

## Chapter 6

### A Dynamic Model of Technological Capability

#### *What Value Do the Firms add to the Emerging Networks?*

Abstract: The firms usually operate with a portfolio of firm-specific, local network-specific, home nation-specific, and common international, knowledge-based capability. American firms are better known for high quality firm-specific and home nation-specific know-how. Japanese firms are more inclined towards the assembly of local network-specific endowments in different nations. Such assembly locks the firms into specific local paths, which have only limited linkages with the common international know-how. To the extent Japanese firms have been actively using the information-efficient services of the American market, they realize an international competitive parity. Any variations in their performance are accounted by the changing nature of their distinctive networks assembled in the newly emergent landscapes.

#### **Introduction**

Scientific models for guiding the workforce in productively exploiting its capability has long been a focus of intellectual inquiry. In an early classic, Aristotle (VI. 3-7) noted, “every science is thought to be capable of being taught, and its object of being learnt. And all teaching starts from what is already known... it is when a man believes in a certain way and the starting-points are known to him that he has scientific knowledge... all scientific knowledge follow from first principles (for scientific knowledge involves proof). This being so, the first principle from which what is scientifically known follows cannot be an object of scientific knowledge... the wise man must not only know what follows from the first principles, but must also possess truth about the first principles.” Subsequently, Descartes (1641) in his fourth meditation on first philosophy, concerning the true and the false, observed, “In order to be free I need not be capable of being moved in each direction; on the contrary, the more I am inclined toward one direction – either

because I clearly understand that there is in it an aspect of the good and the true, or because God has thus disposed the inner recesses of my thought – the more freely do I choose that direction... For although probable guesses may pull me in one direction, the mere knowledge that they are only guesses and not certain and indubitable proofs is all it takes to push my assent in the opposite direction.” Kant (1785: 15-19) elaborated, “All sciences have a practical part consisting of problems saying that some end is possible for us and of imperatives telling us how it can be attained. These can, therefore, be called in general imperatives of skill... the imperative that refers to the choice of means to one’s own happiness, i.e. the precept of prudence, still remains hypothetical; the action is commanded not absolutely but only as a means to a further purpose... But, unfortunately, the concept of happiness is such an indeterminate one that even though everyone wishes to attain happiness, yet he can never say definitely and consistently what it is that he really wishes and wills... Therefore, one cannot act according to determinate principles in order to be happy, but only according to empirical counsels, e.g. of diet, frugality, politeness, reserve, etc., which are shown by experience to contribute on average the most to well-being.” Durkheim (1953: 86) clarified, “The highest virtue consists not in the strict and regular performance of those acts immediately necessary to the well-being of the social order, but rather in those free and spontaneous movements and sacrifices which are not demanded and are sometimes even contrary to the principles of a sound economy... Spencer has shown that philanthropy is often not in the best interests of society. His demonstration will not prevent men from esteeming the virtue he condemns very highly. Economic life itself does not always follow closely the rules of economics. If luxuries are those things that cost more, it is not only because they are often the most rare; it is because they are also the most esteemed.”

At the end of World War II, in 1945, Japanese national income was 60% of that in 1934-36, and the government debts were stood at more than twice the national income. The output of agriculture was 60% of that in 1937, of mining and industry 53%, and of textiles mere 6%.

Japanese government could procure just 70% of the rice targeted for public distribution system. E. A. Ackerman, retained by the US authorities for appraising Japanese capability, concluded in 1949, “In the light of an analysis of its resources, the Japan of the next three decades appears to have one of two aspects if its population continues to grow to 100 million or more: (i) It may have a standard of living equivalent to that of 1930-34 if foreign assistance is continued indefinitely, (ii) It may be ‘self-supporting,’ but with internal political, economic, and social distress, and a standard of living gradually approaching a bare subsistence level.”

The ability of Japan to sustain a population base of 125 million over the next three decades, and to realize a significantly greater-than-historical level of living standards, thus signals: (a) gains from the exchange with international partners, and (b) unusual political, economic and social re-organization for exploiting the international reputation. This chapter investigates the first force, and recommends the second for further academic research.

### **Gains from Exchange with the International Partners**

Breakdown of the international exchange system during the Great Depression era had a detrimental impact on the Japanese initiatives for international leadership. In 1932, Japan abandoned the gold standard and issued deficit bonds underwritten by the Bank of Japan. At the local village and prefecture levels, the expenditures on public works, industrial promotion, and public welfare projects were raised. The prime commercial interest rates fell rapidly from 6.6% in 1931 to 3.7% in 1933. The share of Big-5 banks (Mitsui, Mitsubishi, Daiichi, Sumitomo, and Yasuda) in the total banking loans surged from 30.3% in 1931, to 50% in 1937, and 57.1% in 1940. In contrast, their share in the total bank deposits grew only marginally from 38.3% in 1931, to 42.1% in 1937, and 41.8% in 1940 (Nakamura, 1983: 207). The share of heavy and chemical sector in the total manufacturing value-added surged from 36% in 1930 to 49% in 1935, even though there was no commensurate growth in the fixed investments in this sector. Principal demand for these industries came from within the heavy industry sector, specifically from

machinery, shipbuilding, and steel. By the mid-1930s, Japanese firms developed a capability to manufacture military products out of these heavy industrial initiatives, and began rapidly expanding their investments. After the war, a multi-pronged initiative to refocus this capability was required for a fundamental improvement in the final consumption services.

1) Manpower: The US authorities, in-charge of reforming the Japanese economy, invalidated bank savings on February 14<sup>th</sup>, 1946, and neutralized the hoarding by introducing a new yen. As of November 23<sup>rd</sup>, 1945, 45.9% of the total 5112 hectares farmland in Japan was under tenancy. An Agricultural Reform Bill, promulgated early 1946, limited the land ownership by any person to about 5 hectares. The tenants were required to pay rent in cash with a view to increase the flow of farm products to the market. A revised October 1946 bill further limited the land ownership ceiling to just 3 hectares, and ordered transfer of farm-land from absentee landlords to the tenants. The government bought 1.916 million hectares of land, constituting about 81% of the land under tenancy and 37.5% of the total agricultural land, from 3.7 million absentee landlords at a nominal value of about 7% of the annual crop value, and transferred it to the tenants. These new landowners were provided with low interest loans aimed at land improvement. The share of farmland rents in Japanese national income fell to just 0.06% by 1950, compared to 5.31% in 1930. The rice purchase target for the year 1946 was met by May 20<sup>th</sup> and for the year 1947 by a record date of March 16<sup>th</sup>. Touhoku region, where greatest proportionate land transfer to tenants took place, emerged remarkably ahead in growth rate of total income.

2) Material Power: The US General MacArthur, in-charge of the Japanese reforms, expelled 2,200 executives of 250 large corporations affiliated to the military government, and made the stocks owned by them public. The helm of business affairs was given to the subordinate professionals. The Labor Union Law of March 1946 helped to boost the percentage of unionized employees from 3.2% in end-1945 to 41.5% by end 1946. The Law for the Elimination of Excessive Concentration of Economic Power, promulgated in December 1947, was applied to 18

zaibatsu groups in steel, shipbuilding, paper, cement, and aluminum sulfate industries. Under the new environment, number of trade unions, now organized at the enterprise level encompassing both factory as well as office workforce, jumped from 500 in 1945 to 33,000 in 1948.

c) Marketing Power: A critical factor constraining Japanese industry was the poor capability to develop relevant products from the available resources. In its annual report, Kamaishi iron and steel works noted, “facilities in the pig iron division were in excess supply, and the variety of rolled steel products was also extremely limited.... The most important thing for us was to increase the production of rolled steel, our final product, and to diversify our product line; and for that purpose we sought to renovate and build up rolling facilities.” The First Economic Paper of the Japanese government estimated that if the coal production could be raised by 20%, the mining and manufacturing output would jump by 40%. At the beginning of 1947, the US reform authorities introduced a priority allocation system. The rolled steel obtained from the dismantling of Japanese military products was recycled for the use in coal mining. The coal miners were given food as wages, enabling them to devote their time to work rather than to the market search of best buy on highly costly and scarce food. The community support was mobilized through mass media for applying coal production into manufacturing of new steel. Though water was in short supply and transport system in shambles, the output in 1947 was close to the very ambitious target: 29.34 million of coal and 740,000 tons of rolled steel.

### **Hypothesis Formulation**

Japan established a Reconstruction Finance Bank in January 1947, for low-interest loans to the core industries. The Bank derived two-thirds of its capital from the loans monetized by the Bank of Japan. The loans were initially funded as direct government subsidies using deficit financing, but by 1948 public bonds financed a growing proportion of funds. In March 1949, the Bank's loans accounted for a third of the total outstanding loans of various Japanese commercial banks. The coal industry alone received 30% of the total loans issued by the Bank, or Yen 47.5 billion,

accounting for 70% of the total coal industry borrowings. The electric power industry got another 15% of the Bank's total loan issues. Further, the government granted a subsidy on coal, equivalent to about 79% of the wholesale price, if sold to strategic infrastructure industries. The steel industry received the largest direct subsidy, valued at Yen 21.3 billion in 1948. But after mid-1949, the mining and manufacturing output stagnated. Even as the total value of national exports doubled in 1949, coal inventories grew to more than 4 million tons by March 1950.

Recognizing the weak financial state of Japan, the US government's National Security Council appointed Joseph Dodge, a Bank President at Detroit, on October 9<sup>th</sup>, 1948 as chair of the US aid program. Dodge had earlier headed the reconstruction program of the US government for Germany in 1946. Japan was to be supported by "a vigorous combination of the US aid program envisaging shipments and/or credits on a declining scale over a number of years, and by a vigorous concerted effort by all interested agencies and departments of the US Government to cut away existing obstacles to the revival of the Japanese foreign trade, with provision for Japanese merchant shipping, and to facilitate restoration and development of Japan's exports."

Dodge dismantled the system of reconstruction bonds in Japan, and barred further issues of public bonds. He sharply raised Japanese postal and railway fares to make those activities self-financing. The household income taxes were also increased, and tax incentives were offered for financial savings. The number of price controlled commodities was cut from 290 to 63, and of price controlled items was reduced from 2128 to 531. As a result, black-market prices nose-dived, and consumer prices rose less than the wholesale prices over the fiscal years 1950 and 1951. To further support the working proficiency of the distressed Japanese masses, the US offered generous aid totaling 2.085 billion between 1946 and 1951. The value of yen was stabilized at 360 to a US dollar. The special procurement orders from the US military augmented the producers' surplus in Japan. The special US orders jumped from 0.52% of Japanese national income in 1949, to 0.57% in 1950 and 4.13% in 1951, before falling to 2.21% in 1955. These

orders provided 44% of Japanese commercial export earnings in 1951, 65% in 1952, and 73% in 1953. The special procurements to support the Korean War initiative alone totaled \$1.56 billion during 1950-52. The export earnings supported the import of iron ore, and enabled the open-hearth manufacturers to construct blast furnaces for making value-adding pig iron. Within a year from June 25<sup>th</sup>, 1950, when the Korean War began, mining and manufacturing output had experienced a rapid growth of 50%.

The export earnings allowed the firms to cut the prices of products sold at home. Three forces play a critical role in further modernization and advancement of technological investment base. These forces are (1) monetary power, (2) manufacturing power, and (3) machinery power.

1) Monetary Power: To support special-purpose project finance involving exports and quality improvement, Japanese government created an apex Export Import Bank of Japan in 1950, and Japan Development Bank in 1951. Under a three year First Iron and Steel Rationalization Plan introduced in 1951, 70.3% of the new machinery investments in the steel mills were approved for special depreciation rates in tax computation. The Plan aided a total investment of Yen 120 billion, and financed imports of new strip mills to modernize the rolling mill sector, which used older pullover/ hand sheet milling. Consequently, cost of steel plate fell by Yen 4700/ton. Up to 40% cost savings were generated by subcontracting pullover/ hand sheet milling to the unorganized vendors, who had limited reputation to be eligible for the Plan aid.

2) Manufacturing Power: In domains where the market for a firm's products was clearly on the downhill, substantial manufacturing creativity was needed to reengineer the sunk investment base. The challenge was soon realized by the weapon-makers that moved en-masse to restructure their operations, and began making sewing machines and motor scooters. The consumption of textiles surged 60% in 1952 alone, and the total domestic consumption grew by 14%. There was a rising demand for thin-plated US steel to make consumer durable products. The government introduced an elaborate Yen 500 billion Second Steel Rationalization Plan in

1955-56. As part of the plan, high-tech hot strip mills were constructed using the US oxygen converter technology. The new technology offered enhanced durability and precision of processing iron ore into pig iron, and thence of a variety of specialized steels. The total manufacturing investment into new equipment jumped from 10% of the gross domestic product to 20%. Japan soon gained number 1 position worldwide in the oxygen converter capacity, and was placed after the US in the total number of hot steel mills.

3) Machinery Power: Japanese steel industry found a prolific customer in the ship construction. The amount of steel used for ship construction soared from 410,000 tons in 1954, to 730,000 tons in 1955 and 2,290,000 tons in 1957. In addition, a rapid mass production of washing machines and refrigerators was initiated, as automatic continuous process stamping machines raised the quality of silicon steel sheets to the world-class level. In no time, the volume of television sets, starting with near zero base in 1953, also rose from 0.3 million in 1956 to 1 million in 1958. To service the enhanced usage of machinery, several machine tool makers emerged. The machine tool production jumped from Yen 5 billion in 1955 to Yen 100 billion in 1962.

A key factor in Japan's defeat in the World War II, as noted in 1946 survey on the Strategic Bombing by the US, was the cutting off of overseas marine transport by the US submarines. The cut-off had disrupted the supply of repair parts to the Japanese army lines in Asia, leaving them stranded without sufficient ammunition power. Also, the resulting closure of the access to colonial raw materials had impeded home manufacturing operations. After the War, 6 million Japanese expatriates returned home from the Asian colonies, and were living virtually unemployed on the rural farmlands. The foreign exchange earnings from exports allowed generous financing of several oil refineries, electric power plants, and steel plants. These projects had a high degree of raw material import content, and were located around the coast. The regional linkages of these projects boosted the urban population by 9.05 million between 1955 and 1960, and cut the rural population by 4.9 million. Therefore it is hypothesized that:

### **Hypothesis: Technological Capability and Marketing Alliance**

*The more the firm interacts with non-reputed partners, the greater the technological investment.*

### **Operational Measures**

Japanese general trading firms actively prospected under-developed mining opportunities in Asia and Latin America, with a view to secure increasing supplies of raw materials at decreasing costs. Encouraged by abundant supplies of high quality raw materials, Nissan, Toyota and other Japanese automakers introduced transfer machines and automated presses into their production systems. The older semi-automatic machines were loaned out, or offered as equity share, to proliferating mass of medium and small machine shops. These machine shops had too little capital base or reputation to secure line of credit from the banks. Using machine support from the prominent assemblers, they quickly positioned themselves as dedicated sub-contractors. Japanese government moved fast to shape an Overseas Development Assistance Program. As part of the program, all surplus base of older machinery valued at \$70 million/ year was transferred as war reparations to Korea and Taiwan over the late 1950s and early 1960s. The overwhelmed recipients inadvertently requested supplementary expertise to make the machinery produce quality products. General trading firms, who had been the most active operators in Asia, had little requisite capability. Therefore they commissioned a variety of joint consortia with machine-makers, assemblers and subcontractors. Each consortia participant received a minority equity share in the Asian venture as compensation for its product-services, and an open offer for long-term buy-back of co-specialized output at constant costs. In 1960, Japanese government was encouraged to substitute erstwhile import quotas with liberalized tariffs. The quota-free imports as percentage of total imports surged from 33% in 1959, to 44% in 1960, 70% in 1961, 88% in 1962, and 97% in 1967. Investment of 0.9% of national income over 1961-64 in transport, water and hotel facilities for the 1964 Tokyo Olympics heralded a new era in Japan's international

prestige. These developments suggest a need to correct the **motivating-effect** of the interactions with reputed players in evaluating the proposed hypothesis.

### **Test of the Hypothesis**

Despite a super-normal productivity in their domestic operations, Japanese firms showed an early proclivity for diffusing their firm-specific assets overseas as foreign direct investments. The unusual level of the firm-specific disadvantages, that made the use of these investments at home unproductive, derived from several forces at the corporate, local, national and international levels.

Corporate Forces: Conventionally, the capability of firms to make overseas direct investments has been presumed to be a primary function of their ownership advantages. As of 1960, Japanese firms had little, if any, technological advantage over the competing American firms. Their financial capital base was also quite limited, as was their market reputation. As also illustrated by the case of Honda Motorcycles, Japanese firms had begun acquiring dominant leadership positions in a variety of industrial segments. In many of these segments, British firms had been major players. The cessation of colonial empire foreclosed the British imports of under-priced raw materials from overseas. Japanese firms, using a technological network assembled from the American know-how and Asian raw materials rapidly penetrated the market segments dominated by the British. Japanese firms negotiated deals for licensing advanced integrative know-how of the reputed American firms. Given the sharp scarcity of foreign exchange, inadvertently Japanese licensees prospected for sub-contract suppliers and Asian transplant units. The innovative nature of resulting products implied not only savings in the royalty costs, but also rapid growth in the global markets without any direct competition with the US firms.

Local Forces: The government-motivated financial intermediation generated a rapid growth in the investments into capital goods sector. Over the 1960s, Japanese consumer prices rose rapidly even as the wholesale prices were stable. The value-added in the capital goods sector was surging at rates that put even the five-year income doubling government plans to shame. In this

context, amidst diminishing supply to the domestic consumers, Japanese firms began accumulating abundant reserves of cash, inventory, and inter-firm trade credit. In 1961, the government mandated Tokyo Stock Exchange to open a secondary market for the medium-sized firms. By the end of 1963, 583 mid-sized companies had listed their stocks on the Exchange, and issued new stocks intended to finance employee benefits and housing, as well as distribution system restructuring. Several send their employees for a field visit of the US supermarkets, generating chain-store frenzy from the mid-1960s onwards. A revised era was on cards, with the number of job offers in the Japanese labor market exceeding that of the applicants by 1967.

National Forces: In 1965, Japanese government decided to fully give-up the fiscal discipline. For the first time in nearly two decades since Dodge Initiative, in 1966 it issued deficit public bonds to finance a tax break of Yen 310 billion, construction projects of Yen 730 billion, and general subsidies of Yen 4.3 trillion. Japanese firms also received special war orders from the US troops in Vietnam. These orders generated \$1 billion a year of export revenues, out of a total Japanese export revenues of \$9.7 billion in 1966 and \$11.6 billion in 1967. These unusual foreign exchange earnings were used for extra-ordinary imports of new machinery, thereby causing the domestic equipment investments to grow at the rate of 20% annually. There was a 57-month long upturn, which lasted up to the summer of 1970. The upturn was accompanied by an escalating industrial concentration index. Starting from a base of 100 in 1960 and an interim value of 96.8 in 1965, the index surged to 110.1 by 1970. The share of light industry in total exports fell from 31.9% in 1965 to 22.4% in 1970, but that of heavy industry and chemicals rose from 62% in 1965 to 72.4% in 1970. The effects of government capitalism were most evident in the food consumption. Though Japan got promoted to the ranks of industrially advanced nations, with a membership to the Organization for Economic Development and Cooperation, its average daily calorie intake during 1965-70 was just 2,300. This level was the same as in 1934-38, and far below 3,000 plus levels of the US and the UK.

International Forces: The hollow growth in Japanese fundamentals pushed the Brittain-Woods fixed gold parity into complete disarray. When, in early 1970s, the US Federal Reserve Bank declared its inability to continue supporting the value of US\$, Japanese yen was revalued up by 16.88%. In contrast, the Deutsche Mark of Germany, the other nation to receive substantial reconstruction aid from the US, went up by only 13.58%. Despite the lower costs of imported raw materials, Japanese wholesale prices were sharply up by the end of 1972. By the middle of 1973, severe production constraints emerged in the textiles sector, and soon diffused to the heavy industrial capital-intensive sectors of steel, cement and chemicals. The oil crises of the first quarter of 1974 only catalyzed the problem of weak specialization of capital with the internationally traded technological endowments. The average annualized domestic growth rate tumbled from 8% during 1950-60 and 11.1% during 1960-70, to 4.4% during 1970-80, and 3.5% during 1980-90. Through most years of the 1990s, the growth rates consistently lagged even the most conservative government estimates of 2-3% annually.

The above analysis points to the use of super-normal capital resources for augmenting reputation in advanced technological segments as the dominating force in maturity. The underlying Japanese growth, on the other hand, was pre-dominated by the technological inputs traded from the non-reputed vendors. The linkages with the reputed Japanese assemblers enabled these vendors to secure low-cost credit for expanding the scale of their technological services. The enhanced marketing capability also offered new opportunities for targeting other global customers. The higher wage cost of the vendor workforce limited the assembler productivity of shifting second-hand machinery, processes, and product formulations, to them.

The early Post-war experiences of the German firms, who have been the leaders in the luxury and recreational values, as well as in the ecological and ergonomic dimensions, could be quite instructive in highlighting solutions. Traditionally, German firms, with a priority on the chemicals and heavy industry sector, contributed to substantial ecological and ergonomic risks.

During the Postwar era, German firms rapidly improved the proficiency of their traditional technological trajectories. Over the 1980s and 1990s, the German government rapidly expanded the fiscal expenditures to support internal and pan-European integration. There was a rapid growth in the workforce unemployment and under-employment rates. Further German firms faced increasing pressures to pursue capital-intensive direct investments overseas, using the low cost credit support from the affiliated banks.

### **Correction Factor for the Motivating-effect**

Germany, as did the US and the UK, had accounted for more than a fifth of world's manufactured exports since the last quarter of the 19<sup>th</sup> century. In exchange, Germany received farm produce from Eastern Europe, Far East, and the Americas. Craig (1978: 609-610, 620-621, 629) in the Oxford History of Modern Europe, reports that during the 1930s, "Skilled labor was well rewarded... [which] encouraged increasing numbers of young workers to enroll in ... vocational program. The wages of the average worker kept pace with the cost of living, [and only]... 18 percent of his pay packet was deducted for unemployment, health, and accident insurance, income and poll taxes, and contributions to party relief agencies... [There] was an overall rise in the living standard... [This mass] affluence contributed to the stimulation of the consumer goods industries and the rise in imports of woollen goods, tobacco, coffee and cocoa, and luxury goods... The rationalization of industry increased the number of jobs [women] were capable of performing... The number of working women increased from 4.52 million to 5.2 million between 1936 and 1938." Though there was only a limited employment of women in mining, metallurgy and construction sector, there was a surge in women employees in the chemical, electrical, rubber, textile and food industries. The number of unemployed people fell from more than six million at the end of 1932 to one million in 1936, and to 34,000 in August 1939. A shortage of one million workers was estimated in the industrial sector, which was accounted by one million people employed in the army.

During the World War II, Germany suffered a severe destruction in the productive base. The German Armaments Minister Speer wrote a memo to Hitler on 15<sup>th</sup> March 1945. The memo reported, “The enemy air forces have kept up their attack, concentrating on the transport system... it is no longer possible to supply coal for shipping, the Reich railways, gas and electricity works, and the food industry, nor for the armaments industry, which is last in the line. The final collapse of the German economy is thus to be expected within 4 to 8 weeks... After this collapse it will not be feasible to continue the war on a military basis.” Post-war Germany inherited a highly capital-intensive industrial base. The use of machine tools/ton of civilian output in Germany was 3.4 times that in the US. The net value of German industrial capital assets had fallen to 75% of the 1936 levels, after accounting for 37% depreciation accumulated since then. German gold and foreign exchange reserves had exhausted. 39.8% of the 1944 production was accounted by the armaments, that were now fully banned. In 1935, 75% of the plant and equipment in capital goods sector had been more than ten years old. In 1945, as much as 64% of the plant and equipment in capital goods sector was less than ten years old. German firms sought to explore new non-defense applications, albeit expecting only limited sustainable competitive advantage from their firm-specific resources. For instance, on 7<sup>th</sup> May 1945, Robert Bosch, a top maker of electric inputs, declared, “It is intended to manufacture the following products, which are new to us: 1. Simple household equipment... [Utensils] 2... fittings for... electric appliances... We will probably not continue indefinitely the production of the whole range of goods... The technical department will collect samples of common types, provide documents on the market for such goods, price levels, and so on, and will then make specific recommendations to the management as rapidly as possible.”

In February 1945, Germany had been partitioned into four zones, one each under the supervision of Russia, France, the UK and the US. Russian zone had the richest human capital, skilled in chemicals, mechanical engineering and optics. The small French zone had the rural

backbone, comprising agriculture, small-scale firms, and chemicals. The British zone was the industrial backbone, and was least disrupted by the War. It contained the core Ruhr raw materials, that sustained coal mining, iron and steel, chemical fuel synthesis, and mechanical engineering units. The American zone was the military heartland, and had come to a total halt at the end of the War. It had specialized in mechanical engineering, precision engineering, and vehicles manufacturing.

On 8<sup>th</sup> September 1945, The Economist carried an article on the state of German economy. The article noted, “The increase of productivity per man-shift is an even more difficult and slow proposition because of the appalling housing and food conditions in the Ruhr area. The feeding of miners has recently been improved. It is organized in the mines and aims at giving the heaviest workers a 3,200 calories diet. But the miners’ families live on an average diet of 1,000 calories, and the miners often absent themselves from work in order to search for food for their families. The repair of destroyed houses before winter is another reason for absenteeism. So is the high rate of miners’ lung and gastric diseases... Absenteeism has, for all these reasons, reached 25 to 30%. While labor is the greatest single bottleneck, deficiencies of machinery are not yet impeding output. With production at one-fifth of the normal, it might even be said that Ruhr mines have surplus machinery.” The Allies issued a joint Spartan directive on 20<sup>th</sup> September 1945, to export German raw materials (coal, timber and steel scrap) for funding war reparations and food imports. In the meantime, even with 15% of the German population taking to farms, domestic food production reached just 90% of the pre-war levels. Britain suffered a drastic reduction in food supplies at home in May 1946. In the process, food imported into the British zone over July-December 1946 fell to 0.837 million tons, limiting the total consumption to a rock bottom 2.552 million tons including local farm-output. Besieged with widespread hunger strikes, the British decided an exit strategy by merging their zone with the American one in 1947. The food imports into the ex-British zone jumped to 3.9 million tons in 1947, yielding a total

consumption of 5.695 million tons. The French followed the British in 1948. On the whole, over 1945-48, official US grain aid constituted as much as 67% of the total German imports.

During the winter of 1946-47, the waterways froze on 20<sup>th</sup> December 1946, thereby putting severe burden on railroad transportation. With limited downstream movement, the coal stocks at Ruhr surged from 0.315 million tons in November 1946 to 1.227 million tons in March 1947. A third to a sixth of domestic business transactions took the form of barter. The exports of manufactured goods, which stood at 77% of the total exports in 1937, had fallen to 11% of the total exports by 1947. These limited exports comprised primarily of machinery, which was exported to the small industrial nations of Benelux, Austria, Switzerland, and Scandinavia. The exports of raw materials, that were 11% of the total exports in 1937, grew to 64% of the total exports. 92% of the import bill during 1947 and 1948 was taken by the foods, up from just 34% in 1936. The industrial inputs constituted the residual 8% of the import bill during 1947 and 1948, down from 66% in 1936. The coal distributed per week to the industry recovered from 0.406 million tons in January 1947 to 0.611 million tons in July 1947. But by the onset of winter in late 1947, coal production was stalled. On the whole, coal production of Germany in 1947 was 50% of that in 1938, as against 80% for Denmark and Belgium and 90% for the UK. The industrial production was just 20%, compared to 33% for even Italy.

On 26<sup>th</sup> March 1946, the US introduced a Plan for Reparations and the Level of the Postwar German Economy. The Plan estimated that Germany had a capability to manufacture just 11.4% of its Prewar machine tools production, and only 50-55% of the 1938 level of total domestic economic value-added. After gaining charge of the British and the French zones, the US authorities put top priority on the infrastructure sector (electricity, gas, water, and transport-related work), with additional focus on developing factories in food-processing, medical/ sanitary products, clothing, and shoes. These priorities were already in force at the American zone. The firms were permitted to retain 5% of their export proceeds in foreign exchange, to be used for the

imports of plants, and another 5% for the imports of food and consumer goods distributed as wages to the workforce. The completion of the repairs of wagons and locomotives by November 1947 was ahead of schedule. By end 1947, 40% of the railway bridges, 49% of the railway tracks, and 50% of the road bridges had been renovated. Between November 1947 and February 1948, the accumulating coal stocks at Ruhr mines eased from 1.213 million tons to 77,000 tons. The output of all the industries accelerated through the winter of 1947-48 without any hindrance. The Ruhr coal output, that had tumbled from 1.64 tons/man-shift before the War to 0.86 tons in 1946, also began rising to 0.57 tons in 1948.

In the meantime German firms tried to improve the manufacturing methods, but failed to boost the production. In its annual report dated 27<sup>th</sup> July 1948, Robert Bosch noted, "There were difficulties in the supply of raw materials, fuel and energy, which during the winter 1946/47 halted production in most factories entirely... Production has been rationalized on the basis of work-studies and new processes, and a number of products are once again being manufactured on assembly lines. Special machines and equipment have been brought into use. The success of these measures has been shown in a reduction in the number of rejects and re-worked jobs."

On 21<sup>st</sup> June 1948, the US introduced an Economic Reform Package as part of the Marshall Plan for pan-European reconstruction. The Package offered Germany \$1.6 billion in aid spread between 1948 and 1952, on the top of \$1.6 billion already committed since 1945. Out of the total Marshall Plan aid package of \$13.2 billion for 16 nations, \$3.2 billion was offered to the UK, \$2.7 billion to France, and \$1.5 billion to Italy. On the whole, 30% of the \$13.2 billion aid was granted as agricultural goods (good, feed and fertilizers), 30% as industrial inputs and semi-finished products, a sixth in the form of machinery and vehicles, another sixth as fuel, and the residual as the cost of US marines. The aid constituted 3% of the West European national income. 65% of it was used in production, and 35% as investment. Out of a total of \$22 million aid to Germany in 1948, \$16 million was in hard currency for the import of raw cotton. German

production index, with a base of 100 in 1936, dramatically jumped from 54 to 79 between June 1948 and December 1948. The heavy industrial military plants were rapidly dismantled, yielding 220,000 tons of scrap equipment by mid-1949 in the American zone, and 1,274,000 tons of scrap equipment by September of 1950 in the British zone. In together, these dismantled plants were valued at 3.46% of the 1948 total domestic gross fixed capital. The proceeds from the domestic sale of food aid were set apart as Counterpart fund. These funds formed the capital base of a new Reconstruction Credit Corporation. The Corporation issued public bonds to finance reconstruction loans for first coal mining, and then railways, iron and steel, and energy generation industries. The Corporation financed 47% of the capital investments in coal mining and nearly 60% of those in electricity generation. On the whole, the Corporation financed 6.7% of the total domestic capital investments between 1948-52.

### **What Value Do the Firms add to the Emerging Networks?**

A crucial element in the Marshall Plan was technical assistance “to make the European economy familiar with the current state of technical development in the USA by means of intensive exchange of experience, and thereby to achieve a considerable increase in productivity.” In 1948, a group of 123 German students were invited to study at the US universities. In 1949, besides 384 students, 642 German leaders in politics, trade unions, agriculture, and other fields visited US for specialized training. A memo dated 21st February 1949 illustrates the typical nature of the training: “The project is designed to acquaint a leading official of the Department of Manpower with the methods of administration and operational procedures prevailing in the field of labor allocation in the US. It is hoped that this official will be able to secure the adoption in Germany of those practices which are adaptable to the German scene.” To maximize the program effectiveness, all the visitors were asked to give written reports of their experiences and potential applications of acquired knowledge. The Director of the US technical assistance program submitted a report to the Public Advisory Board of the US on 28<sup>th</sup> June 1950. The report noted,

“the comments of team visitors to this country refer not so much to our superiority in technological developments or our natural resources, as to the management practices found in American plants... They were enthusiastic about plant layout, lighting, and material handling methods that they saw. They were also interested in the specialization of jobs and the extent to which research went hand-in-hand with production.” The US boosted the total value of its technical assistance to Germany from \$2.5 million in 1949, to \$10 million in 1950 and \$15 million in 1951. The number of Germans invited for technical education in the US surged to 2426 in 1950 and 2559 in 1951. In 1952, 2000 Germans visited the US, another 1000 were funded to visit other European nations, and about 250 American and European specialists visited Germany for imparting consulting and training on operational organization. Over 1950-58, Rationalization Board published 90 joint studies of various European groups. These covered all the American organizational elements including general business management, market research, human relations, and production (simplification, standardization, and specialization).

As part of the 1948 reform package, the base income tax in Germany was left high, but marginal income and corporate tax rates were cut down. Substantial tax credits were offered for financial savings and retained earnings, and generous depreciation rates were given for depreciation on new investments. The dividends were penal taxed. More than 1,000 of the nearly 2,500 cartels in force during the Pre-war era were terminated, and the others put on a watch list. The prices of consumer as well as producer manufactured goods were deregulated. The prices of essential products – staple foods, fuel, rent, transport, agricultural fertilizers, and iron and steel – remained under rationing/ price control. To boost coal production further, miners were offered premium compensation. To facilitate repairs of railroads, coal was delivered on a priority basis to iron and steel industry. In the meantime, enhanced food supplies cut the absenteeism rates from 25% to just 3-4% in firms such as Daimler-Benz. The average weekly work soared from 39.5 hours before the Plan to a high of 48 hours in 1950. A sharp migration of

refugees from the Russian zone to the joint Western zone ensued, and added 20% or 10 million to the latter's population between 1945 and 1953. The value of the US aid, as percentage of total German imports, dropped from a high of 37% during the fourth quarter of 1949, to 18% in 1950, 12% in 1951, and just 3% in 1952. This value included an additional \$0.7 billion of aid offered by the US as mutual security assistance as part of its Korean War initiative. Awarding a Nobel Prize for Peace to General George Marshall on 10<sup>th</sup> December 1953, the world recognized the revolutionary contributions of the Marshall Plan.

A new conservative German government, under the leadership of Konrad Adenauer and with Ludwig Erhard as economic minister, was elected in September 1949. All the import quotas were liberalized, and a major tax relief program was introduced in March 1950. The private lenders received a total tax relief of DM 1.5 billion, in exchange for their loans to the shipping sector until 1954. An Investment Aid Law was formulated in December 1951. The bottleneck infrastructure sectors of energy, railways, coal, and iron and steel, were offered a generous total depreciation allowance of DM 3.2 billion, and low-cost loans of DM 2.5 billion. To finance this aid, the firms in all other industries were obligated to pay 3.5% of their taxable profits into a DM 1 billion a year fund. The normal rate of depreciation allowance was raised from 28.5% to 28.3% in 1953 for a period of four years. The firms could write off 50% of the cost of replacement investments up to DM 100,000 within two years. Induced by these initiatives, the total short-term and long-term bank loans surged 166% between 1950 and 1954.

With common knowledge American methods and high-end American market supporting the domestic German machine and material base, auto production and exports surpassed the peak pre-War levels by 1951. The output of mechanical engineering industry doubled in value between 1950 and 1952. The significant contribution of American methods to the German technological capability became quite evident after 1954. Under the 1954 European Economic Cooperation Agreement, Switzerland and Netherlands liberalized 90% of import quotas, and in

1957 Belgium 90%, UK 80%, Denmark and Norway 75%, and Austria 50%. By 1955, German production was 55% above the 1950 levels, with half the increase deriving from exports. The money supply had grown by 94%, net of price inflation. A rapid growth in a variety of new consumer products, such as washing machines, radio and television receivers, refrigerators, and cars, ensued, while the industrial emphasis on the older generation coal, textiles and steel diminished. By the late 1950s, German share in world manufactured exports reached peak Pre-war levels. In 1959 the consumer goods exports were 6 times the 1950 levels, while those in electrical and mechanical engineering were 7 times. In products such as gramophones, record players and tape recorders, German firms developed new niches using the technology of American firms who had accounted for a half of the world exports in 1950. Germany gained a 33% global market share in global electric washing machine, up from 0 before the War. Germany's share of global market in cars jumped from 20.4% to 34.8%, and in home refrigerators from 15% to 27%. Much of these gains were contested from the US, with the UK also continuing its Pre-war downward slide.

The above suggests that the import liberalization in European market complemented the American interactions. Yet German advantage suggests that the German firms did not just copy the standard American processes – rather they sought substantial improvements using complementary links with pan-European and German know-how. These improvements were supported with enhanced inputs from fresh more diverse apprentices. The proportion of 15 to 18 year old boys in apprenticeship grew from 62% in 1952 to 71% in 1958, and that of the girls from 22% to 39%. Due to a high relevance of resulting adaptations to the German work-culture, the share of domestic income spent on household durable products doubled over the 1950s, as did the share on transport. The share of disposable income spent on food fell from 46.4% in 1950 to 39.2% in 1959, and the per capita food consumption topped the Pre-war average of 3000 calories/day. Another 3.6 million refugees were therefore attracted from the Eastern Europe

between 1950 and 1962, including 20,000 engineers and technologists, 4000 medical doctors, and 1000 university teachers. These refugees were estimated to have added an annual average DM 2.6 billion to the domestic product, equivalent to a third of 1950 industrial exports.

### **Conclusions and the Recommendations for Further Research**

In its report “Protecting the most vulnerable of today’s workers,” International Labor Organization (1997) finds that the, “Seasonal workers were widely used in Europe – for instance in France, Germany, and Switzerland,” and concludes, “Migrants are rarely if ever treated on par with nationals, nor are they adequately covered by the existing international labor standards.” In the early 1997, Europe had 12 million legally working foreign immigrants, topping North America with 8 million, Africa with 7 million, and Middle East with 6 million legally working foreign immigrants. Without the immigrants, the firms may have to bear significantly higher human capital as well as investment capital costs. Perrow (1972: 72-74) investigated the radical changes in American managerial ideology after the 1930s. He found that as the structure and technology of industry “became more bureaucratized, large, and mechanized, interpersonal problems loomed large and those of the sheer force of will, inventiveness, or effort declined. As skill requirements increased in the work force, retention of experienced employees became more important. As immigration dried up and capital investments increased (making work stoppages more costly for management), unionization became a more potent weapon... The new ideologies of management, however, rested not on fixed qualities of managers or the system; instead, they stressed things that management had to do, such as discovering a common purpose, or making a purposeful effort to structure a cooperative system.”

A feasible solution to sustain international reputation was to rely on the material services of the outside vendors, who typically had lower cost manpower. Increasing returns could thence be realized on the machinery investments. In addition, focused learning of the factors supporting the super-normal dynamism of the emerging firms could further the energy-conserving methods.

Sample and Data Source: Over the 1980s, several prominent Japanese firms used their reputation for workforce involvement and continuous quality improvement, to acquire controlling or trading links in the US auto assembly and parts sector. A similar phenomenon ensued during the 1990s, when the leading German auto firms expanded their operations in the US. To evaluate the comparative cost-effectiveness of the resources in the assembly and parts networks of the US auto industry, the analysis uses the industry segment level data. The National Bureau of Economic Research compiled the raw data, collected by the Annual Survey of Manufacturers in the US, as a comparable annual time-series for the period 1961-90. For each industry segment, cost-effectiveness is evaluated for four resources. (1) **Manpower** is measured as manufacturing labor cost/sales, (2) **material** is measured as cost of intermediate inputs/sales, (3) **machine** is measured as new fixed investment/sales, and (4) **method** is measured as energy cost/sales. The analysis evaluates two network-level catalyst forces in technological investments: (1) **Trading-effect**, or contribution of global forces, is measured as [auto-assembly \$ gross profits/ production worker hour *less* auto-parts \$ gross profit/ production worker]. (2) **Human-effect**, or contribution of local forces, is measured as [auto-assembly \$ value-added/production worker hour *less* auto-parts \$ value-added/production worker]. In Table 6.1(a), each of the four resources of the auto assembly segment is regressed on the trading-effect and human-effect. The intercepts yield the **cost-effect** of each resource. The t-values are in brackets.

All the four resources networked by the American auto assembly segment had a significantly constant cost-effectiveness. Corporations, as a whole, derived 13.24% of the overall production value from manpower, 67.46% from material, 1.86% from machine, and 0.67% from energy-using method. Thus 83.23% of the production value derived from the perpetually tradable resources. Trading-effect significantly improved the manpower cost-effectiveness, and encouraged procurement of material- and machine- intensive services from the auto parts vendors. Human-effect significantly saved the manpower costs, and sustained the cost-

effectiveness of material and machine resources.

Table 6.1(a): Value-added to the American Auto Assembly Over 1961-90

	Manpower	Material	Machine	Method
Cost-effect	0.1324 (37.884)	0.6746 (88.341)	0.0186 (8.407)	0.0067 (14.342)
Trading-effect	0.0179 (5.163)	-0.0565 (-7.455)	-0.0080 (-3.627)	0.0000 (-0.018)
Human-effect	-0.0178 (-5.524)	0.0529 (7.530)	0.0073 (3.595)	0.0000 (-0.089)
R sq.	0.776	0.686	0.334	0.175

Table 6.1(b) investigates the impact of US auto assembly trading-effect and human-effect on the cost-effectiveness of resources used by the auto parts segment. The auto parts enjoyed a more cost-effective tradability of manpower and machine, despite lower value-added by the commonly traded material and energy-using method. Trading-effect of the auto assembly significantly improved the value-added by material to the auto parts, but limited the value of manpower, machine and method. Human-effect of the auto assembly significantly added to the cost-effectiveness of manpower, machine and method of the auto parts segment, but limited the value-added by material.

Table 6.1(b): Value-added to the American Auto Parts Over 1961-90

	Manpower	Material	Machine	Method
Cost-effect	0.1674 (18.303)	0.6236 (52.766)	0.0277 (5.950)	0.0052 (6.166)
Trading-effect	-0.0281 (-3.103)	0.0590 (5.034)	-0.0173 (-3.751)	-0.0063 (-7.543)
Human-effect	0.0267 (3.174)	-0.0557 (-5.116)	0.0163 (3.803)	0.0060 (7.730)
R sq.	0.324	0.519	0.367	0.737

The networking of the global manpower and machine resources contributed to the manpower and machine cost-effectiveness of American auto parts segment. The direct foreign assembly in the US motivates the Japanese firms to more intensively network the American auto parts resources. As such the ability of the Japanese firms to use innovative material and energy-intensive methods is limited, and their incentives for further investments are hampered. Therefore there is a further need to investigate the incremental value of alternative network linkages. The diffusion of the information on the vendors internationally can help firms sustain their international reputation in the age of competitive globalization.

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