

Success Illgotten? The Role of Meiji Militarism in Japan's Technological Progress

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*Success Illgotten?  
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**T**HE central goal of this brief essay is to argue that Meiji Japan's sustained efforts to build "a strong army" and its decision to wage a war with China in 1895, and another with Russia in 1904, contributed in substantive ways to building the technological foundation for Japan's successful industrialization. The argument is based on two closely related hypotheses. First, the "strong army" policy, combined with the wars, was the principal motivation behind creating and expanding the arsenals and other publicly-financed shipyards and modern factories which acted as highly effective centers for the absorption and dissemination of Western technologies and skills. The other hypothesis is that the "strong army" policy and the wars provided, at crucial junctures, the demand necessary for assuring the survival and for aiding the growth of often financially and technologically struggling private firms in the shipbuilding, machinery, and machine-tool industries. Moreover, it was on the technological and productive foundation established in these industries that Japan was able to benefit to the extent it did from the opportunities offered during the First World War and to continue, through the interwar years, to transform its economy by expanding its heavy electric machinery and chemical industries.

The body of this essay presents the historical evidence needed to support these two hypotheses. The remaining few pages examine the views of other scholars on the effects, beneficial or detrimental, of Meiji militarism on Japan's economic performance. Readers' attention is also directed to the insights gained from this study and to the potential usefulness of further studies of the role of the "strong army" policy and the wars for increasing our knowledge of Japanese economic history of the Meiji and interwar periods.

FROM THE RESTORATION TO THE EVE OF THE SINO-JAPANESE WAR

After being forced to sign the humiliating unequal treaties with the Western powers and witnessing also the fate of China, the new Meiji

*Journal of Economic History*, Vol. XXXVII, No. 1 (March 1977). Copyright © The Economic History Association. All rights reserved. This essay is an abbreviated version of the first half of my study on processes of technological change in prewar Japan.

government hastened to expand Japan's military capabilities. Thus, within a dozen years of the Meiji Restoration, four major arsenals with satellite plants and three government shipyards were fully engaged in supplying the needs of a modern military force.

Two of the arsenals, located in Tokyo and Osaka, were for the army. In 1877 the Tokyo arsenal was equipped to repair small arms and cannons, and to produce explosives and simpler hand-operated machinery for its own use.<sup>1</sup> Only seven years later, in 1884, the arsenal had Belgian, French, and German engineers and foremen, imported machinery, 2,094 workers, and was capable of producing small arms and shells and of repairing larger cannon. The Osaka arsenal was established even earlier, as it had the benefit of the skilled men and tools employed at Osaka castle and the Bakufu's Nagasaki ironworks.<sup>2</sup> By 1870 it was already repairing small arms and producing guns of a French design from copper processed domestically. By 1883, the Osaka arsenal had succeeded in building a reverberatory furnace and, with imported machinery and the assistance of an Italian artillery major, it began to produce one year later a large quantity of explosives and large shells and a variety of larger cannon. The number of workers employed at the arsenal stood at 925 in 1884.

The navy's arsenals in Yokosuka and Tsukiji were no less ambitious. The Yokosuka arsenal took over the Bakufu's ironworks at Yokosuka immediately following the Restoration, and by the end of 1871 it had a completed dock, "116 pieces of machinery," and "50 melting furnaces."<sup>3</sup> When in 1882 a decision was made to discontinue the production of wooden ships and to produce iron ships exclusively, three 12-ton steam hammers were imported for this purpose and a blast furnace of 5-ton capacity was constructed in the same year. In 1884, when an unspecified number of skilled workers and a 12-ton crane arrived from England, the arsenal was ready to carry out its earlier decision to build iron ships. The Tsukiji arsenal, begun with the

<sup>1</sup> Among a dozen Japanese sources on the development of the arsenals and other government-owned plants which were established mainly for military purposes, the following two works by Hirotake Koyama are most useful: *Kinsei Nihon gunjishi gaisetsu* (A survey of the military history of modern Japan), (Tokyo, 1944); and *Nihon gunji kōgyō no shiteki bunseki* (A historical analysis of Japanese military industries), (Tokyo, 1972). Facts contained in this and the following paragraphs are obtained from pp. 64-70 of the latter.

<sup>2</sup> Despite several isolated efforts made by a few domains (*han*) during the last decades of the Tokugawa period, technological capabilities attained in metallurgy and machine-making before the Restoration were clearly insufficient for meeting the needs of a modern army as envisioned by the Meiji leaders. See Koyama, *A historical analysis*, pp. 100-02; and Terutomo Makino, *Meiji-Taisho-shi*, (A history of the Meiji-Taisho periods), vol. 3, *Keizai-hen* (Volume on economy), (Tokyo, 1930), pp. 282-87 and pp. 303-06.

<sup>3</sup> Koyama, *A historical analysis*, p. 69.

machinery acquired from two Bakufu shipyards, was repairing ships and cannon by 1874. The arsenal was designated to concentrate on steel making, and in 1882 succeeded in constructing “a Krupp-type crucible” and began to produce the first “Western steel.” Providing the needed expertise for the accomplishment were two Japanese who had been sent to England and Germany to acquire the metallurgical knowledge.<sup>4</sup> By 1884 the arsenal was employing 720 workers and was producing machine guns, cannons, gun carriages, shellcase pulleys, and numerous other requirements of a modern army.

It is important to note that the efforts made to import Western metallurgical technology by the Bakufu and a few large domains before the Restoration were “hardly useful” in meeting the needs of the Meiji military. The technology available in 1868 was insufficient to produce tempered and cast iron in the large quantity needed for modern machinery or military ordnance, and a rolling press imported by the domain of Saga remained unused by the time of the Restoration.<sup>5</sup> Also, for most of the Meiji period only the arsenals were successfully able to use “Western-type” blast furnaces. The Meiji government’s efforts, beginning in 1874, to build and operate two large blast furnaces at Kamaishi proved unsuccessful from the start, despite an investment of 2.5 million yen and the guidance of English specialists. In 1882 the venture was declared a total failure with the principal blame placed on the difficulty in obtaining suitable ore and a sufficient amount of coke, as well as on the inexperience and incompetence of the personnel involved. No private buyers could be found when the Kamaishi plant was placed on sale in 1883.

Three machine-tool factories—cum—shipyards were begun in Nagasaki, Hyogo, and Akabane, all in 1871, under the jurisdiction of the Ministry of Construction. Their task was to meet “in all spheres, the needs of public bodies and private firms” by “learning from England.”<sup>6</sup> Their initial duties and performance left little doubt that their primary responsibility in fact was to meet the needs of the military. By 1884 the Nagasaki shipyard had acquired a dock, plants for iron casting and tempering, a “copper plant,” a 50-ton crane, steam hammers, riveting machines, and a French advisor. Having

<sup>4</sup> On the technological changes in the iron and steel industry during this period see Seiichi Kojima, *Nihon tekkō-shi* (A history of iron and steel in Japan), *Meiji-hen* (the Meiji volume), (Tokyo, 1945), pp. 155-82.

<sup>5</sup> *Ibid.*, p. 155.

<sup>6</sup> This is from an 1875 report of the Ministry of Construction (Kōbushō) as quoted in Koyama, *A historical analysis*, p. 74.

acquired the capability to repair many ships and to produce “many types of machines,” the shipyard was willing to overstate its ability in 1884 and claim that the quality of the boilers it produced was “widely known even by foreigners.” The Hyogo shipyard, which came into being by acquiring ironworks from an American trading company, built a dock and steadily bought “more machinery required in building iron ships” in order to specialize in the repair and construction of ships. The Akabane machine factory, begun with the machinery imported by the domain of Saga, imported a variety of machinery to produce steam engines. By 1883 it had produced the first 40-HP steam engine; in the same year, this factory was transferred to the navy “along with its 139 pieces of installed machinery.” In 1883 the total number employed by these three factory-shipyards was about 1,200, exclusive of foreigners and administrative personnel.<sup>7</sup>

These arsenals and the government shipyards which spearheaded Meiji Japan’s technological progress were important both because they were large by Meiji standards and because many of them aided private, nonmilitary shipyards and factories. In the early 1880s, when the cotton textile industry had yet to make its presence felt in the Meiji economy, these arsenals, shipyards, and their satellite plants together employed about 10,000 workers compared to fewer than 3,000 in the small private shipyards producing wooden ships and in the factories “still primarily using or making machinery of a ‘pre-machine age.’”<sup>8</sup> Fourteen private “shipyards” together employed 1,076 and many aspiring “modern” factories, each with less than 10 workers, employed the remainder of this 3,000.

That these technologically advanced arsenals and government shipyards actively aided the private sector can be shown readily. From the late seventies to the early eighties the Osaka arsenal is known to have produced a “large number” of “machines” used with steam engines, lathes, planers, grinding machines, gears and a variety of other “machinery” for private firms, as well as to have constructed an iron bridge in Tokushima using iron produced and worked at the arsenal. And, in 1882, the arsenal supplied gears for the first large-scale cotton textile company, which was beginning operation in Osaka, because “those produced for the company by a private firm broke into pieces on first use.”<sup>9</sup>

<sup>7</sup> Mitsubishi Nagasaki Zōsenso, *Mitsubishi Nagasaki zōsenso-shi* (Tokyo, 1928), pp. 18-20, and Koyama, *A historical analysis*, pp. 73-74.

<sup>8</sup> Koyama, *A historical analysis*, p. 75.

<sup>9</sup> *Ibid.*, p. 79.

The Yokosuka arsenal, too, is known to have produced mining and other machinery as well as repaired twice as many foreign and privately-owned Japanese ships as navy ships. With its heavy machinery the arsenal constructed lighthouses and participated in the construction of government buildings, private factories, roads, and harbors. Though rarely noted by economic historians, six of the ten private cotton textile firms, which began operation in the early 1880s using spindles imported by the government, relied on steam engines produced at the arsenal. Many of the satellite, specialized plants of the arsenal produced numerous simple machine tools and more explosives for mining than for military use. Akabane and other factories, under the jurisdiction of the Ministry of Construction, were even more actively engaged in aiding the private sector by producing boilers, steam engines, and several dozen other types of machinery used in the mining, textile, machine-tool industry and others, as well as by the railroads.<sup>10</sup>

These examples, and numerous others which could be added, provide ample evidence that during the initial years these arsenals and government shipyards played the crucial roles of technological pathfinders and conveyors of Western technology to a fledgling industrial nation. It is important to remember what these arsenals and shipyards had already accomplished by the time the cotton textile industry began to stir.

The four arsenals and government-owned shipyards continued to provide technological leadership in the machinery, machine-tool, shipbuilding, and iron and steel industries into the decade between the early 1880s, when the rapid growth of the cotton textile industry was beginning, and the eve of the Sino-Japanese war. With a goal of "weapons independence" earnestly pursued by the military starting in the early 1880s, an increasing variety of larger and better weapons began to be made. In 1890, the army, too, in addition to the navy, began to produce steel, and the technological capabilities of building and equipping iron ships rapidly began to approach Western standards. Important also was the sale of several government plants which resulted in the sharply increased technological competence of certain private machine producers and shipyards.<sup>11</sup>

By 1877 the army was producing rapid-fire rifles of Japanese design at the high rate of 30,000 per year. To reduce the dependence on

<sup>10</sup> *Ibid.*, pp. 74, 80.

<sup>11</sup> For an elaboration and some useful data, see Koyama, *A survey*, pp. 251-74.

imported steel, the army in 1891 tripled its steelmaking capacity to 600 tons. The use of copper in cannon was discontinued and an increasing variety of better and larger guns was made of tempered iron and steel. The army's ability to produce a wide variety of powered machinery and machine tools also steadily increased, but the navy's technological capabilities advanced even more visibly. By importing more machinery and recalling the workers sent to Krupp and Creusot, the navy was able by 1890 to build larger warships equipped with the larger guns, boilers, and other machinery and fittings required by these warships. Thus, on the eve of the Sino-Japanese war, the navy could say that "in designing and supervising the construction of warships, virtually no assistance from foreigners was required." Much heavy machinery that had depended on imports—drilling machines, steam hammers, large cranes, and the like—was then being produced at navy arsenals, along with locomotives, steam engines, larger boilers, torpedoes, and a yet larger quantity of explosives.<sup>12</sup>

Purchase of government-owned machinery and buildings on very favorable terms marked the beginnings of a few private shipyards that were to lead the shipbuilding industry within a decade. Ishikawajima Shipyard, established in 1876, had produced only wooden ships, most of which were equipped only with sails. In 1884, however, it began to make iron ships fully equipped with boilers and other "Western fixtures" after acquiring machinery from the navy's Tsukiji arsenal on three-year credit at no interest and with the navy's "encouragement." This encouragement consisted of an order for an iron ship, technical advice, and only nominal rent for the government-owned land the shipyard occupied. No less important was the fact that this militarily-motivated assistance enabled the shipyard to produce, beginning in 1885, boilers for textile factories, stone crushers, iron bridges, carpet-weaving machines, printing presses, and a variety of other machinery, all to meet orders placed by private firms.<sup>13</sup>

The Nagasaki and Hyogo shipyards of the Ministry of Construction were sold in the early eighties respectively to Yatarō Iwasaki, the founder of the Mitsubishi zaibatsu, and to Shōzō Kawasaki, which enabled them to start what came to be two of the largest shipyard-cum-machine factories in Japan for decades to come. As the company histories of these firms evince, their growth, allowing them to pro-

<sup>12</sup> Koyama, *A historical analysis*, pp. 88-94.

<sup>13</sup> *Ibid.*, p. 107.

duce a variety of machinery to meet the increasing demand then arising in the private sector, crucially depended on the navy orders.<sup>14</sup> We should also note that the first step toward rapid growth by Hisashige Tanaka's small "machine-making factory," established in 1873, was made possible by the navy's 1882 order for torpedoes and the technical assistance which came with it.<sup>15</sup> On the other hand, the Ikegai Ironworks which, as we shall see shortly, grew to be the leading producer of lathes and other machine tools after the Sino-Japanese War, was still using "hand-operated machines" and subsisting on small military orders as it had done since 1889 when it was established.<sup>16</sup>

While the cotton textile industry was beginning to grow rapidly during the decade preceding the Sino-Japanese War, the military arsenals and government-owned factory-shipyards, along with their private counterparts (established with the aid of the military and the Ministry of Construction), were providing steam engines, many types of machinery, and machine tools in order to enable the cotton textile and other industries to take the critical initial steps toward rapid growth. Those familiar with the repeated scenes of the tragicomedy the early textile firms enacted in their search for machinery and advice can hardly fail to appreciate the significance of the growing technological competence then becoming available to emerging Japanese industrial firms.<sup>17</sup> Reexamining the Meiji industrialization process, a Japanese historian wrote of the early 1880s:

The technological level of the arsenals, as evidenced by the large numbers of workers and horse-power, was distinctly superior to that of other government-owned plants and private machine and shipbuilding firms. Thus . . . the arsenals were producing

<sup>14</sup> See the company histories cited in nn. 19 and 34 below.

<sup>15</sup> Yasuichi Kimura, ed., *Shibaura seisakusho 65-nen-shi* (A 65-year history of the Shibaura machine works), (Tokyo, 1940), pp. 16-17. Tanaka's "factory" became the Shibaura Machine Works in 1893 with the infusion of capital from Mitsui.

<sup>16</sup> Koyama, *A historical analysis*, p. 106. Noda writes of the Ikegai Ironworks of the period: "At the Ikegai, the machines were still operated by manpower, i.e., apprentices were turning flywheels by hand. The ironworks had about ten employees and had not yet succeeded in selling even a single machine in the market." Kazuo Noda, *Nihon kaisha-shi* (A history of companies in Japan), (Tokyo, 1966), p. 243.

<sup>17</sup> Though spindles and mules were imported, the emerging cotton textile firms experienced serious difficulties in obtaining competent advice for operating the machinery and in finding Japanese producers capable of providing them with suitable steam engines and various other machinery and parts. A detailed account of the above can be found in Taichi Kinukawa, ed., *Itō Denhichi O* (The venerable Denhichi Itō), (Tokyo, 1936) and Tōyō Bōseki Kabushiki Kaisha, *Tōyō Bōseki 70-nen-shi* (A history of the 70 years of Tōyō Textiles Company), (Tokyo, 1953). See also Kozo Yamamura, *A Study of Samurai Income and Entrepreneurship* (Cambridge, Mass., 1974), pp. 178-83.



not only weapons but also many types of machinery required by private firms and mines in order to assist and supplement the yet low technological level of the latter.<sup>18</sup>

#### FROM THE SINO-JAPANESE WAR TO 1914

Both the Sino-Japanese and Russo-Japanese wars had a profound effect on the technological and productive capabilities of the arsenals and private firms in the shipbuilding, machinery, and machine-tool industries. The impact of the war with Russia, a much stronger foe than China, was especially wide-ranging.

By the fall of 1893, when the decision to wage war with China was made, the arsenals had gone into a twenty-four-hour production schedule to increase the output of ships, guns, shells, and other military needs, and the largest private shipyards, such as Ishikawajima and Kawasaki, were also called upon to upgrade their technological competence and increase production. Ishikawajima imported 23 grinders for shellmaking and Kawasaki went on a crash program to build eight warships that were completed within two months of the beginning of the war.<sup>19</sup> The Sino-Japanese War, however, was basically within Japan's military capacity in 1894, and thus it did no more than strain her technological and productive abilities. The war lasted for only eight months and during this time the navy, with warships faster than those of the Chinese navy and armed with larger guns, easily won crucial battles.<sup>20</sup>

The defeat of China and the expansion of Japan's politico-economic sphere of interest into her newly acquired colonies and into China shifted the power balance in eastern Asia. If Japan were to continue to exert her power into Korea and northern China, a confrontation with Russia was only a matter of time. Under the circumstances, the military raced to increase Japan's ability to equip and supply her military forces so that they would be capable of challenging the Russian forces. To cite only a few examples of the actions taken between 1895 and 1903: in 1895 the arsenals succeeded in producing smokeless powder required for rapid-fire guns; and the navy's Kure

<sup>18</sup> Tetsuo Kondō, "Shokusan kōgyō to zairai sangyō" (Promotion of industries and traditional industries) in Naohiro Asao et al., eds., *Iwanami kōza Nihon rekishi*, vol. 14 (Kindai, I), (Tokyo, 1975), p. 239.

<sup>19</sup> Ishikawajima-Harima Jūkōgyō Kabushiki Kaisha, *Ishikawajima jūkōgyō kabushiki kaisha 108-nen-shi* (A 108-year history of the Ishikawajima Heavy Industries Company), (Tokyo, 1961).

<sup>20</sup> Mikio Sumiya, *Dai-Nihon teikoku no shiren* (The trials of the Japanese Empire), *Nihon no rekishi* (A history of Japan), vol. 22 (Tokyo, 1966), pp. 20-25.

shipyard, opened in the same year, was rapidly expanded into a large arsenal so that by the end of 1896 it had two blast furnaces, "248 pieces of large machinery," and a twenty-ton steam hammer used in producing steel, plus a full line of ordnance ranging from shells and torpedoes to large guns and warships.<sup>21</sup> The arsenals began in 1897 to mass-produce much improved rifles, the so-called 1897-type, and the production of more efficient and heavier steam-driven hammers and a variety of special purpose lathes was begun in 1898/99. The shellmaking capacity continued to increase between 1895 and 1900, and by 1901 the newly acquired ability to produce alloy steel and extremely large (up to 1,200-ton) forging machines (*tanrenki*) enabled Japan to produce large and specialized artillery pieces and their shells.<sup>22</sup> Though the total tonnage of foreign-made warships exceeded that produced domestically until 1914, Japanese capacity to build and equip larger warships continued to improve following the Sino-Japanese War. By the turn of the century, the navy arsenals were capable of producing warships harnessed by 20,000-HP steam engines and guns as large as those found on most Western warships.<sup>23</sup>

If the principal effect of the Sino-Japanese War was to increase the technological capabilities of the arsenals and a few large private shipyards, the most significant effects of the Russo-Japanese War were the rapid dissemination of modern technology to a large number of private firms and a suddenly accelerated growth in the fledgling and often struggling private machine and machine-tool makers who received increased and timely military demand and technological assistance. The rapidity of the dissemination of technology and the sudden placing of orders to many private modern firms were the results of an urgent necessity born out of the war being fought with Russia. The urgency can perhaps best be typified by the following crisis which the Japanese army faced in the winter of 1904/05. Despite the sustained full-capacity operation of the arsenals the army, which had calculated the estimated need for shells and other supplies using examples of European wars fought during the second half of the nineteenth century, began to face critical shortages of shells by the fall of 1904.<sup>24</sup> The division then fighting in Sha Ho, which was

<sup>21</sup> Kojima, *A history of iron and steel*, p. 161, and Kodama, *A survey*, p. 454.

<sup>22</sup> Koyama, *A historical analysis*, p. 117.

<sup>23</sup> *Ibid.*, p. 126.

<sup>24</sup> Since "the Sino-Japanese War did not furnish a useful example because of the weakness of China," the calculations "estimating the consumption of shells and explosives was made using data obtained from the Franco-Prussian War and the Russo-Turkish War." Such efforts, however, resulted in a serious underestimate of the needs in the Russo-Japanese War; Koyama, *A*

keeping a close count of rapidly dwindling supplies of all types of ammunition into October, found that its "supply was virtually exhausted on October 16." The division's desperate plea for resupply remained unanswered because production at the arsenals and a small number of private firms could no longer be increased. Under the circumstances, the best the division could do was to hold the line over the winter and hope that the Russians would not mount a major assault.<sup>25</sup>

Faced with this crisis, the only course open to the military for increasing the output of ammunition and other weapons needed was to place urgent orders with private firms. Given the wide technological gap then existing between the arsenals and private firms, however, these orders could be filled only if the military also provided requisite machinery, experienced personnel, and technical supervision. Thus, in order to assure that "detonators detonated and guns fired properly," the army often had to provide machinery and technical personnel with the orders.<sup>26</sup> In some cases, such as with the Oki Electric and the Hattori Seiko, a watch manufacturing company, not much technical assistance was needed for them to produce detonators; but in others, such as in the making of shells and shell-casings by the larger local ironpot factories, extensive technical assistance and machinery had to be borrowed from the army. A major problem in expanding output, in all instances, was the training of a large number of workers newly recruited by the private firms.<sup>27</sup> For example, a major general described his experience in recruiting workers for private firms that had been enlisted to produce small arms in 1905:

By the end of the war the output of small arms was nearly ten times as large as at the beginning of the war. This meant that the number of workers making small arms increased by a similar magnitude, and the newly engaged workers numbered almost 10,000. The most difficult task was to train these temporary employees quickly. We somehow and barely managed to succeed by making experienced workers instant instructors and by recommending the use of milling machines.<sup>28</sup>

Under such pressure the arsenals themselves were unable to adopt new technology during the war, but they rapidly increased their capacity to produce most required types of lathes and other machine

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*survey*, p. 475. This source also contains revealing observations and data attesting to the shortage of many types of guns, detonators, and other military supplies in 1905, pp. 475-83.

<sup>25</sup> *Ibid.*, p. 477.

<sup>26</sup> *Ibid.*, p. 478.

<sup>27</sup> Further details and several quotations from contemporary military sources concerning these observations are found in *ibid.*, pp. 476-77.

<sup>28</sup> *Ibid.*, p. 478.

tools and several types of gauges and measuring devices (including slide calipers which were as yet little known among private firms) to be loaned to the instant private arsenals.<sup>29</sup>

Another visible impact of the war was the critical assistance that war-related orders rendered to the many machine and machine-tool makers who were still, financially and technologically, struggling. One such firm, Ikegai Ironworks, the oldest private machine-tool making firm, began to grow rapidly during the war, aided by a large military order for machine tools and the technological assistance which accompanied it. By 1906 this firm was producing "Ikegai lathes" (soon to become widely known for their efficiency and low cost) and gasoline engines.<sup>30</sup> Many other machine and machine-tool producers, including such future leaders in this industry as Niigata, Okuma, Kubota, and Wakayama, came into being during the war and grew rapidly during the subsequent years, benefiting from the timely large military orders and the model machines and guidance furnished by the anxious military.<sup>31</sup> One Japanese work summarized the impact of the war on the machine-tool industry as follows:

Because of the war, the importance of the domestic production of machine-tools was realized for the first time. The navy allowed the machinery which it had imported to be examined and copied by [private firms]. . . . To encourage domestic production, the navy chose to buy some types of domestically produced machine-tools. Aided by such active assistance, what could be called "a machine-tool" industry gradually emerged.<sup>32</sup>

Japan's shipbuilding capacity also took a large stride during the war and in the decade following. While the navy arsenals grew visibly both in technological competence and in productive capacity,<sup>33</sup> the most significant change observed during this period was the rapid growth of large private shipbuilding firms such as Ishikawajima, Kawasaki, and Nagasaki. After serving during the war as arsenals and producing warships, specialized lathes, shells, and "a large number of

<sup>29</sup> Koyama, *A historical analysis*, p. 147.

<sup>30</sup> *Ibid.* For a good description of the underdeveloped state of the machine-tool industry during this period, see also Minoru Toyosaki, *Nihon kikai kōgyō no kiso kōzō* (The basic structure of Japanese machine industries), (Tokyo, 1941), pp. 25-44.

<sup>31</sup> Koyama, *A historical analysis*, p. 149, and Toyosaki, *The basic structure*, pp. 43-44.

<sup>32</sup> The Heavy Industries Bureau, Ministry of International Trade and Industry, *Nihon no kikai kōgyō: sono seichō to kōzō* (Japan's machine industries: their growth and structure), (Tokyo, 1960). p. 36.

<sup>33</sup> Excluding smaller military ships such as torpedo boats and submarines, 21 "large" warships with a total tonnage of 23,772 tons were produced during the 1896-1905 period. But production rose to 58 "large" warships with a total tonnage of 293,278 tons for the 1906-1915 period. Koyama, *A historical analysis*, p. 121. The technological progress made by the navy arsenals is described in *ibid.*, pp. 120-27.

sets of machinery for shell-production," these private shipyards continued after the war to make advances in their technological capabilities both in shipbuilding and in the production of a wide range of machinery.<sup>34</sup> Such advances were made possible by the large profits earned in the war years, the technological assistance received from the navy, and the shipyards' efforts to absorb Western technology. By the end of the Meiji era (1912), these larger shipyards were able to claim with considerable justification that their technological capabilities were "at par with any large shipyard in Europe," and they were able to produce locomotives, railroad cars, turbines, and an increasing quantity of machinery to meet the rapidly rising demand for these in the private sector.<sup>35</sup> The growth of the shipbuilding capacity both in the arsenals and in the private shipyards was such that by the end of the Meiji period more than 80 percent of Japan's total tonnage consisted of ships built in Japan.<sup>36</sup>

To review the relative importance of the arsenals (with their satellite plants and other publicly-financed establishments created basically for military purposes) vis-à-vis the private shipyards and factories in the shipbuilding, machinery (including rolling stock), and machine-tool industries, let us present Table 1.

TABLE 1  
NUMBER OF WORKERS AND PRIME-MOVER CAPACITY (IN HORSE POWER) IN SHIPBUILDING, MACHINERY, MACHINE-TOOL, AND WEAPONS INDUSTRIES

Year	Army and Navy Arsenals			Private Firms		
	Workers(A)	Prime-movers(B)	(B)/(A)	Workers(C)	Prime-movers(D)	(D)/(C)
1899	25,074	8,438	0.337	20,872	4,054	0.194
1903	53,593	19,843	0.370	32,029	5,494	0.172
1907	93,704	68,403	0.730	55,829	15,469	0.277
1910	68,605	97,063	1.415	46,834	29,904	0.639
1912	76,526	129,590	1.693	69,810	53,515	0.767

Source: Koyama Hirotake, *Nihon gunji kōgyō no shiteki bunseki* (A historical analysis of Japanese military industries), (Tokyo, 1972), p. 105.

The total number of workers in the arsenals (and the satellite plants and related government establishments) can be estimated at approximately 13,000; the number in private firms in shipbuilding, machin-

<sup>34</sup> Gensui Arai, *Tokyo Ishikawajima 50-nen-shi* (A 50-year history of Tokyo Ishikawajima), (Tokyo, 1930), p. 36. This source, with Ichisuke Abe, ed., *Kawasaki zōsenjo 40-nen-shi* (A 40-year history of the Kawasaki Shipyard) (Tokyo, 1926) contains many descriptions of a wide range of activities that these firms undertook for the navy during this period.

<sup>35</sup> Koyama, *A historical analysis*, p. 142.

<sup>36</sup> *Ibid.*, p. 124.

ery, and machine-tool industries was less than 6,000 for the 1888-1890 period. This being the case, the data for 1899 clearly show the rapid growth of these industries both in the public and private sectors.<sup>37</sup> As described, the principal reasons for this rapid growth were the "weapons independence" policy, the Sino-Japanese War, and the buildup of Japan's military capacity.

The rapid growth of the number of workers in the arsenals from 1899 to 1907 requires little explanation. We note, however, two important facts. The first is that nearly 25,000 workers who left the arsenals between 1907 and 1910 must have taken their newly acquired skills, whether as specific as the ability to use lathes or as general as an increased familiarity with machinery and factories, to private industries in related areas. Either they replaced less skilled workers in private firms or, much more likely, went to the cotton textile industries which were demanding an increasing amount of machinery and prime movers, or to the iron and steel mills which appeared after 1907 (as will be discussed), or to the many other industries that were being rapidly mechanized. The second important fact is that as late as 1912 both the total and per worker capacity of prime movers of the arsenals were at least twice those of private firms, indicating the technological superiority of the former.<sup>38</sup> Another way of appreciating the significance of the data is to realize that in 1907, only a generation after the Meiji Restoration, Japan had nearly 150,000 workers who were qualified in various degrees to work in industries that were essential in increasing the technological capabilities of Japanese industry.<sup>39</sup>

Our examination of the impacts of the wars on the technological progress made during the Meiji period cannot be concluded without a brief discussion of the Yawata Ironworks, a large government-financed steel mill constructed and expanded primarily for military

<sup>37</sup> For both the bases of these estimates and further quantitative evidence of the growth of these industries, see Koyama, *A survey*, pp. 483-95; id., *A historical analysis*, pp. 110, 129; and Koyima, *A history of iron and steel*, pp. 272-75.

<sup>38</sup> Though the difference in horsepower per worker cannot by itself serve as a measure of the technological gap, the private firms' slower rate of increase in, and the low level attained even in 1912 of horsepower per worker reflected the smallness of the scale of operation and the relatively low degree of mechanization achieved by these firms.

<sup>39</sup> Serious shortages of skilled workers, especially in the industries discussed in this essay, continued to be a major problem facing Japanese industries, and even more acutely during the First World War years. For example, Toyosaki wrote that a constant shortage of "good engineers and skilled workers" was one of the main reasons why "the machine tool industry remained technologically backward" in comparison to those in the West; Toyosaki, *The basic structure*, p. 293.

purposes.<sup>40</sup> From the late 1880s the military was very much interested, as an integral part of its weapons independence program, in building a large mill capable of producing steel and wrought iron in large quantities in order to reduce its steadily growing reliance on imports. Thus, in 1891 the navy proposed a plan for such a mill, but it failed to win the necessary political support, mostly on the grounds that it would impose a considerable economic burden on the already strained Meiji coffers and that domestically produced steel would probably have a high unit cost in comparison to imported steel. Despite the military pleas repeated in 1892 and 1893 and the steadily increasing demand for steel and iron, the Diet continued to refuse to fund the proposed mill.<sup>41</sup>

A change in government policy finally came about in 1895. Following the Sino-Japanese War political support for the military was easier to win, especially for the navy which now had the task of defending the newly acquired colonial possessions. There also were other significant factors contributing to the change. First, the demand, of necessity to be supplied by imports, for iron and steel continued to rise as the result of the persistent military buildup and an increase in demand from the private sector. Second, in 1888 a group of private individuals established Nihon Steel (which was capitalized at one million yen, a huge sum by the standard of the day), but this effort ended in bankruptcy in 1891 and no other private efforts were on the horizon.<sup>42</sup> And, third, Japan had just won reparations of 365 million yen from the Chinese, and its earmarking 4.09 million of the sum in

<sup>40</sup> Kojima quotes the following speech made in the 1891 session of the Diet by Prime Minister Masayoshi Matsukata in support of the navy proposal for a large steel mill: "To meet the needs of our national defense, the army urgently requires more weapons, better explosives, and the construction of batteries, and the navy is in dire need of warships. However, as of this time, we heavily depend on imported iron and steel in producing weapons and ships. This is not only extremely costly, but also exposes us to a high risk of not being able to obtain required [iron and steel] in the event of national emergency" (Kojima, *A history of iron and steel*, p. 189). Also, for a description of the explicit military motivation, see Makino, *A history of the Meiji-Taisho periods*, p. 306.

<sup>41</sup> Kojima, *A history of iron and steel*, p. 190.

<sup>42</sup> The Nihon Steel failed principally because the financial backers seriously underestimated the large initial capital requirement and were unable, owing to the recession of 1891, to borrow needed funds during the critical first year. Contributing causes of the failure included unanticipated technological difficulties and speculative investors who chose to withdraw their financial support as soon as it became clear that no chance for a quick profit-taking was in the offing. For a full discussion of this episode see Kojima, *A history of iron and steel*, pp. 162-68. Before deciding to support a government-financed steel mill, Kentarō Kaneko, then Vice Minister of Commerce, is known to have approached both Mitsui and Mitsubishi to see if they were interested in starting a steel mill either independently or jointly. Kaneko was informed that neither was interested in the venture "because of the extreme difficulties involved in such an undertaking," *ibid.*, p. 234.

1896 for the initial budget of the new steel mill met little political opposition.<sup>43</sup>

The mill was legally charged with “meeting the needs of the military as its primary objective” and planned to produce 60,000 tons of steel (of which 4,500 was wrought iron).<sup>44</sup> The road between the planning and the actual production, however, was fraught with difficulties. Even though the total budget was grudgingly raised to 25 million yen by the end of 1898, problems encountered prevented the production of steel until 1901. The major problems were the acquisition of a site and the assurance of an adequate quantity of suitable Chinese ore on a long-run basis, plus numerous technological difficulties faced in constructing a large mill which required almost complete reliance on German engineers and foremen.<sup>45</sup> In 1901 the administrative head of the mill reported:

Since the beginning of operation, we produced 18,880 tons of iron, 3,753 tons of Siemens steel, and 24 tons of Bessemer steel. The future depends on the training of workers. As they become better accustomed to the furnaces and machines and their skills improve, we should soon be able to produce 45,000 tons of steel at the mill.<sup>46</sup>

His assessment proved to be optimistic; the mill’s capacity in 1904, before the beginning of the Russo-Japanese War, failed to exceed 40,000 tons. The nation’s total demand, however, neared 310,000 tons of steel because of the naval expansion plan of 1903, the continuing buildup of the army, and the growing demand by the rapidly expanding railroad network and other industries. The total output of all military furnaces and Yawata combined failed to exceed 60,000 tons, so that still more reliance had to be placed on imported steel to meet the demand.<sup>47</sup>

<sup>43</sup> While the fact that the Chinese reparations aided the yen in achieving a fully convertible status is often recognized, little attention has been paid to the specific disposition of the huge windfall. Of the 364,868,586 yen, as much as 53.8 percent was allocated to “the expansion costs” of the military, with the navy taking a lion’s share of 38.2 percent. Furthermore, the military received an additional 32.6 percent for “emergency expenditures,” “improvement of the transportation capacity,” and “a supplement to the construction of torpedo ships” (Koyama, *A historical analysis*, p. 465). To the extent that such expenditures aided the rapid growth of Japan’s technological capabilities as its by-product, one is perhaps justified in arguing that the Sino-Japanese war both stimulated and financed Japan’s technological progress following 1895.

<sup>44</sup> Noda, *A history of companies*, p. 194.

<sup>45</sup> The story of the Yawata, including the problems relating to its establishment and technological and labor difficulties experienced before the First World War, is fully told in Masaki Hitotsuyangi, *Kan’ei seitetsujo monogatari* (A story of the government-operated iron-works), vol. I (Tokyo, 1958). The most relevant pages concerning the observations made in the text are pp. 209-25, 305-19, and 511-24.

<sup>46</sup> Kojima, *A history of iron and steel*, p. 249.

<sup>47</sup> Imports of iron also rose similarly. For the data on total demand and on imports of iron and steel, see *ibid.*, pp. 293-94.



The coming of the Russo-Japanese War demonstrated that the military campaigns against a well-supplied enemy and an emergency buildup of naval powers could not be pursued if Japan had to depend so heavily on imports.<sup>48</sup> Thus, Yawata's capacity was steadily increased from 1904 in order to reduce the reliance on imports. Under the circumstances, the government was willing to cover Yawata's continuing losses and to appropriate the funds needed for expansion. In 1905 Yawata's steel producing capacity reached 41,000 tons, and rose rapidly to 46,000 and then to 70,000 tons during the following two years. The output of pig iron also rose from 33,000 tons in 1905 to 101,000 tons in 1907.<sup>49</sup>

As output continued to rise, through economies of scale and the accumulation of experience, the per ton cost of pig iron became competitive with that imported from the West. For example, by 1909 a ton of pig iron imported from the U.S. was around 28.2 yen plus about 10 yen for shipping costs, tariff, and forwarding charges, while Yawata's pig iron was being sold at about 28.4 yen. Though no simple price comparison is possible for steel, which varied widely in price depending on the product, one can generally say that on the eve of the First World War Yawata was competitive with imported steel in simpler product lines (such as round and sheet) but was still unable to compete with foreign firms in many processed lines (such as galvanized steel, pipes, rails, and a variety of alloyed steel and construction materials) despite the protection offered by tariffs and shipping and forwarding costs. Yawata finally reported a modest profit in 1910, the first of the profitable years to follow, due mostly to its competitive ability which continued to increase and then virtually to overtake the Western firms in an increasing number of specialized steel products.<sup>50</sup>

Paralleling the growth of Yawata was the birth of several large, private iron and steel companies after the end of the Russo-Japanese War. Such large postwar firms as Nihon Seikōshō, Sumitomo, and Kobe were established with the well-justified assumption that a large portion of their products would be sold to the navy, which was then in the process of rapidly increasing the number of warships, and to the

<sup>48</sup> Revealing quotations, relating to the tactical and supply problems created by the delayed delivery of guns and shells ordered from Krupp, are found in *ibid.*, pp. 360-62.

<sup>49</sup> *Ibid.*, pp. 438-44 and Hitotsuyanagi, *A story*, pp. 449.

<sup>50</sup> The data and observations in this paragraph are taken from Kojima, *A history of iron and steel*, pp. 455-72. These pages also include detailed discussions of import prices, competitive pricing by German, U.S., and English exporters during the first decade of this century, and the technological disadvantages Yawata still suffered vis-à-vis its Western competitors.

Railroad Bureau (Tetsudo-In) which was also rapidly expanding its lines.<sup>51</sup> The author of *A history of iron and steel in Japan* summarized the importance of the military in aiding the growth of Yawata and these new private iron and steel firms during this period.

One should at no time forget the crucial role played by the military, especially the navy which was embarking on a large build-up program, in promoting, directly and indirectly, the growth of the iron and steel industry during this period [1905-1911]. The aid given by the military was not limited to buying the products at highly favorable prices. All the producers, such as Yawata, Muroran [Nihon Seikōshō], Sumitomo, Kobe, Kawasaki and many others received assistance in solving the technological and other problems which they encountered.<sup>52</sup>

Because of such encouragement provided by the military and because of its increasing demand, as well as that of the Railroad Bureau and the private sector, the private firms in Japan's iron and steel industry were able to weather the initial difficulties facing an infant industry. By the time of the First World War these firms were ready and able to expand their capacity, thereby rapidly to increase their competitive ability.

#### CONCLUDING NOTES

A brief review of the literature on the Meiji economy reveals that no consensus has yet been reached on the effects of the Meiji preoccupation with "a strong army" on the economic performance of the period. Though Lockwood wrote in 1954 that "the drain of empire building went far to nullify the more constructive use of state power to mobilize saving for investment in productive enterprise,"<sup>53</sup> Rosovsky, who also recognized "competitive and deterrant aspects" of the military investments, was willing to say in 1961 that such an investment "has multiplier and accelerator effects and its impact on the heavy industry must be profound."<sup>54</sup> Emi, going further than Rosovsky, concluded his 1963 analysis of the war-generated demand and output, and of war-induced changes in fiscal and taxation policies: "Military expenses naturally contracted to a peacetime level after

<sup>51</sup> The importance of the navy order is demonstrated, for example, in Kihachirō Okura's decision to abandon his plan to start a firm specializing in steel pipes when he discovered that he was unable to obtain from the navy a prior commitment for the purchase of his products. *Ibid.*, p. 473.

<sup>52</sup> *Ibid.*, p. 473.

<sup>53</sup> William W. Lockwood, *The Economic Development of Japan: Growth and Structural Change, 1868-1938* (Princeton, 1954), p. 577. The quoted passage is his observation on the entire 1868-1938 period and is not limited to the Meiji period.

<sup>54</sup> Henry Rosovsky, *Capital Formation in Japan, 1868-1940* (Glencoe, Ill., 1961), pp. 22-23.

each war, which, however, was always higher than the prewar level. . . . War seems to have been the greatest stimulus to the expansion of the economy.”<sup>55</sup>

In reaction to the views expressed by Rosovsky and Emi, Oshima argued in 1965 that “these massive military expenditures” in the Meiji period “formed the major impetus to the inflationary tendencies of the era” rather than contributing to economic growth since “there was nothing in the character of the underdeveloped Meiji economy which resembled a Keynesian world continually moving towards an under-consumption equilibrium with sizable unemployment.”<sup>56</sup> Oshima has been joined recently by Kelley and Williamson who argue, on the basis of their careful counterfactual study of the Meiji economy, that “military expenditures retarded growth in the Meiji economy and thus retarded improvement in real wage and earnings as well.”<sup>57</sup>

With the exception of Rosovsky, who explicitly stated that the government production and purchase of “vast quantities of military equipment . . . must have been a tremendous stimulus” to private heavy industry,<sup>58</sup> all of the other authors plus many more base their conclusions as to the effects of Meiji Japan’s “empire building” and “military adventurism” primarily, and often exclusively, on their analyses of the more readily quantitatively tractable macro-economic

<sup>55</sup> Kōichi Emi, *Government Fiscal Activity and Economic Growth in Japan, 1868-1960* (Tokyo, 1963), p. 33.

<sup>56</sup> Harry T. Oshima, “Meiji Fiscal Policy and Economic Progress,” in W. W. Lockwood, ed., *The State and Economic Enterprise in Japan* (Princeton, 1965), p. 372. Oshima, who did not explicitly refer to the views of Rosovsky and Emi, went on in support of his view to cite a 1922 study sponsored by the Carnegie Endowment for International Peace which examined the impact of Meiji militarism on “prices, taxes, money and credit, public debt, foreign trade, and wages” (p. 376). Like most other authors, nowhere did he consider the effects of the Meiji militarism on technological change. Similarly, many non-Marxist Japanese economic historians generally stress the negative effects of Meiji militarism on these macro-economic grounds. See, for example, Takafusa Nakamura’s *Seizenki Nihon deizai seichō no bunseki* (An analysis of the prewar Japanese economic growth), (Tokyo, 1971), pp. 13-14, which emphasized the effects of war-related taxes in depressing private consumption. He notes, however, the possible importance of military demand as “a factor in economic growth” (p. 26).

<sup>57</sup> Allen C. Kelley and Jeffrey G. Williamson, *Lessons from Japanese Development* (London and Chicago, 1974), p. 127.

<sup>58</sup> Rosovsky, *Capital Formation*, p. 27. Rosovsky chose not to speculate on the magnitude of this “tremendous stimulus.” The full passage reads: “Throughout Japanese industrialization, the government was ready to buy and produce vast quantities of military equipment. It is, of course, impossible to say precisely what effects this policy had on private heavy industry, but it must have been a tremendous stimulus.” He continued: “Military demand probably became more important as technology developed, and military demand undoubtedly played a larger role in countries which industrialized after the new technology reached a certain state of maturity.” In the context of these quotations the purpose of this essay has been to suggest the desirability of making more precise the “tremendous stimulus,” placing a special emphasis on the technological impact of the policy which was not considered by Rosovsky.

changes resulting from the war-induced shifts in taxation, expenditures, investments, and savings. In noting the above, my intent is not to criticize these scholars whose main interests were macro-economic analyses of Meiji Japan and its military expenditures, but to stress the need for a fresh re-examination of the possible substantive growth-promoting effects of the "strong army" policy in reassessing their views. If my argument is correct the statements of Emi and Rosovsky, for example, could be strengthened while those of Lockwood, Oshima, and Kelley and Williamson must be modified or revised.

I am fully aware that the absence of quantitative evidence to justify adjectives such as "substantive" and "significant," used frequently in the preceding pages, seriously weakens my argument. Clearly the next task is to make every effort to obtain as much quantitative evidence as possible in order to measure the net effect of the growth-promoting and growth-retarding aspects of Japan's militarism. As the task is pursued and the evidence obtained from such an endeavor combined with the findings from micro-economic examinations of industries, firms, governmental policies, zaibatsu, and the other facets of the Japanese economy described earlier in this essay, we will then be able to fill the gaps left by the basically quantitative macro-economic analysis made of Meiji Japan to date, and to provide crucial input for a better understanding of the economic history of the Meiji and interwar periods.

Beyond the potential usefulness of my argument in reassessing the effects of Meiji militarism on the performance of the Japanese economy at such a general level, what I have presented may also be useful in clarifying or in shedding additional light on the analyses that rely basically on macro-economic theory and data. Let me cite only two examples of such instances.

In criticizing the recent work of Rosovsky and Ohkawa that identified a Meiji growth spurt from 1905 to 1918, Kelley and Williamson wrote:

Ohkawa and Rosovsky postulate that the investment spurt after 1905 was induced by a "higher-than-average rate of return on capital so that the incentive to invest remain[ed] strong." They then confront the critical issue: Why was the investment incentive so strong? First, borrowed technology flooded Japanese industry after 1905. (Its timing is not wholly explained.) This had two effects. On the one hand, the new technology raised potential rates of return and induced new investment. On the other hand, investment demand was reinforced by the increased capital-intensity inherent in the new technology. Ohkawa and Rosovsky view the cotton textile industry, with its modernization and the development of large integrated spinning-weaving establishments, as a prime example of the process. Second, the investment

spurt "during the 'teens' of this century was certainly affected by the bonanza atmosphere" of the Japanese economy around World War I. Some difficulties with this argument should be noted. Why 1905?<sup>59</sup>

In view of the argument advanced in this essay, I believe that Rosovsky and Ohkawa could have deflected, at least in part, the criticism had they also noted the demonstrably accelerated diffusion of technology beginning in 1904 from the arsenals and other government-owned plants to private firms in such key industries as shipbuilding, machinery, and machine tools; the increased ability of these industries to provide machinery and equipment which promised a higher productivity of and return to capital; and the stimulating effects of war-related demand on many segments of the economy including watchmakers and local producers of iron pots.<sup>60</sup> Though space does not permit here, one can readily cull quotations from numerous company histories which quickly convince readers that a major effect of the Russo-Japanese war was "to begin domestic production of machinery in earnest."<sup>61</sup>

Kelley and Williamson, too, had they been familiar with the facts and the argument of this essay, would probably have moderated their criticism which is principally based on the difference in the "actual" and the counterfactual "peacetime" saving ratio. To argue that "a key distinction between the late nineteenth century aggregate growth experience is the lack of military adventurism" by emphasizing the growth-retarding effects of the Meiji military expenditure to the extent they did is to overemphasize the results of their counterfactual exercise and to reduce the appeal of their important contributions for many historians familiar with Meiji Japan.<sup>62</sup>

<sup>59</sup> Kelley and Williamson, *Lessons from Japanese Development*, p. 109. It should be pointed out that their criticisms are not directed to the most recent work, H. Rosovsky and K. Ohkawa, *Japanese Economic Growth—Trend Acceleration in the Twentieth Century* (Stanford, Cal., 1973), but to their earlier works, "Postwar Japanese Growth in Historical Perspective: A Second Look," in L. Klein and K. Ohkawa, eds., *Economic Growth: The Japanese Experience Since the Meiji Era* (Homewood, Ill., 1968). As indicated in the title of their book, the 1973 work by Rosovsky and Ohkawa no longer contains the observations and analyses criticized here by Kelley and Williamson.

<sup>60</sup> The full-length version of this essay will include an examination of the roles played by the machine and machine-tool industries as the "conveyers" of new technologies. As one can readily envision, assisted by Rosenberg's insights, the impact and implications of the ready availability of low-priced domestic lathes and steam engines, for example, were large and wide-ranging in promoting technological levels of the users of these products. See Nathan Rosenberg, "Technological Change in the Machine Tool Industry," this JOURNAL, 23 (Dec. 1963), 414-43.

<sup>61</sup> Mitsubishi Jūkōgyō Kabushiki Kaisha, *Shin-Mitsubishi jūkōgyō kabushiki kaisha-shi* (A history of the new Mitsubishi Heavy Industries Company) (Tokyo, 1967), p. 6. The quoted statement applies to the Mitsubishi Shipbuilding Co., the Meiji forerunner of the Mitsubishi Heavy Industries.

<sup>62</sup> Kelley and Williamson, *Lessons of Japanese Development*, p. 126.

In the work of Rosovsky and Ohkawa the “social capability to import technology” or “the ability to absorb technology” is offered as a key component in their explanation of long swings and trend acceleration. For example, they suggest that this capability may have been increasing over time to generate trend acceleration and that “social capability grows more smoothly than capital formation” and “downswings are periods of adjustment in which reserves of capability can be built up.” What is the “social capability” that performs such a crucial role in their analysis? They define the term as “factors constituting a country’s ability to import or engage in technological and organizational progress.” Their discussion of “factors” for the Meiji period is virtually absent and for the interwar years is limited to general observations on the zaibatsu, permanent employment, cartelization, and “an increasing emphasis on military-related heavy industry.”<sup>63</sup> Given the importance of the concept in their analysis as well as in our understanding of Japanese economic growth, apparently our future task must be to enhance the empirical content of what Rosovsky and Ohkawa called “social capability.” In doing so, further efforts must certainly be made to increase our knowledge of the role Japan’s military played in adopting and disseminating Western technology.

Since the central interest of these authors, however, was a macro-examination of trend acceleration, the preceding comments should perhaps be more appropriately directed to all specialists of Japanese economic history as a call for further study of the effects of Japan’s militarism on its prewar economic history. I believe such studies must include an examination of the following: the extent to which the growth-promoting effects of Meiji militarism contributed to building the technological foundation which enabled Japan to exploit the opportunities offered during and after the First World War;<sup>64</sup> the effects of the increased access (and at lower cost) to Western capital markets which Japan enjoyed as the results of its victory over Russia and of the enhanced credit worthiness that resulted from the economic growth made possible because of the First World War;<sup>65</sup> the continued role

<sup>63</sup> Rosovsky and Okawa, *Japanese Economic Growth*, pp. 212, 216, and 218-21.

<sup>64</sup> One can show, I believe, that the rapid transformation of the Japanese economy during the First World War years and the growth of electric machinery, electric power, and heavy machinery industries during the interwar years owed a significant debt to the technological foundation built during the Meiji era. See Kozo Yamamura, “The Decade of Sowing: Absorption of Western Technology by the Electric Machinery and the Machine Tool Industries of Japan During the 1920’s,” paper presented at the Conference on Japanese-American relations during the 1916-1931 period, held under the auspices of the Social Science Research Council in Kauai, Hawaii, Jan. 1975.

<sup>65</sup> See, for example, Mitsuhaya Kajinishi et al, *Nihon shihonshugi no hatten* (The development of Japanese capitalism), vol. II (Tokyo, 1957), p. 307, for the decline in interest rates

the military, especially the navy, played in importing and disseminating technologies (a limited list of examples: ball bearings, micrometers and other precision measuring machines and instruments, pressure gauges, cutting machines for hard metals, lenses, wires and wireless communication, aluminum, trucks, automobiles and airplanes during the war years);<sup>66</sup> the wide-ranging effects of colonialism;<sup>67</sup> the significance of the basically militarily motivated subsidies;<sup>68</sup> and numerous other ways through which the Japanese economy was affected because of decisions made primarily on political-military grounds. Since one can show with little difficulty that the wars, especially the First World War, played a demonstrably major role in the growth of the zaibatsu, we must, in discussing the effects of wars in Japanese economic history, also examine the role which the zaibatsu were able to play in advancing technology in prewar Japan through their ability to pool their capital and managerial talents, to assume risks involved in importing new and "lumpier" technology, to coordinate the adoption of new technologies among the firms within the zaibatsu, and to carry out many other measures

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observed before and after the victory over Russia. A neglected but important topic for future research is the contribution made by foreign capital in increasing the total electric generating capacity in Japan. Since the reduced cost of electricity during the interwar years played a significant role in the growth of the chemical industry and others, one should not, as we have often done, neglect the importance of foreign capital simply because the total amount was relatively small. For both a good description and relevant data concerning the role of foreign capital in the electric power industry during the interwar years, see Haruaki Miyake, *Denryoku kōntserun dokuhon* (A reader on electric power *konzern*), (Tokyo, 1937), pp. 85-118. On the close relationship that existed between the declining cost of electricity and the growth of the chemical industry, see Shōsabarō Fujino, *Nihon no keiki junkan* (Business cycles in Japan), (Tokyo, 1965), 435-49.

<sup>66</sup> For detailed descriptions, see The Heavy Industries Bureau, *Japan's machine industries*, cited in n. 32. The effects of the Sino-Japanese and Russo-Japanese wars on the machine, machine-tool, and shipbuilding industries are discussed on pp. 103-06, 110, and 125-27.

<sup>67</sup> This is another important topic that has long been neglected by non-Marxist economic historians. In English, good studies on the topic are limited to the effects of Japanese colonialism and its contribution to the agricultural productivity in Korea and Taiwan. For an example of such works and for citations of the related literature, see James I. Nakamura, "Incentives, Productivity Gaps, and Agricultural Growth Rates in Prewar Japan, Taiwan and Korea," in Bernard Silberman and Harry Harootunian, eds., *Crisis in Japan* (Princeton, 1974), pp. 329-73.

<sup>68</sup> Emi, in agreement with Lockwood, wrote that the subsidies were relatively unimportant because they were "limited in scope and usually confined to a short period of years" (Emi, *Government Fiscal Activity*, p. 76, and Lockwood, *The Economic Development*, p. 528). Rosovsky noted that "a subsidy is an official vote of confidence in an enterprise: It may mean additional investment funds from private sources, better banking connections, and perhaps even a larger share of the private market" (*Capital Formation*, p. 22). In several important industries, such as the shipbuilding, machine-tool, and chemical industries, what was crucial was the effect of subsidies in enabling the firms to survive and to adopt new technologies despite the limited scope and duration of the funds provided. In this essay I can only suggest the importance of the topic in relation to technological change.

that effectively reduced the costs and risks involved in aiding Japan's technological progress.<sup>69</sup>

When such studies are continued, one of the important by-products may very well be the realization on the part of many students of Japanese economic history that they (including the present writer) have misallocated their research efforts in frequently asking how important the conscious efforts of the government, especially the Meiji government, were in industrializing Japan "from above."<sup>70</sup> We may find that a question which should have been pursued is: In aiding the industrialization of Japan, how important were the political decisions to have a strong army, to attempt to expand Japan's interests in East Asia, and to prepare for an envisioned conflict with the West? Further studies could show that the Meiji government's slogan, *fukoku kyōhei* (a rich nation and a strong army), which has often been accused of being inherently contradictory, was more maligned by economic historians than it deserved. They may show that, in fact, the medicine administered to hasten the growth of Japanese industry in the form of pilot plants in the silk industry, loans to the fledgling cotton textile firms, and an invitation to foreign technical advisors—all of which have been fully documented—may have been much less effective than the unintended benefits of technological progress which resulted from political and military incantations with their accompanying blood-shedding sacrifices.

Finally, I should add explicitly that the goal of this essay has been to suggest a re-examination of the role of the wars and the militaristic policies of prewar Japan so that we will better understand the process by which Japan was able to adopt and disseminate Western technology, one of the most important ingredients in Japan's successful industrialization. The counting of technological blessings resulting from Japanese militarism justifies Japan's political past no more than the finding that slavery was profitable condones that odious institution.

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<sup>69</sup> For the rapid and measurable increase in the financial power of the zaibatsu resulting from the First World War see Kozo Yamamura, "Japan, 1868-1930: A Revised View" in Rondo Cameron, ed., *Banking and Economic Development: Some Lessons of History* (New York, 1972), pp. 186-97.

<sup>70</sup> For the focus of and literature on this debate, see Kozo Yamamura, *A Study of Samurai Income*, pp. 137-62.