W. 1999. *Embracing Defeat: Japan in the Wake of World War II*. New York: W.W. Norton & Co.
- Elbaum, Bernard. 1986. 'The Steel Industry Before World War I.' In *The Decline of the British Economy*, eds. Bernard Elbaum and William Lazonick. Oxford: Oxford University Press: 51–81.
- Hanami, Andrew Kenichi. 1987. 'The State, Steel, and Development in Japan: A Comparative Analysis with the US.' Ph.D. Dissertation, University of California, Berkeley.
- Hein, Laura E. 1990. *Fueling Growth: The Energy Revolution and Economic Policy in Postwar Japan*. Cambridge: Harvard University Asia Center.
- Hellman, Thomas, Kevin Murdock, and Joseph Stiglitz. 1997. 'Financial Restraint: Towards a New Paradigm.' In *The Role of Government in East Asian Economic Development*, eds. Masahiko Aoki, Hyung-Ki Kim and Masahiro Okuno-Fujiwara. Oxford: Clarendon Press: 163–207.
- Iida, Kenichi. 1980. *Origin and Development of Iron and Steel Technology in Japan*. Tokyo: United Nations University.
- Ito, Takatoshi. 1996. 'Japan and the Asian Economies: A "Miracle" in Transition.' *Brookings Papers on Economic Activity* 2: 205–260.
- Itoh, Motoshige and Kazuharu Kiyono. 1988. 'Foreign Trade and Direct Investment.' In *Industrial Policy of Japan*, eds. Ryutaro Komiya, Masahiro Okuno and Kotaro Suzumura. New York: Academic Press: 155–182.
- . Masahiro Okuno-Fujiwara and Kotaro Suzumura. 1991. *Economic Analysis of Industrial Policy*. San Diego: Academic Press.
- Johnson, Chalmers. 1982. *MITI and the Japanese Miracle*. Stanford: Stanford University Press.
- Kawasaki, Tsutomu. 1985. *Japan's Steel Industry*. Tokyo: Tekko Shimbunsha, Ltd.
- Kawahito, Kiyoshi. 1972. *The Japanese Steel Industry*. New York: Praeger Publishers.
- Lerner, A. P. 1936. 'The Symmetry between Import and Export Taxes.' *Economica* 3(August): 306–313.
- Lynn, Leonard H. 1982. *How Japan Innovates: A Comparison with the U.S. in the Case of Oxygen Steelmaking*. Boulder, CO: Westview Press.
- Matsuyama, Kiminori. 1997. 'Economic Development as a Coordination Problem.' In *The Role of Government in East Asian Economic Development*, eds. Masahiko Aoki, Hyung-Ki Kim and Masahiro Okuno-Fujiwara. Oxford: Clarendon Press: 134–162.
- McCraw, Thomas K. and Patricia A. O'Brien. 1986. 'Production and Distribution: Competition Policy and Industry Structure.' In *America Versus Japan*, ed. Thomas K. McCraw. Boston: Harvard Business School Press: 77–116.
- Murphy, Kevin M., Andrei Shleifer and Robert W. Vishny. 1989. 'Industrialization and the Big Push.' *Journal of Political Economy* 97(5): 1003–1026.
- Mutoh, Hiromichi. 1988. 'The Automotive Industry.' In *Industrial Policy of Japan*, eds. Ryutaro Komiya, Masahiro Okuno, and Kotaro Suzumura. New York: Academic Press: 307–332.
- Nagashima, Osamu. 1991. 'Comment.' In *Changing Patterns of International Rivalry: Some Lessons from the Steel Industry* (International Conference on Business History 17), eds. Etsuo Abe and Yoshitaka Suzuki. Tokyo: University of Tokyo Press: 191–192.

- Nagura, Bunji.** 1981. 'The Prewar Japanese Steel Industry and Iron Ore Resources in Southeast Asia: The Development of Malaysian Iron Ore by the Ishihara Sangyo Company.' Working Paper, Japanese Experience of the UNU Human and Social Development Programme Series 33. Tokyo: United Nations University.
- Nakamura, Takafusa.** 1995. *The Postwar Japanese Economy*, 2nd ed. Tokyo: University of Tokyo Press.
- Nishida, Eiho,** ed. 1973. *History of Steel in Japan*. Tokyo: Nippon Steel Corporation.
- O'Brien, Patricia A.** 1985. 'Coordinating Market Forces: The Anatomy of Investment Decisions in the Japanese Steel Industry, 1945–1975.' D.B.A. Dissertation, Harvard University.
- . 1987. 'Coordinating Market Forces: The Anatomy of Investment Decisions in the Japanese Steel Industry, 1945–1975.' *Business and Economic History* 16: 205–209.
- . 1992. 'Industry Structure as a Competitive Advantage: The History of Japan's Post-war Steel Industry.' *Business History* 34(1): 128–154.
- Ohkawa, Kazushi and Henry Rosovsky.** 1997. "Capital Formation in Japan." In *The Economic Emergence of Modern Japan*, ed. Kozo Yamamura. Cambridge: Cambridge University Press: 203–238.
- Okazaki, Tetsujji.** 1991. 'Import Substitution and Competitiveness in the Prewar Japanese Iron and Steel Industry.' In *Changing Patterns of International Rivalry: Some Lessons from the Steel Industry* (International Conference on Business History 17), eds. Etsuo Abe and Yoshitaka Suzuki. Tokyo: University of Tokyo: 168–190.
- . 1997. 'The Government-Firm Relationship in Postwar Japanese Economic Recovery: Resolving the Coordination Failure by Coordination in Industrial Rationalization.' In *The Role of Government in East Asian Economic Development*, eds. Masahiko Aoki, Hyung-Ki Kim and Masahiro Okuno-Fujiwara. Oxford: Clarendon Press: 74–100.
- . 2001. 'The Government-Firm Relationship in Postwar Japan: The Success and Failure of Bureau Pluralism.' In *Rethinking the East Asian Miracle*, eds. Stiglitz Joseph E. and Shahid Yusuf. Oxford: The World Bank and Oxford University Press: 323–342.
- Pekkanen, Saadia M.** 2003. *Picking Winners? From Technology Catch-up to the Space Race in Japan*. Stanford: Stanford University Press.
- Pounds, Norman J. G.** 1952. *The Ruhr: A Study in Historical and Economic Geography*. London: Faber and Faber.
- Roepke, Howard G.** 1956. *Movements of the British Iron and Steel Industry, 1720 to 1951*. Urbana, IL: University of Illinois Press.
- Shinjo, Koji.** 1988. 'The Computer Industry.' In *Industrial Policy of Japan*, eds. Ryataro Komiya, Masahiro Okuno and Kotaro Suzumura. New York: Academic Press: 333–363.
- Smith, Thomas C.** 1955. *Political Change and Industrial Development in Japan: Government Enterprise, 1868–1880*. Stanford: Stanford University Press.
- Sumiya, Mikio,** ed. 2000. *A History of Japanese Trade and Industrial Policy*. Oxford: Oxford University Press.
- Tresize, Philip H.** (with the collaboration of Yukio Suzuki). 1976. 'Politics, Government, and Economic Growth in Japan.' In *Asia's New Giant*, eds. Hugh Patrick and Henry Rosovsky. Washington, DC: Brookings: 753–812.
- United Nations Department of Economic Affairs.** 1950. *World Iron Ore Resources and Their Utilization*. Lake Success, NY: United Nations.
- US Bureau of Corporations.** 1913. *Report of the Commissioner of Corporations on the Steel Industry*, 3 vols. Washington, DC: US Government Printing Office.
- US Federal Trade Commission, Bureau of Economics, Staff Report.** 1977. *The United States Steel Industry and Its International Rivals*. Washington, DC.
- Vestal, James.** 1993. *Planning for Change: Industrial Policy and Japanese Economic Development, 1945–1990*. Oxford: Oxford University Press.
- Wade, Robert.** 1990. *Governing the Market*. Princeton: Princeton University Press.
- Warren, Kenneth.** 1975. *World Steel: An Economic Geography*. New York: Crane, Russak & Company, Inc.
- Weinstein, David.** 2001. 'Historical, Structural, and Macroeconomic Perspectives on the Japanese Economic Crisis.' In *Japan's New Economy: Continuity and Change in the Twenty-First Century*, eds. Magnus Blomstrom, Byron Gangnes and Sumner La Croix. Oxford: Oxford University Press.
- World Bank.** 1993. *The East Asian Economic Miracle: Economic Growth and Public Policy*. Oxford: Oxford University Press.

- Yamamura, Kozo.** 1982. 'Success That Soured: Administrative Guidance and Cartels in Japan.' In *Policy and Trade Issues of the Japanese Economy*, ed. Kozo Yamamura. Seattle: University of Washington Press: 77–112.
- . 1995. 'The Role of Government in Japan's "Catch-up" Industrialization: A Neoinstitutionalist Perspective.' In *The Japanese Civil Service and Economic Development: Catalysts of Change*, eds. sHyung-Ki Kim, Michio Muramatsu, T. J. Pempel, and Kozo Yamamura. Oxford: Oxford University Press: 102–132.
- Yamawaki, Hideki.** 1988. 'The Steel Industry.' In *Industrial Policy of Japan*, eds. Ryutaro Komiya, Masahiro Okuno and Kotaro Suzumura. New York: Academic Press: 281–302.
- Yonekura, Seiichiro.** 1994. *The Japanese Iron and Steel Industry, 1850–1990*. New York: St. Martin's Press.
- Yonezawa, Yoshie.** 1988. 'The Shipbuilding Industry.' In *Industrial Policy of Japan*, eds. Ryutaro Komiya, Masahiro Okuno and Kotaro Suzumura. New York: Academic Press: 425–450.