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A Long, Contingent Path to Comparative Advantage:
Industrial Policy and the Japanese Iron and Steel Industry, 1900-1973

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Abstract

From the 1890s to 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 suggests the importance of large and pervasive market failures within a national context of underdevelopment. Over the longer term, on the other hand, as the Japanese economy grew more mature and its markets less expansive, implicit public commitment of aid to troubled industries may have engendered moral hazard, over-investment, and excess capacity—a set of problems that significantly reduces the attractions of the Japanese model.

A Long, Contingent Path to Comparative Advantage:
Industrial Policy and the Japanese Iron and Steel Industry, 1900-1973

As of the mid 1970s, the Japanese iron and steel industry led the world in production, exports, and efficiency, and posed enough competitive menace to companies and jobs in Europe and the United States to provoke protectionist measures. Public inquiries then held in the United States found little evidence of differential government aid (see United States Federal Trade Commission, 1977, pp. 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 strong basis for optimism regarding industry prospects *ex ante*. Upon founding modern Japanese steel-making 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 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 (Yonekura, 1994, p. 33; Warren, 1975, pp. 100-101; Allen, 1981, p. 212).

Within 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* (Eg. Matsuyama, 1997, pp. 134-162).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: 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 post-W.W.II era. The main distinction of the present paper is its attempt to place industrial policy debate in new light by drawing upon theoretical models to flesh out opposing arguments and by assessing the arguments against the long-term, comparative record.

¹ Debate is sufficiently polarized that I know of no source in English on industrial policy in the steel industry which adopts the middle position taken by the present paper.

Pre-W.W. 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 percent. From 1880 to 1920, central and local government expenditures took 14 percent of GDP, the largest single component going to the military, which in the three successive decades after 1890, absorbed 34, 48, and 41 percent of total government outlays (Crawcour, 1997, pp. 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 percent of the workforce. But from 1880 until World War I most of gross national investment came from public expenditures (Ohkawa and Rosovsky, 1997, p. 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, p. 103).

In 1891, the Japanese government submitted a bill before the Diet for the establishment of its own steelworks. An accompanying statement underlined that private ventures would be unprofitable until exploration uncovered a viable domestic source of iron ore, and 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.

In the early 1890s, domestic steel supply failed to expand significantly, despite a boom in steel demand fed by railroad construction and ongoing military buildup. In 1895, amid patriotic fervor fueled by the Sino-Japanese war, the government passed by overwhelming majority a bill to establish a state-owned iron and steel works on the coast at Yawata.²

Founded with military purposes foremost in mind, Yawata was to include an arsenal to meet specialized navy demand. Despite navy objections, the arsenal was never built, falling victim to competing priorities and budgetary constraints. Upon completion, the bulk of Yawata's output went for civilian demand, where its principal product—rails—was much in demand from the nationalized railway.

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 World War II in English.

Without its Yawata arsenal, the navy turned to the private sector for military production. Before World War I, 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 war-time.

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 steel-making 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, p. 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 steel-works 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, pp. 32-59).

Contrary to optimistic scenarios, raw materials at first posed another difficulty. In the early twentieth century, iron and steel production was materials intensive, with raw materials comprising the greater part of costs.³ The European and U.S. industries had grown up on ore and coal fields. No country had ever before ventured into steel-making so resource poor as Japan.

Yawata was founded with captive ownership of the Futase coal mines, which could provide some 50-60 percent of its coal consumption (Kawasaki, 1985, p. 397). Initial plans to supply the Yawata works with 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

³ Raw materials comprised some 60 percent of costs for the British steel industry. The figure is unlikely to have been very different for Japan.

output, however, fell far below expectations: 1,700 tons in 1901, just 63,000 tons in 1906, 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 steel-making techniques and adapt them to a distinctive raw material supply (Yonekura, 1994, pp. 35-56).

In short, public undertaking of iron and steel production was marred by serious mismanagement and miscalculation. Still, intervention yielded upward trending benefits which 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 were 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, pp. 35-56, 74). By comparison with nationalized steel industries later established in other less developed economies, 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 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 World War I, contrary to prominent contemporary and historiographic 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 yen per ton, compared favorably with costs per ton of 18.7 in Britain and 15.0 in the United States. At 7.0 yen 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 United States. 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 world-wide, and below that in Britain or the United States (Okazaki, 1991, pp. 171-173).⁴

Ex ante the Japanese could hardly have anticipated obtaining such low materials costs. But a careful reading of comparative experience on the eve of World War I 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 World War I importing one-third of its ore requirements; if allowance is made for iron content, the figure would be of the order of 46 percent. 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, pp. 190-191; Roepke, 1976, p. 78; pp. ; Elbaum, 1986, pp. 71-73). Germany's main production center in the Ruhr imported over 50 percent of its ore, chiefly from Sweden and Spain (Pounds, 1952, pp. 112). The U.S. 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 U.S. industrial heartland, but distant from other important markets. Major U.S. producers transported their domestic Great Lakes ores some 1500 kilometers, 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 U.S. producers were

⁴ I report figures from Okazaki, 1991, pp. 171-173, for consistency of comparison across the different countries. Okazaki's unit cost figures, however, appear too high for the United States, where data reported by vertically integrated companies, particularly U.S. Steel Corporation, are distorted by monopolistic ownership of ore and transport, and by internal transfer pricing designed to shift profits. If instead U.S. unit costs are calculated from estimates reported by the U.S. Bureau of Corporations (1913, p. 335), which correct for the distortions, the figures would be significantly lower. The qualitative picture, however, would remain unchanged.

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 8000 km away (Warren, 1975, p. 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 ordered the Industrial Bank of Japan to extend huge loans. The arrangement 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 U.S. 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 materials. 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 low cost Asian resources were available exclusively to Japanese producers.

In the last years before W.W.I, Yawata became quite profitable. So did Japan's private steel-makers, 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 percent tariff. During the war-time 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 (Okazaki, 1991, pp. 168-175; Nagashima, 1991, pp. 191-192; Crawcour, 1997, p. 106).

From the Japanese policy standpoint, the coming of World War I vindicated the government's bet on strategic military concerns as 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 in a sort of low development trap in which lack of international competitiveness blocked accumulation of modern industrial expertise and human capital--a presumption rendered plausible for iron and steel by the limited extent of private ventures. Intervention aimed 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 opportunity for very large gains from escaping the low development trap 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, the leading Asian centers of steel-making might have been built by European or American multinationals in Korea or China, and might have yielded greater efficiency.

If the government arrived at a winning portfolio for industrial policy support, success seems to have derived less from powers of selectivity than from the prevalence of low enough opportunity costs to make the potential for misallocation of resources a secondary concern. Amid underdevelopment, opportunity costs may well have been low because different industries were more likely to be complements than substitutes (Aoki, Murdock, and Okuno-Fujiwara, 1997, p. 6). Collectively, state industrial interventions might have generated a “big push” that helped overcome supply and demand constraints in a set of complementary sectors, providing each other with markets, inputs, entrepreneurship, and capital. In addition, for Japan circa 1900 or even as late as the

1950s, the opportunity cost of labor may have been quite low, perhaps as low as that of underemployed agricultural labor.

Had world war 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 1905-11.⁵ 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.

From the First World War Through the Second

The war-time 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 industrywide efficiency. Yawata increased the scale of its steel-making 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 percent of issued stock. Leading zaibatsu competed in a basically capitalist

⁵ From 1907 to 1973, Japanese steel output in tons grew at a compound annual rate of 10.8% (Kawasaki 1985, pp. 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 (United States Federal Trade Commission 1977, pp. 217-8)..

market environment, but stood out because of their financial and managerial resources and political connections, and were called upon to serve as economic agents of a government committed to their success (Crawcour, 1997, pp. 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. Steel-makers who imported their pig iron benefited enough from cheap Indian supplies 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, pp. 168, 179-180).

Having encouraged aggressive war-time expansion that compounded later distress the government again came to the aid of the industry. Government intervention was in part—as in interwar Britain—a response to the unfavorable macroeconomic environment.

Government rescue measures included enactment of higher tariff levies on steel (1921 and 1926) and subsidies on the production of pig iron (1926). By reducing the competitive threat from imports, protection and subsidy 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 integrated zaibatsu organization.⁶

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, p. 131; Yonekura, 1994, p. 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 (formerly Tanaka Mining), by the late 1920s, the cost of pig iron matched that of Yawata and of Vereinigte Stahlewerke Aktiengesellschaft in Germany (Okazaki, 1991, pp. 84-85).

“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, p. 118). In 1931 Japan abandoned gold and the yen fell some 40

⁶ On contingent rents and agency costs see Hellman, Murdock, and Stiglitz, 1996, pp. 163-207.

percent in value. Thereafter, the cost of finished steel fell below that of German imports and Japanese steel-makers became highly profitable.

Profits were boosted by maintenance of subsidies until 1934 and tariffs through the 1930s, well after protection had served its original purpose. 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, pp. 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 steel-making than in alternative uses. Japan's fledgling capital markets, however, would have had 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 intervention costs.

As before the tally of costs and benefits is likely dominated by returns from military buildup (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. At its prewar peak, Japanese industry output was a tenth the level of the United States, 58 percent of Britain, 37

percent of Germany, and 149 percent of France. If dwarfed by the world's largest industries, Japan had nonetheless become a sizable producer.

In the latter 1930s, the central question for the industry once again became raw materials, as a drive for military self-sufficiency made remarkable strides, but ultimately fell short, with disastrous wartime consequences. In 1934 legislation mandated 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. By late 1937, Japanese iron and steel consumption as well as production passed under control of the military government under an administrative apparatus featuring elements that carried over to the post-war period.

Rebuilding from World War II

Immediately after W.W.II, 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. After the onset of the cold war, the occupying authority—the Supreme Command for the Allied Powers (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. Despite a retreat from de-concentration policies, 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, p. 544).

How MITI Planned

MITI promptly initiated consultations between industry and government, which became the basis for its first rationalization plan. The process of policy formulation and implementation was marked by what some authors dub “bureau pluralism” and others, with more negative connotations, call “bureaucratic sectionalism” (Tresize, 1976, p. 786). Industry associations and government planning agencies—with antecedents that went back to World War II-- made policy by conferring and bargaining with each other. The process was pluralistic (or sectionalist) in that it involved various private interests and government ministries. Its decentralized structure allowed local information to flow upwards to decision-makers responsible for broader policy (Okazaki, 1997, pp. 76-81; Okazaki, 2001, pp. 332-333; Aoki, Murdock, and Okuno-Fujiwara, 1997, pp. 31-32; Tresize, 1976, pp. 783-805).

While industry and MITI representatives deliberated, a wider debate occurred over what course of economic development was desirable. A sizable literature depicts the debate as concerning a choice between light industry, favored by static comparative advantage, and heavy industry, favored by more dynamic considerations. Another body

of literature makes much of the guidance for industry target selection from detailed projections provided by MITI planning mechanisms.

The industries MITI in fact chose for promotion, however, conform to no single, coherent model of economic development. Industries selected include most that were targeted during immediate post-war reconstruction—among them electric power and textiles—and spanned light as well as heavy industries, recommendations from both camps in policy debate. Rather than being driven by a specific economic viewpoint, industrial policy “was and would continue to be an amalgamation of past policies and experiences, concerned more with practicality than with a single *raison d’être*” (Vestal, 1993, p. 34). Antecedents for a MITI stance favoring promotion of heavy industry can be found in the views of preceding governmental agencies, various business associations, and even SCAP (Dower, 1999, pp. 538-540; Vestal 1993, p. 17).

Nor could much stock be put in the projections MITI obtained from consultations with industrial associations. Optimistic projections, it should be recognized, are common when firms go looking for capital or public subsidy. If steel firms consistently overshot projections by a large margin, coal mining companies, for example, hardly began to implement projected plans for investment and rationalization as Japan’s coal deposits proved to be too poor to meet competition from foreign coal and oil (Hein, 1990, pp. 230-235).

In theory, targeting could reap gains from trade if it identified and promoted *ex ante*, industries that turned out to have more elastic demand and higher productivity growth *ex post* (Itoh, Kiyono, Okuno, and Suzumura, 1988, pp. 257-276; Itoh, Kiyono, Okuno-Fujiwara, and Suzumura, 1991, pp. 31-40, 75-90). Itoh and Kiyono (1988, p.

157) report that between 1956/57 and 1964/65, Japan in fact benefited from a high income elasticity of world demand for its exports and a low income elasticity for its imports. On the other hand, Beason and Weinstein (1996) find that between 1955-90, 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 amount of Japanese productivity convergence with the United States. The latter 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. But 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.

Ex post, the case data indicate that the government targeted--and shielded from damaging foreign competition in the home market--a striking number of industries that went on to spectacular achievement. *Ex ante*, the question of target selection is more problematic, as evidenced by the case of steel.

In iron and steel, raw material costs once again presented a wide and crucial margin of uncertainty *ex ante*. With the rise of communist regimes, pre-war 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, 1950, p. 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.

On the other hand, a consensus formed around iron and steel as a target for industrial policy because of the high input costs it was imposing on Japanese users, which left the first MITI rationalization plan facing some of the same problems of post-war reconstruction as had SCAP.⁷ In June 1950 planning and debate were overtaken by the onset of the Korean War 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 percent higher than those of its chief foreign competitors, posing a critical handicap for the competitiveness of domestic machinery manufacture (Kawahito, 1972, p. 23).

In important respects, post-WWII prospects for steel-making also were better and the case for public support stronger than in earlier periods. The industry had been throughout its history more a technological imitator and adapter than innovator. But by now it had a long record of efficiency gains, and of productivity advances in excess of wage increases, which had by the 1930s allowed it to attain competitive cost levels. Should past trends continue, the future held the prospect of advantageous labor costs. If raw materials posed great uncertainty, the industry by now had a 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).

⁷ There was a movement by larger mining companies in the early 1930s toward mechanization, rationalization, and large-scale production. But smaller mines were labor-intensive, and relied on forced labor well before World War II (Hein, 1990, pp. 31-37)

In addition, infant industry arguments obtained renewed plausibility from a gap in market coordination created by the dissolution of the zaibatsu, recent privatization, and disruption of industrial production and financial markets. Adding to the case for intervention, as in the 1920s, were the sizable industry-specific investments in steel production capacity and skills already in place, the professed willingness of private firms to invest, the potential for external economies arising from inter-industry complementarities, and the low prevailing opportunity cost of labor (Aoki, Murdock, and Okuno-Fujiwara, 1997, p. 6).

But if MITI targeting of steel could find promising support in infant industry arguments, *ex ante* it remained a highly risky venture, and amid such great uncertainty, it seems doubtful that MITI possessed special skill in gauging expected return against risk. Much the same appears true of the overall portfolio that MITI targeted, which tilted toward heavy industry, but avoided high technology sectors of the day to specialize in the likes of automobiles, consumer electronics, and shipbuilding. In each of these industries, the Japanese were at war's end well behind Western standards of technology and productivity. In each, Japanese gains in competitiveness depended upon narrowing the productivity gap while exploiting low wages, a prospect, circa 1950, that was highly uncertain.

After World War II, as in the early 1900s, industrial policy success appears to have owed less to government powers of portfolio selection than to a macroeconomic environment of underdevelopment, in which industries were more likely to be complements than substitutes, the opportunity cost of labor was low, and the potential for misallocation of resources a secondary concern. Amid the nexus of industries just cited,

for example, autos and shipbuilding were to provide Japanese steel with rapidly expanding demand in the home market, and shipbuilding and steel were to provide one other with vital reductions in input costs—a scenario that MITI could hardly have anticipated as early as 1950.

The MITI Rationalization Plans in Steel: Mechanisms and Cumulative Results

MITI undertook three successive rationalization plans for iron and steel: from 1951–55, 1956-60, and 1961-65. For the first and second plans, MITI drew upon several pieces of legislation which 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.

The steel industry also obtained allocations of cheap credit. In the first plan low interest loans from the Japan Development Bank provided 9 percent 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 supplied 1.2 percent of the financing itself and forwarded another 6.8 percent 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, p. 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, p. 136). In 1952 the Ministry of Finance explicitly requested financial institutions to emphasize loans to steel among other industries (Vestal, 1993, p. 120). The Bank of Japan also mediated efforts by city banks to organize loan consortia (Okazaki, 1997, p. 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 (Vestal, 1993, p. 119; Yamawaki, 1988, pp. 289, 304 note 14). Foreign exchange controls, from which industry imports could be exempted at MITI discretion, provided further protection, until eliminated for imports of pig iron and steel in 1960-61.

Between 1961-76, 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 1960-74 steel production increased by 438 percent, output grew to rival that of the U.S. in magnitude, and exports grew from 14 to some 40 percent of output. The high growth achieved during a relatively free market regime for the industry unduly colored subsequent assessments of industrial policy impact.

In a 1977 report, the U.S. Federal Trade Commission (FTC) estimated that cumulative post-war subsidies to the Japanese industry circa 1975 amounted only to some one-fifth of one percent of the delivered price of Japanese steel to the United States (pp.

367-370). The magnitude of subsidies relative to Japanese costs, however, would have been far larger in the early 1950s, when the FTC concedes, “they improved the competitive chances of the Japanese steel industry during its formative years” (p. 372). The largest aid components were then the tariffs and exchange controls that limited imports to less than 3 percent of sales despite high domestic costs.

The FTC calculation of cumulative subsidy value is also conceptually flawed. 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 nontraded good into an exportable (United States Federal Trade Commission, 1977, pp. 329; Itoh and Kiyono, 1988, p. 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 were a key period when the Japanese industry made strategic

competitive gains. By far the greater gain in Japanese/U.S. unit production costs came in 1951-56 and 1956-60, when the ratio fell from some 1.5 to 1.08 and then to .71, as opposed to 1960-76, when it fell further to .55 (United States Federal Trade Commission, 1977, pp. 113; Kawahito, 1972, p. 23). Until 1960 the real cost of Japanese steel fell sharply; between 1960-76 it was unchanged.⁸

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.

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 re-build domestic industries without violation of the rules of international commerce. The FTC was also correct in deeming retaliatory subsidy by the United States as an unappealing option, for by the time the Japanese emerged as major competitors in the 1970s, they had acquired a crushing competitive advantage.

⁸ My calculation of relative Japanese/U.S. costs is from data estimated by United States Federal Trade Commission (1977, pp. 113); and for 1951, from Kawahito (1972, p. 23). To obtain an index of real costs, that data was deflated by the Japanese producer price index reported in Allen (1981, pp. 279).

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

The emphasis of the first rationalization plan was on improvement of existing plant, especially in rolling, by rounding out, renovation and replacement of old pull-over mills with strip mill technology licensed from the United States. Because new investments had to fit the proportions of existing facilities, the results could fall short of best practice technique abroad. Although some credit MITI with ameliorating the problem through effective investment coordination, MITI sought to maintain neutrality and inter-firm competition by preserving market shares, a practice that was inconsistent with full exploitation of scale economies to minimize costs.⁹

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 at Chiba—a facility that anticipated the later course of industry development. But contrary to some accounts, MITI did approve of the proposal in principle and ultimately MITI and the Bank of Japan decided to help fund it.¹⁰

By 1956 labor productivity remained low, and raw materials costs high. But low real wages provided sufficient offset, and industry costs were competitive. Being cost competitive, steel by 1956 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

⁹ MITI is credited with effective coordination by O'Brien (1985, 1987, 1992); and McCraw and O'Brien, (1986). But MITI itself complained that investments were haphazard and had caused over-production. See O'Brien (1985, p. 144).

¹⁰ Yonekura (1994, pp. 207-215) makes much of MITI dissent from Kawasaki's path breaking proposal. But O'Brien (1992) and especially Okazaki (1997, pp. 89-91) document that Kawasaki did have MITI backing.

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 the second plan, investment concentrated on elimination of the shortfall of pig iron from steel capacity, and introduction of basic oxygen furnaces in steel-making. The Japanese (and contrary to some authors, not the United States) became the fastest in adoption of the basic oxygen furnace, a superior new technology that offered productive efficiencies as well as economies in scrap utilization. MITI intervention helped Japanese firms license basic-oxygen technology at low cost on terms that made it available throughout the industry.¹¹ 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.¹²

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 United States and within Japan.

¹¹ 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 United States.

¹² 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.

In the United States between 1956-76, while the dollar depreciated by 17.8 percent, the real domestic cost of producing steel grew by 37 percent.¹³ Although steel had historically been a materials intensive sector, by 1956 in the United States, 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 1956-76: unit labor costs by 35 percent; unit materials costs by 38 percent. Each therefore made like contributions to a loss in U.S. comparative advantage in steel-making. The main reason for the rise in unit materials costs was a 48 percent increase of the real price of iron ore, and (with our 1976 end date falling in the aftermath of the 1973 OPEC 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 percent. Although wages increased more than tenfold, gains in labor productivity more than compensated, so that real unit labor costs fell by 16.3 percent, accounting for about 5 of the 39 percent drop in real costs. The rest of the 39 percent 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 1956-76 real unit costs for materials declined by some 46 percent. The great bulk of the gain in Japanese comparative advantage in steel-making came from that sharp reduction in unit materials

¹³ Input price and cost data are from U.S. Federal Trade Commission (1977, vol. 1, pp. 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 United States, and the wholesale price index for Japan.

costs. The largest contributing component was a 57 percent drop in the real price of iron ore.¹⁴ Despite OPEC, the real price of coke for Japan was also up just 8 percent.

The contrast between the two industries arose from different path dependent courses of development. To cope with the depletion of its Great Lake ranges of high-grade iron ore, in the 1950s, U.S. firms 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 percent iron could be upgraded to 65 percent for ease and economy in shipping and blast furnace operation. The investment of some \$2.7 billion allowed the continued use of Lake 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 as firms turned to new overseas sources—notably to Australia, Latin America, and Canada--and reinvented supply logistics. The government assisted in the financing of investments and in the provision of public goods, with MITI playing a coordinating role. Transport costs were revolutionized. By the end of the decade, Japanese bulk cargo carriers, modeled on the giant oil tanker (which Japan also pioneered), carried raw material supplies from new foreign sources to new steel plants on deep tidewater for much the lowest assembly cost in the world. Once a cost burden, Japan's heritage of import dependence and coastal plant location had become a decisive advantage.

¹⁴ Between 1956-76, Japanese unit scrap utilization fell by 48 percent, while unit iron ore consumption increased by only 10 percent. 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 percent figure for price decline understates the cost savings considerably. The U.S. Federal Trade Commission data make no adjustment for grade of iron ore consumption.

The Sixties 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 (Miwa, 1988, pp. 480-485; Yamawaki, 1988, pp. 292-299).¹⁵

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, p. 231). MITI 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.

¹⁵ O'Brien (1985, 1987, 1992) and McCraw and O'Brien (1986) attribute the expansion to MITI promotion of recession cartels in steel. Yamamura (1982, pp. 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 United States, where firms adhered to a long-standing practice of price leadership. The effective influence of industry cartel arrangements on investment quotas lasted only from 1958-62. Thereafter, firms were

Conclusions

Japanese industrial policy made an important contribution to steel industry achievement even though it was flawed, subject to political influence, and based on limited forecasting power *ex ante*, particularly with regard to the recurrent problem of raw materials. Without industrial policy intervention, Japan might never have become a major steel producer, for it had little source of comparative advantage apart from the technical expertise and capital investments it gradually accumulated over a long extended period. At the least, without state intervention, industry development would have been substantially delayed.

The 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 and that limit the attractions of the Japanese model.

The experience of the Japanese steel industry also suggests that international trade has long involved friction over strategic policies that seek the domestic acquisition of good jobs that offer opportunities for training, technological learning, and commensurately high pay. Although economic literature often tries to describe strategic trade behavior with symmetric game theory models, in the case of steel, resolution sprung from asymmetries between the parties that were rooted in divergent, path dependent courses of development.

unrestrained in vying for market share through investment in massive new plants (Kawahito, 1972; Miwa, 1988, pp. 480-485; Yamawaki, 1988, pp. 292-299).

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