INDUSTRIAL POLICIES AND GROWTH: LESSONS FROM INTERNATIONAL EXPERIENCE

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1. INTRODUCTION

For a period of roughly 35 years the Republic of Korea, Japan, and Taiwan pursued industrial policies (IP) defined as an effort to alter the sectoral structure of production towards sectors they believed offered greater prospects for accelerated growth than a typical process of evolution would generate. Used without more specificity, all developing countries, excluding perhaps Hong Kong, have employed and continue to utilize industrial policy. Credit directed at specific sectors at below market interest rates for long term and working capital, sectorally differentiated profits taxes, subsidized electricity rates, highly differentiated tariffs and non-tariff barriers are all a form of industrial policy. Several Asian countries, particularly Japan, Korea, and Taiwan (JKT) are the exemplars of these efforts. Given their success over this period it is tempting to conclude that the industrial policy played a decisive role in their success.

Two questions immediately arise. First, even during the period of successful growth, say 1955-90 for Japan and 1965 through the late 1990s for Korea and Taiwan, was industrial policy "the" source of growth or was it a mild accelerant, improving the growth rate from 9.5 to 10 percent given the high growth of capital, education, and from the almost inevitable gains in total factor productivity (TFP) to be realized from borrowing technology from abroad even in the absence of industrial policy. Second, are any of the problems encountered in Japan since 1990 and in Korea since 1997 partly the legacy of one aspect or another of industrial policy?

A plausible alternative scenario to the role of industrial policy in explaining these Asian success stories has been that they resulted largely from getting macroeconomic policies correct: responsible

government monetary and fiscal policy, low inflation, maintaining the correct real exchange rate were key to their success as was the considerable investment in the education system. Growth was propelled largely by physical and human capital accumulation and the growth rate of TFP while not spectacular was very high by LDC standards.

The disagreement between those who have a quasi-religious belief in the efficacy of industrial policy and those who believe economic fundamentals were critical is, at one level, unbridgeable as it would require an agreement on the counterfactual evolution of sectors and productivity in each. Nevertheless, the considerable body of evidence available that attempts to empirically assess the impact of industrial policy brackets most plausible counterfactual scenarios. The neoclassical scenario that argues that success was due to getting the fundamentals right may be correct but it must deal with the carefully documented and abundant evidence that JKT were indeed interventionist. The issue is whether that being documented, the effect can be shown to have been quantitatively significant. If growth rates, conditional on physical and human capital accumulation and normal TFP growth rates would have been 9.7 and were increased to 10 percent as a result of industrial policy, IP may have played a positive but not overwhelming role. Did such an increase occur and at what contemporary cost including lost consumer surplus as well as future costs, including the weakening of the financial system that had a negative effect in the late 1990s.

Some would argue that the above view is too partial and that going one step back, factor accumulation rates were themselves positively affected by industrial policy. The 35% saving rate and the passion for education reflected profit and wage opportunities that were generated by industrial policy or the

lower risk attached to a given prospective rate of return. We will briefly survey the evidence on this later in the paper.

2. THE CASE FOR INDUSTRIAL POLICY

For selective government intervention or industrial policy to be welfare improving, policymakers must identify market failures that would provide the scope for welfare-enhancing interventions; design and implement the appropriate interventions; and correct or terminate the applied policy as changing circumstances warrant.[1] Economists have identified numerous circumstances in which market failures could provide scope for welfare-enhancing IP. These include:

1. real external economies such as the diffusion of knowledge that one set of firms obtains without incurring its own costs. One mechanism by which this occurs is the movement of individuals among firms but the knowledge spillovers may occur without such movement from informal exchanges in both professional and social contexts. In the case of traded goods, real externalities improve welfare only if they allow goods to be produced at less than the imported c.i.f. price.[2]
2. external economies that arise as the size of a competitive industry increases, permitting a falling long run supply curve. Such gains in productivity in a competitive sector in which individual firms exhibits constant or increasing costs are attributable to economies of scope in the use of specialized equipment and greater specialization of individual skills. Accelerating the growth of the sector may generate an earlier move toward lower long run costs. In the case of noncompetitive sectors in

[1] We use the term welfare-enhancing and growth-accelerating interchangably in this discussion. Most of the theoretical models are explicitly static, hence the normative results are expressed in terms of welfare-enhancement, not growth-acceleration. While it is possible that IP could could generate a one step increase in welfare that would not lead to an acceleration in the secular growth rate, we believe that focusing solely on explicitly dynamic models would be too limiting in this context.

[2] This is not, however, sufficient to justify intervention. A socially successful intervention depends on whether the present discounted value (PDV) of future producer surplus exceeds the PDV of the social cost of subsidies.

which large scale economies exist, firms will incur lower unit cost if capacity is established at higher levels of output. If they perceive only a domestic market, they will construct a larger plant only if potential purchasers also establish large plants that generate extensive demand. The market failure is that at a given point in time, current prices may not convey the information about prospective expansion that is relevant to attaining a lower cost of production through larger plant size. (Scitovsky, 1953, Chenery, 1959). This generates an argument for coordination of planned investment given by Murphy, Shleifer, and Vishny (1989) who formalize Rosenstein-Rodan's (1943) idea of the "big push." There are multiple equilibria due to pecuniary externalities generated by imperfect competition with large fixed costs. They argue that industrial policy which "encourages industrialization in many sectors simultaneously can substantially boost income and welfare even when investment in any one sector appears impossible" (p. 1024). Growth of the size of the economy will eventually preclude the need for policies to obtain the productivity gains from either economies of scope or scale.

3. externalities conferred on other firms in an industry by the first entrant. These include the demonstration that the sector is physically and economically feasible (Pack and Westphal, 1986, Rob, 1989) and the diffusion of information on technology and marketing conditions.[3]

4. the incomplete appropriability of the results of R & D and the possibility that its private riskiness

[3] Okuno-Fujiwara (1988) provides a formal example of this in the form of a model of the interdependence of two industries. One industry, which produces an intermediate product, is assumed to be oligopolistic due to underlying scale economies and engages in Cournot competition. The other industry, which produces a final product, from an intermediate product, is perfectly competitive. In this situation there may be multiple equilibria with one equilibrium Pareto-superior to the others. Industrial policy has a positive role in the form of pre-play communication to generate a superior coordinated equilibrium. For the intervention to convey some purely *national* welfare-enhancement, there has to be some non-traded aspect of the externality. Otherwise, foreigners have access to the same low cost inputs, and the pattern of production in the downstream industry is indeterminate without additional assumptions.

exceeds social riskiness.

5. externalities that arise from the interaction of suppliers and buyers on the design or method of production of a product leading to a better or cheaper good than is available internationally. In this case, the source of the externality is the nontradability of some types of inputs or knowledge - otherwise the improved method or product could be obtained from international suppliers.

In these cases, IP can be directly welfare-enhancing by improving the competitiveness of domestic industry, leading to both higher national (and world) output. There are additional cases in which IP can be welfare enhancing or growth-promoting through the capture of rents or terms of trade effects associated with international trade.[4] In these cases, national industrial policies have a zero-sum element at the global level and could hence be thought of as containing a strategic or predatory element. Similarly, the new trade and growth literature which links the cross-national pattern of international trade specialization to differential cross-national growth rates provides numerous theoretical possibilities for growth-enhancing IP at the national level (Grossman and Helpman, 1991).[5]

This discussion has established the theoretical possibility for welfare or growth-enhancing industrial policies. It would be beyond the scope of this paper to comprehensively map the advisable policy interventions to the specific market failures or strategic opportunities identified in the literature. Nevertheless, it is probably worthwhile pointing out a few general caveats for the successful implementation of IP. First, the appropriate policy response may be very case specific. For example, in the well-known

[4] Early formalizations of arguments along these lines are contained in Spencer and Brander (1983) and Itoh and Kiyono (1987). Helpman and Krugman (1989) contains a synthesis of the subsequent literature on strategic trade policy.

[5] It might seem at first blush surprising that the normative results of these models to a large extent turn on conventional differences in factor usage across industries. As a consequence, they do not appear to yield robust policy inferences. Empirical work has focused on modeling international spillovers arising from research and development activities (e.g. Coe and Helpman (1995), Coe, Helpman, and Hoffmaister (1997)) rather than on the implications of IP policies. However, has raised serious questions about the robustness of these results.

Brander-Spencer model, the optimal intervention changes from an export subsidy to an export tax, if Bertrand rather than Cournot competition is assumed.[6] In the case of the international trade models, multiple policy tools may be necessary to pursue domestic and international goals if the good in question is not pure importable or exportable.

Second, with the exception of some policies that might be accomplished through pure informational or coordination effects, industrial policies require scarce resources. It is not sufficient, for example, to show that in a partial equilibrium sense that a particular production or export subsidy might be potentially growth-enhancing if the necessary resources are mobilized at the expense of even more worthy sectors (Dixit and Grossman, 1986). This, of course, suggests a more general informational problem, namely, even if policymakers identify the possibility of a growth accelerating intervention and the appropriate policy package, they still have to calibrate the appropriate magnitude of, say, a tax or subsidy: after all, it is as possible to intervene too much as too little.

Third, in the case of globally zero-sum strategic policies, policymakers must consider the possibility of retaliation. As a general proposition, one would expect that the possibility of retaliation would reduce the likelihood of growth-accelerating IP.[7] A basic lesson from the strategic trade literature is that the possibility of retaliation further complicates the problem of identifying optimal policies.[8]

Finally, in the cases discussed thus far, intervention may be effective if the government itself does not

[6] Similarly, the presence of increasing returns to scale, decreases the likelihood that the optimal policy is a subsidy, since a subsidy may encourage the entry of additional firms into the market and reduce efficiency by reducing plant size or output. See Helpman and Krugman (1989) for more such examples.

[7] However, as demonstrated by Johnson (1953-54), the possibility of retaliation does not eliminate the possibility that the introduction of a tariff by a large country would necessarily be welfare-reducing even allowing for retaliation.

[8] For example, in the Brander-Spencer model with retaliation, the previously optimal export subsidy policy is

suffer from deficiencies leading to government failure. One of the notable lacunae of the IP literature is the general absence of discussion of political economy factors, in particular the possibility of rent-seeking behavior by self-interested firms and policymakers and the concomitant degradation of policy. One of the important aspects of Asian industrial policies was the relative lack of corruption, perhaps reflecting the high status of civil service jobs and their relatively high rate of remuneration.[9] This will be touched upon in the discussion of the specific cases below.

3. INDUSTRIAL POLICY IN JAPAN

3A. The Policies

The roots of contemporary industrial policies in Japan go back all the way into the Meiji Restoration of the mid-19th century, and the state-led development under the slogans *Shokusan-Kogyo* (industrialization) and *Fukoku-Kyohei* (a wealthy nation and a strong army.) Ironically, the unequal treaties concluded between Japan and Western powers which greatly circumscribed Japan's ability to protect its domestic industries through tariffs, encouraged Japanese policymakers to develop other tools such as targeted subsidized lending through state-controlled banks to achieve the same effect. Intellectually, the Japanese took their cues from Prussia (a curious precursor of the Axis alliance of World War II), not Britain, and it was Friedrich List, the proponent of infant industry promotion, not Alfred Marshall, the father

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welfare-reducing, and the optimal policy is a coordinated export tax by both national governments.

9 See World Bank, 1993, Chapter 4 and Campos and Root (1996)

of neoclassical economics, who developed a following in Japan.[10]

Japan developed a dual economy exporting labor-intensive products such as tea, textiles, and apparel while at the same time developing considerable heavy industry, much of it organized by family-dominated conglomerates (*zaibatsu*) and oriented toward military production. Japan defeated first China (1895) (annexing Taiwan), then Russia (1905) (eventually annexing Korea) and established itself as a formidable military power as recognized by Great Britain in the Anglo-Japanese Alliance of 1902.

State-dominance of the economy, which had waned in the early part of the 20th century as the private sector expanded, revived with the political radicalization of the late 1920s, the Great Depression, and the onset of the Pacific War. Many of the institutional features often thought of as uniquely Japanese have their origins in the wartime economy (Okazaki, 1993; Noguchi, 1995). The devastation of World War II left Japan ' s per capita income in 1950 at less than three-fourths its prewar level. However, the contemporaneous level of per capita income was surely a misleading indicator of Japan's underlying technological capacity – Japan, after all, had produced battleships for the Russo-Japanese War of 1905 and aircraft carriers and world class fighter airplanes in the 1930s, and as indicated by Table 1, the human capital embodied in Japan's labor force was quite high relative to per capita income.

In the aftermath of the war, the Japanese government together with American occupation authorities implemented an economic reconstruction plan characterized by a considerable amount of direct state resource allocation, multiple exchange rates, and extensive quantitative controls on imports, foreign

[10] Neoclassical economics remained weak in Japan, and until quite recently the bulk of Japanese academic economists were Marxist in orientation. This is relevant to the extent that there was a general coincidence between the neomercantilist orientation of many of the so-called modern economists, and the Japanese Marxists, who regarded IP as the manifestation of state monopoly capitalism, arguably a progressive development from their perspective.

exchange, inward foreign investment, and technology through licensing schemes.[11]

After the withdrawal of US occupation forces in 1950, Japan continued to implement sectoral IP through tax policy, off-budget finance, direct subsidy, subsidized credit, research and development policy, and controls on international trade, investment, and technology importation, and tolerance of cartels and other kinds of anti-competitive behavior on the part of domestic firms. Capital channeling required repression of the financial system and discouragement of direct finance. In addition to these formal policy tools, government officials also sought to exercise influence through informal administrative guidance (*gyosei shido*), coercing recalcitrant firms if necessary. The focus of these efforts was largely oriented toward rebuilding heavy industries such as steel and transportation equipment that had been destroyed during the war.

The conventional wisdom among economists is that direct subsidies have played little role in fostering changes in Japan's industrial composition. As shown in Figure 1, the declining sectors of agriculture, forestry, fishing, and coal mining have typically accounted for 90 percent or more of direct on-budget subsidies, and one study by the Japanese government found that only one sector, food processing, received direct subsidies exceeding 0.1 percent of GDP originating in that sector (Saxonhouse, 1983).

Another possibility would be indirect subsidies through the tax system and off-budget finance. The primary source of subsidized capital is the Fiscal Investment and Loan Program (FILP), under the control of the Ministry of Finance Trust Bureau. The FILP is an off-budget program around half the size of the general account budget and has been a powerful policy tool, allowing bureaucrats to address priorities not met in

[11]For histories of early postwar economic policies, see Shinohara (1982), Morishima (1982), Johnson (1982), and Calder (1993). The classic work on Japanese IP is Komiya, Okuno, and Suzumura (1988). See also Johnson

the general accounts budget with this second or shadow budget.

Funds for the FILP come mainly from the postal savings system. In addition to financing the activities of public corporations, private sector investments are financed through public financial institutions such as the Japan Development Bank, the Export-Import Bank, and the Housing Loan Corporation. In the early postwar period nearly one-quarter of FILP finance went into strengthening industry, but the share dropped steadily through the 1950s, 1960s, and 1970s, and by 1980 less than 3 percent of FILP funds went to industry, while housing, regional development, and other activities have received half of the money (Ogura and Yoshino, 1988, Table 3).

One source of indirect subsidies is the public financial institutions that offer loans at rates below the prevailing market interest rate. A second source of implicit capital subsidy is the accelerated depreciation allowed under the tax system.[12] Although some countries allow instantaneous depreciation of new investment, the only method that does not distort profitability of new investment, most require depreciation to be taken over some part of the life of the asset. Insofar as legal asset life and the structure of assets differ among sectors, there may be implicit differentiation among them in the present discounted value of depreciation allowances. In addition, an export-based special depreciation system existed from 1961-1972.

An indication of the quantitative significance of the implicit capital subsidies is given in Table 2, which reports the ratio of the implicit capital subsidy to investment for 14 industries in 1968, 1976, and 1984.[13] In general, the low interest rate loans have been of greater quantitative significance than the special

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(1984) and Patrick (1986).

[12] This discussion follows that of Ogura and Yoshino (1988). Special deprecation schemes have existed in Japan throughout the postwar period. The most important of these had the effect of subsidizing certain classes of investment goods.

[13] The implicit subsidy provided through the provision of these low interest loans has been calculated as the

depreciation provisions. With the exception of mining, where investment has been weak and the involvement of public financial institutions high, the implicit capital subsidy to investment ratio has been low, generally less than 5 percent. After mining, the greatest beneficiary of the reduced interest burdens has been the transportation machinery industry, which includes shipbuilding, motor vehicles, and aircraft.[14]

Certain tax and budget policy provisions beyond the relatively uniform low subsidy ratios reported in Table 3 have been used to promote high technology sectors. There are special depreciation provisions for the purchase of numerically controlled machine tools, computers and terminals, computer aided design equipment, and industrial robots. Additional tax incentives exist for the use of these products by small businesses, though the amounts appear to be relatively small. Other special tax provisions exist for the software industry.[15] The Japanese computer and robotics industries have been further assisted by the Japan Development Bank and Small Business Finance Corporation funding, including the establishment of special leasing corporations to encourage the leasing of Japanese computers and robots, especially by small firms.[16]

The government has also promoted high technology sectors through direct subsidies to R&D

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difference between interest rates charged by private and public sector financial institutions multiplied by the amount of government financial institution loans. In the case of the tax provisions, the special tax depreciation can be thought of as an interest-free loan, thus the subsidy value of the special depreciation provisions is the implicit interest burden reduction associated with the loan.

[14] Japanese policymakers also have access to off-budget funds for industrial promotion through revenues of quasipublic organizations such as the Motor Boat Racing Association and the Japan Bicycle Rehabilitation Association (Prestowitz, 1988). The amounts of these funds do not appear to be particularly large, however. Saxonhouse (1983) cites *The Wall Street Journal* to the effect that no more than $500,000 a year from these sources was made available to the Japan Machine Tool Builders Association.

[15] The tax benefits are not contingent on the origin of the purchased software or equipment, so the impact of these provisions has been to expand the Japanese market for these products, not assist Japanese manufacturers per se. Likewise, special provisions which allow computer manufacturers to deduct expected losses on the return of equipment offered to users on a trial basis do not discriminate by origin and thus in principle could be used by domestic manufacturers, local subsidiaries of foreign manufactures, or importers.

[16] Unlike the tax provisions, which are justified on the grounds of promoting the diffusion of new technologies and do not discriminate between domestic and foreign products, the leasing schemes specifically apply to Japanese made equipment. The amounts of money involved appear relatively small, however.

activity, special deductions for R&D costs, and reduced interest burdens through the provision of low interest loans by public financial institutions. Tax preferences were provided through a variety of schemes. In addition, there have been direct subsidies to R&D activity. The most important channel in quantitative terms has been the system of research contracts on large-scale industrial technology R&D established in 1966. Of particular significance were subsidies to promote the development of computers in the 1970s, and research contracts on next generation industrial technology, including new materials, biotechnology, and new electronic devices, in the 1980s.

Lastly, private R&D has been subsidized through the provision of low interest loans by public financial institutions for "financing development of new technology." Private R&D activities are provided indirect support by a number of government-supported institutions. These include national and public research institutes, private nonprofit research organizations, special public corporations, and the mining and manufacturing technology research associations, such as the Very Large Scale Integration Research Association.

In quantitative terms, the direct subsidies are the most important component of government R&D support, running about twice as large as the tax provisions in most years. Implicit subsidies through the provision of low interest loans have been relatively unimportant, Government support for research organizations is approximately as large as direct subsidies. Assessing the sectoral pattern of R&D is difficult. Direct subsidies from the government, public corporations, such as Nippon Telephone and Telegraph (NTT), and special R&D tax deductions are only reported at the aggregate level. Sector-specific indirect support through the research associations is difficult to ascertain, partly because individual associations

frequently encompass more than one sector and partly because the budgets of these organizations include private, as well as government, funding.

Data on the government subsidy share of total R&D expenditures are reported in Table 3. As can be seen in these figures, government support of R&D activities is low, with total government support, allowing for non-subsidy financing, certainly less than 5 percent of private R&D expenditures for the economy as a whole, far less than the comparable figure for the United States. If one looks at individual sectors, government R&D, as a share of total R&D, is seen to have been highest in the declining mining industry. After mining, support has been highest in the energy-related sector of petroleum and coal products and, as in the case of the capital subsidies, the transportation equipment industry, which includes aerospace.

With respect to external relations some have emphasized the government's role as a "doorman," "determining under what conditions capital technology and manufactured products enter and leave Japan" (Borrus et al.,1986, p. 98). Effective rates of protection (ERPs), computed from tariff data and the Japanese input-output table, are shown in Table 4.[17] In 1968, ERPs were greater than 10 percent in all manufacturing sectors except publishing, where the ERP was negative. The highest ERPs, in excess of 40 percent were in food processing, textile products, and transportation machinery. The estimates for food processing and textile products are probably upwardly biased indicators of the true ERPs, however, since in these cases major inputs were subject to quota protection not included in the ERP calculation. By 1975, ERPs had fallen for most manufacturing categories. The reductions in ERPs were most dramatic in the machinery sector, where the ERPs for transportation and precision machinery fell by approximately 40 and

[17] The ERPs for the primary product sectors are misleading because they do not take into account quotas in agriculture and subsidies in agriculture and mining.

20 percentage points, respectively. The final column for Table 4 presents estimates of ERPs for 1987 based on tariff cuts agreed to under the Tokyo Round negotiations. With the aberrant cases of food processing and textiles excluded, the ERPs are under 10 percent for most manufacturing categories, indicating a general fall in rates of protection over a 20 year period. Again, it should be noted that these calculations are based on tariff protection only; they do not take non-tariff barriers into account and the sectors are relatively aggregated. Nonetheless, barring a dramatic increase in nontraditional protection, a distinct impression of a gradual liberalization in most manufacturing sectors emerges.

Perhaps of equal or greater importance than the Japanese government's role in affecting goods trade has been its use of its various policy levers to bargain with foreigners from a monopsonist ' s standpoint. Goto and Wakasugi (1988) provide the example of royalty payments on the importation of a particular Austrian steel production technology that were held down to 1 cent per ton for Japan through an agreement between MITI and the industry, while U.S. firms paid up to 35 cents per ton for the licensing of the same technology (p. 190). Borrus et al. provide examples from the microelectronics industry in the 1960s and 1970s of how the Japanese government used its monopsonist power to extract technology transfers from United States firms. The 1980s dispute over the FSX fighter agreement could be interpreted as an attempt by the United States government to use its market power to counterbalance the Japanese government's monopsony position vis-à-vis General Dynamics. What is common in these cases, steel, numerically controlled machine tools, microelectronics, and possibly aircraft, is a pattern of selective protection, strict regulation of inward foreign direct investment and technology transfer, and preferential tax treatment and access to capital until industry has achieved international competitiveness. Rosovsky (1985)

has called this pattern "the denial of the profits of innovation."

3B. Assessment

A number of researchers have attempted to model the impact of Japanese IP on output, trade, and welfare in a cross-industry framework.[18] Lee (1993) examined the impact of Japanese IP using a computable general equilibrium model. Unfortunately, the high degree of aggregation (only three traded goods sectors) and the assumption calibration assumption (IP in the 1950s had no impact) render his results suspect.

Noland (1993a) attempted to evaluate the impact of these policies on the Japanese economy. The results obtained in this paper indicate that trade protection as measured by the ERPs in Table 4 was generally associated with worse than expected trade performance, apparently contradicting the notion that Japanese policymakers had successfully promoted infant industries.[19] Indirect subsidies, however, were associated with the expansion of output and better than expected trade performance. In fact, the estimated effects were so large as to give credence to the argument that Japanese industrial policy had acted as a signaling device to private investors, either because the government was better able to process information than private agents or because government participation in a sector or project created a moral hazard or one-way bet. While the industrial policies were effective in the sense that market interventions did appear to have an impact on sectoral resource flows, on the whole they did not appear to be welfare enhancing, when

[18] See Baldwin and Krugman (1988) and Flamm (1996) for examples of models of single industries.
[19] Noland (1997) obtained more ambiguous results for a more detailed menu of Japanese trade policies. Audretsch

the Itoh-Kiyono model, which runs off of terms of trade effects, was used to evaluate policy impact. Indeed, from this perspective welfare-enhancing interventions appeared to be the exceptions, not the rule.

There is considerable evidence supporting the unsurprising notion that during the postwar period, Japan's comparative advantage shifted into R&D-intensive activities (Balassa and Noland (1989), Vestal (1989), Grossman (1990).) Evidence on the impact of public policies is more scarce. Noland (1996), disaggregated R&D into basic, developmental, and applied activities and separated public and private sources of funding. At the end of the sample period 1969-1989, Japan had a comparative advantage in goods intensive in total, privately funded, and applied R&D activities, and a comparative disadvantage in publicly funded and basic R&D intensive goods. However, the change in coefficient values over the course of the sample period suggested that publicly financed R&D had had a large positive impact on sectoral trade competitiveness through the late-1970s/early-1980s. This result could be interpreted as being consistent with the notion that the relative impact of public support could be relatively high at early stages of development before the private sector R&D capacity was significantly developed and during the period of technological catch-up when R&D priorities could be relatively well-defined on the basis of existing technologies. However, Sakakibara (1997) casts doubt on even this modest formulation, arguing that participation in publicly supported R&D consortia was concentrated in slow growth sectors and that sharing fixed costs was not an important factor in determining participation.

Beason and Weinstein (1996) directly confront the issue of IP and sectoral TFP growth. Working with a 13 sector sample for the period 1955-1990, they fail to uncover evidence that IP, in the form of the

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and Yamawaki (1988) investigated the impact of Japanese IP by including a dummy variable for "favored industries" in a regression on US-Japan bilateral trade. The coefficient was significant with the expected sign.

ERPs reported in Table 4, taxes, or subsidies, targeted sectors with increasing returns to scale or that IP contributed to TFP growth. They do find some evidence that prior to the first oil shock, IP targeted sectors with high labor usage. Lawrence and Weinstein (2001) extend this work on a slightly different data set and find that differential corporate tax rates had an impact on sectoral TFP growth, while direct subsidies and subsidized loans did not. Moreover, they find that the ERP measure is negatively associated with sectoral TFP growth and that imports, not exports, are positively associated with TFP growth.

It is more difficult to assess the impact of the informal policies, if for no other reason than that they are less amenable to formal modeling. For this reason, it would be desirable to develop better descriptions of the workings of the industry councils (*shingikai*) and the process of setting targets. It would be equally desirable to develop better accounts of the penalties and rewards used to encourage adherence to informal guidance. The one study that attempted to model the impact of administrative guidance, Weinstein (1995), found that administrative encouragement of cartels had only a minor impact on prices, margins, and sectoral resource allocation during the period 1957-1988. Sakakibara and Porter (2001), who examine the impact of tolerance of cartels on domestic competition and international trade performance, interpret their results (cartels are negatively associated with domestic competition which, in turn, is positively associated with international competitiveness) as undercutting what they perceive as the conventional wisdom that IP has promoted Japanese competitiveness.

Lastly, it should be noted that this discussion has focused on issues relating to cross-sectoral resource allocation. Some argue that Japanese policy has had a "pro-producer" bias and that this may have contributed to Japan's growth performance by increasing incentives to save, providing Japanese firms with a

ready supply of low cost capital.[20] As shown in Figure 2, Japan (as well as Korea and Taiwan) did in fact accumulate capital more rapidly than the major Latin American economies. This argument is seldom if ever formalized however, and while it has some surface plausibility, it is hard to square with the life cycle hypothesis, and research on Japanese saving behavior has not uncovered links between IP and national saving.[21] However, an interesting paper by Yano (2001), demonstrates that in a dynamic two-country model, that lax competition policies with respect to the non-traded sector of a large trade-surplus economy can act as a "beggar-thy-neighbor" policy, shifting real income to itself from its trade-deficit partner.

3C. Politics and Implementation

IP intrinsically supports some sectors to the detriment of others. It would seem plausible that this would be manifested in conflict among sectors and among their bureaucratic counterparts. Within ministries, the bureaucratic hierarchy can ensure plan consistency, with conflicts resolved through conventional means. Ensuring consistency between plans of different ministries in Japan has been far more problematic.

Indeed, conflicts between competing ministries are a recurrent feature of Japanese politics. One example would be the perennial clashes between the Ministry of International Trade and Industry (MITI) (or its successor the Ministry of Economy, Trade and Industry (METI)) representing the interests of the electronics firms and Ministry of Posts and Telecommunications (MPT) (or its successor, the Ministry of Public Management, Home Affairs, Posts, and Telecommunications) representing the interests of NTT.[22]

[20] A largely closed capital account up through the mid-1980s would facilitate the maintenance of a pool of captive saving, though this is not absolutely necessary if there is home-bias in portfolio allocations.
[21] See Balassa and Noland (1988) chapter 4, and Horioka and Watanabe (1997) on this point.
[22] In the past year Japan has undertaken a number of telecommunications reforms. Nevertheless, the principal theme of METI's 2001 White Paper – which was released after the telecom reforms were enacted – was the need

Inevitably what is at issue is the desire of the electronics firms to see telecommunications reform to encourage the growth of electronic data transmission and other activities which could be expected to increase demand for electronic equipment such as computers. The result of these disputes can be protracted periods of uncertainty and policy paralysis until the inter-ministerial conflict is resolved. One could interpret the results reported above that policy interventions were not welfare enhancing, as evidence of a lack of overall policy coherence.

The degree of ministerial coordination in formulating industrial policy points to the issue of rewards and punishments to encourage compliance. An important question is whether the government can coordinate its incentives across ministries. Could, for example, bureaucrats threaten recalcitrant firms with retribution through actions, say, tax harassment or exclusion from government procurement, that are the purview of another ministry? Put differently, is the game firm vs. ministry, or firm vs. government? There is little evidence of cross-ministry coordination, and although most of the political science literature extolling the impact of industrial policy implicitly assumes benevolent bureaucrats, Ramseyer and Rosenbluth (1997) argue that Japanese IP can best be understood as a product of self-interested political actors.

3D. Conclusions

There is considerable evidence that IP has influenced the sectoral composition of output and trade in Japan. However, rather than being the forward-looking drivers that IP-proponents envision, at least in terms of measurable interventions, the evidence suggests that IP was aimed overwhelming at internationally non-competitive natural resource-based sectors. Indeed, once general equilibrium considerations are taken

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for further reform of the telecom sector – the purview of another ministry.

into account, in all likelihood the manufacturing sector as a whole experienced negative net resource transfers.[23] Within the manufacturing IP might then be regarded as a compensatory policy toward some favored activities or firms.

There is no firm evidence that IP was welfare- or growth-enhancing. This could be due to the inability of policymakers to identify market failures and design appropriate interventions. However the evidence that most resource flows went to large, politically influential "backwards" sectors, suggest that political economy considerations may be central to this outcome.

4. INDUSTRIAL POLICY IN KOREA

The Korean IP experience has generated significantly less attention than the Japanese case – Korea is a smaller economy, Korea has posed less of a competitive threat to US industry and hence has attracted less attention from US-based scholars, and finally, limitations of Korean data on the relevant policy instruments have severely constrained the ability of researchers to do the kind of applied work on Korea that they have on Japan.

Like Japan, Korea went through an extended period of relative isolation from the rest of the world, which came to an end in the late 19th century. As noted earlier, Korea was occupied by Japan in 1905, and formally annexed in 1910. Japanese colonial rule ended with Japan's defeat in 1945, and the peninsula was divided into US and Soviet zones of military control. The partition of the peninsula was formalized in 1948.

Considerable industrialization and technological learning occurred during the Japanese colonial

[23] The data on taxes and subsidies reported in Beason and Weinstein (1996, Table 1) support this supposition for the period 1955-1990.

period, though most of the industry was located in the northern part of the peninsula, with the southern part of the peninsula serving as the breadbasket.[24] Japanese economic institutions and practices were transferred to the peninsula. As in the case of Japan, operation of the economy during the period of US military occupation was characterized by a high degree of state control and use of quantitative allocations.

The Korean War (1950-53), which involved the armies of both sides traversing the peninsula, destroyed much of the capital stock. Mass population movements (mainly from north to south) presumably resulted in a net flow of human capital the North to the South. As in the case of Japan's emergence from the Second World War, the data in Table 1 suggest that in the aftermath of the Korean War, South Korea's endowment of human capital was high relative to its contemporaneous income level. Moreover, South Korea continued to accumulate human capital rapidly after the war (Figure 3).

Economic policy in South Korea following the war is generally regarded as lacking any overarching rationale or coherence. The government pursued a policy of "three lows" – low grain prices, a low (i.e. overvalued) exchange rate, and low interest rates. The results were misallocation of capital and recurrent balance of payment crises. Considerable barriers, including an import licensing system and multiple exchange rates, characterized the trade regime. These policies, together with an export-import link system, encouraged rent-seeking behavior and the development of giant conglomerates or *chaebol*.[25]

The maintenance of negative interest rates inhibited the development of the banking sector, which was permitted little freedom from government control, and encouraged the channeling of capital to large

[24] See Noland (2000) for additional details and references to the relevant literature.

[25] These family-dominated businesses resembled the prewar Japanese *zaibatsu* (indeed, they are represented by the same Chinese ideograph), with which the Koreans were well-acquainted. However, while the *zaibatsu* (and their descendants, the *keiretsu*) were typically built around a bank, the Korean chaebol were dependent on state-dominated institutions for finance.

politically influential borrowers. As the prominent South Korean economist Cho Soon observed, "the most notable feature of the [South] Korean economy during the 1950s was its dependence on US economic aid" (Cho, 1994, p.13).[26]

The orientation of Korean policy changed significantly in the mid-1960s following a military coup which brought General Park Chung-hee to power. Export performance was seized as a barometer of success – as one observer put it, "they were the only statistics that couldn't be faked." Multiple exchange rates were unified and the currency devalued in 1964. Export targets were formulated in considerable detail by product, market, and exporting firm. Firms not achieving them were not subject to penalty; however, the targets were sometimes negotiated jointly with wastage allowances, and there is some evidence that firms achieving their targeted goals could expect more favorable tax treatment (Westphal and Kim, 1982).

At the same time the government began to introduce a wide range of export promotion measures. A government-subsidized organization, the Korea Trade Promotion Corporation (KOTRA), was established to promote exports and perform market research. Exporters were provided exemptions from duties on imported intermediates, tax incentives, preferential access to capital, special depreciation allowances on imported capital equipment, and a variety of non-pecuniary awards. Exporters were also availed generous wastage allowances on duty-free imports and reduced prices for electricity and rail transport.[27] The export-

[26] This assistance was not entirely without merit, however. South Koreans were able to expand their skill base through cooperation with the US. American aid directly contributed to the rapid expansion of education within South Korea and made overseas training and education possible for thousands of Koreans (Westphal et al., 1981), including some of its future economic policymakers. Some transfer of technical skills and management techniques undoubtedly occurred through close contact with US military forces, but its significance is difficult to assess. Likewise, local firms certainly benefited from participation in local military procurement programs, and later from offshore procurement programs during the Vietnam War (Rhee, 1994).

[27] The excess wastage allowances on duty-free imports for export production allowed export oriented firms to divert these duty-free inputs into the production of goods for local sale to their competitive advantage in the domestic market.

import-link system allowed exporters to earn rents through the importation of restricted items. Overall, the trade regime could be characterized as modestly pro-export biased, with established industries receiving roughly neutral effective incentives, while a few infant industries were actively promoted (Westphal and Kim, 1982).[28]

Economic policy began to change in the 1970s in response to a variety of internal and external political developments. Korea initiated the heavy and chemical industry (HCI) drive in an attempt to steer the composition of industrial output toward more engineering-intensive products with the aim of upgrading its export profile and reducing its reliance on imported arms. IP efforts were intensified, and in contrast to the relatively rules-based policies of the 1960s, greater policy discretion and selectivity was introduced.

The financial liberalization policy was reversed in 1972, when interest rates were lowered and direct government control of the banking system was increased in order to channel capital to preferred sectors, projects, or firms. In order to finance large-scale projects, special public financial institutions were established, and private commercial banks were instructed to make loans to strategic projects on a preferential basis. By the late 1970s, the share of these "policy loans" had risen to 60 percent (Yoo, 1994). These loans carried, on average, negative real interest rates, and the annual interest subsidy grew from about three percent of GNP in 1962-71 to approximately ten percent of GNP on average between 1972 and 1979 (Pyo, 1989). Capital channeling policies were augmented by extensive tax incentives for the

[28]While the trade regime was being recast toward greater export-orientation, reforms were also implemented in other areas of economic policy. In 1963, the military government revised the labor laws to discourage the establishment of independent labor unions, and instead to encourage the organization of unions within a centralized system, established so as to facilitate government control. This system was tightened further in 1971 by the introduction of legislation banning strikes, which made virtually any form of collective bargaining or action illegal (Haggard, 1990; Cho,1994).Financial reform began in 1965, when interest rates were raised encouraging saving and financial deepening as well as more efficient use of capital. The national saving rate doubled in five years, and

priority industries. It is estimated that the effect of the special tax measures was to reduce the marginal corporate tax rate from 50 percent to 20 percent for the targeted industries. These industries also received trade protection. This era came to a close in late 1979 with the assassination of Park in 1979 and the second oil shock. Subsequent Korean governments have attempted to scale back IP, with varying degrees of enthusiasm and success.

4A. Assessment

For industrial policies to be successful, the market equilibrium must be sub-optimal. Governments must be able to identify these opportunities for welfare-enhancing interventions, formulate and implement the appropriate policies, and prevent political market failures from leading the policies astray. In the case of Korea, IP policies clearly affected the cross-sector allocation of resources. As a consequence of the HCI credit, tax, and trade policies, Yoo (1994) estimates that during the late 1970s around 80 percent of fixed investment in the manufacturing sector went to the favored heavy and chemical industries. During the first three years of the Fourth Five Year Plan (1977-81), investment in basic metals and chemicals was 130 percent and 121 percent, respectively, of the targets for the entire period, while textiles and other light industries received only 50 percent and 42 percent, respectively of their planned investment (Balassa, 1990). Whether this resource channeling was welfare-enhancing or growth promoting is less clear.

Kim (1990) surveys the fiscal, credit, tax, and trade policies undertaken during this period and concludes that the policy was unsuccessful: it had the predictable result of generating excess capacity in favored sectors while starving non-favored sectors for resources, as well as contributing to inflation and the

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the ratio of M2 (a broad definition of the money supply) to GNP nearly tripled over the same period.

accumulation of foreign debt. Moreover, "the government [was] reckless in its selection of launch enterprises and in its almost haphazard provision of generous incentives… [its] direct, unlimited role in industrial promotion placed it in the position of an implicit, de facto risk-partner, thus complicating the efforts at market-determined adjustment" (p. 44).

Yoo (1990) covers similar terrain, distinguishing between the less selective efforts at export promotion in the 1960s, and the more aggressive industrial promotion efforts of the 1970s. Yoo (1990) also directly confronts the argument that the HCI policy was a success inasmuch as the industries favored by the HCI policy became major exporters in the 1980s. He addresses this argument by posing two counterfactuals: what would the Korean economy have looked like in the absence of the policy, and how would the Korean trade structure have looked in its absence?

Using reasoning similar to Kim's, Yoo concludes that in macroeconomic terms the Korea economy would have been better off without the HCI policy. But what about industrial upgrading? Yoo compares the Korean experience with other, similarly endowed economies (in particular Taiwan) and concludes that on the basis of upgrading or trade performance the HCI policy was not a success. Indeed, given the high rates of return on capital, the opportunity costs of prematurely promoting a sector could have been enormous.

Park and Kwon (1995) conclude that during the HCI drive, the establishment of oligopolistic positions by the *chaebol* retarded technological change. They argue that once scale economies were taken into account, TFP, correctly measured, actually turned negative, though the disentangling of scale economies from TFP is not straightforward. Similarly, Kwon and Paik (1995) use a computable general equilibrium

model calibrated to 1978 to investigate the potential magnitude of these directions. They conclude that resource misallocation reduced GDP by less than one percent if capital is assumed to be immobile, and more than three percent if it is mobile. The welfare impact they calculate is higher.

The one paper that directly takes on the linkage between IP and sectoral productivity growth is Lee (1997). It examines a panel of 38 Korean industries over the period 1963-83. Lee finds that trade protection in the form of tariff or non-tariff barriers is negatively associated with the growth rate of labor and total factor productivity. Tax incentives and subsidized credit were uncorrelated with sectoral productivity growth.

These results cast doubt on the efficacy of resource channeling. What about the line of argument of Pack and Westphal, Rob, and Okuno-Fujiwara that has focused on inter-industry linkages and the potentially welfare-enhancing coordination role for the government? Pack and Westphal suggested that Korea's selective intervention policy might have been successful in fostering infant industries without significant losses in efficiency. The key has been to capture latent inter-industry pecuniary and non-pecuniary externalities. "The Korean government can be seen as having achieved integrated decision-making by acting as a central agent mediating among market agents, forcing and facilitating information interchange and insuring the implementation of decisions reached…weighing costs and benefits from a collective standpoint and often intervening to reward cooperative players and punish uncooperative ones" (p.99)

In both this model and that of Okuno-Fujiwara, the same outcome could presumably be attained through organizational integration. Pack and Westphal argue that in the case of Korea this is not feasible:

"the externalities may flow in complex and inseparable patterns among (actual and potential) agents covering most if not all of the industrial sector" (p.99), necessitating government intervention.[29] However, the existence of the giant *chaebol*, spanning the industrial sector, would appear to undermine this argument. If the *chaebol* cannot internalize these externalities, then it is hard to imagine what institution could. Indeed, it is unclear why the government would be any better able to coordinate decisions than the *chaebol*.[30]

These papers claim that the possibility exists for welfare-enhancing industrial policies through government coordination activities to capture inter-industry externalities, thus promoting growth and industrial development without the standard efficiency losses. The key is the existence of inter-industry externalities, which when captured, expand the production set of the economy.

It is difficult to model these notions rigorously. However it would seem that the likely scope for growth-enhancing interventions would be increased if the industries targeted for intervention met three criteria. The first is that they have strong inter-industry linkages to the rest of the economy. Second, they should be leading in a casual sense, so that growth stimulus would be transmitted forward through the economy. One might think of a input supplier industry in the Okuno-Fujiwara model, as an example. Finally, variations in output should have a strong industry-specific component: otherwise variations in output might simply be due to common macroeconomic shocks and there is little scope for industry-specific

[29] Indeed, Auty (1991) provides detailed descriptions of indivisibilities and other entry barriers in the HCI industries. Even after assessing possible pecuniary and non-pecuniary externalities, however, he concludes that from an economy-wide perspective, resources were misallocated.

[30] If anything, this argument seems more applicable to the Japanese case: in Japan vertical integration is less complete: the *keiretsu*, networks of affiliated firms, strike a balance between the coordination advantage of full integration, and the maintenance of competition among suppliers. In this more loosely organized system the government's coordinating role could be larger.

stimulus. The existence of industry-specific variation in output suggests the possibility for industry-specific technical change and/or scope for industry-specific policy interventions to increase output.

Noland (1993b) examined data on 26 Korean manufacturing industries over the period 1960-1989. He identified four sectors that possibly met these criteria: wood products, paper, petroleum and coal products, non-ferrous metals, and a fifth, non-metallic products, which arguably did. These are not the typical sectors that one would associate with IP, nor were any of them promoted during the HCI drive.

Another test of potential inter-industry externalities is provided by Pack (2000). So far it has been assumed that selective industrial policies directly affected the promoted sectors and that the high rates of productivity growth in the neglected sectors were not affected by spillovers from the promoted sectors. But industrial policies could have generated benefits in other sectors as a consequence of three developments:

(1) domestic production of intermediate goods with special characteristics that were not available internationally but improved productivity in the local purchasing firm;

(2) movement by workers and managers from firms in promoted sectors to firms in other sectors, the movers bringing with them uncodified knowledge;

(3) direct interactions on equipment design by producers and local buyers of machinery that led to adaptations to machinery that were particularly suitable for local firms;

All three externalities could potentially increase TFP growth in the neglected sectors. The potential quantitative importance of specialized non-traded intermediate inputs and uncodified knowledge transmitted by workers depends on how much the neglected sectors interact with the promoted ones. One way to gauge the potential benefits is to measure the purchases of inputs from a favored sector per won of gross output in the neglected sector. The larger the purchase, the more likely it is that the neglected sector may derive some benefits from the existence of local producers. The neglected sector may also derive greater

benefits if there are few imports, which constitute an alternative source of specialized inputs.

We assume that (1) and (2) depend on the magnitude of interaction with the promoted sectors. Such interactions can be measured by Leontief input-output coefficients. The n x n input-output coefficient table, A, consists of two sets of flows, the domestic inter-sectoral flows, A_D, and the import flow matrix, A_M, $A = A_D + A_M$. a_{ij} is a typical coefficient of the domestic flow table while m_{ij} denotes elements of the import matrix. The extent of interaction between favored and neglected sectors is given by the domestic input-output coefficient a_{fn} which measures the purchases of an input from a favored sector per dollar of gross output of the neglected sector. The larger is a_{fn}, the more likely the neglected sector may derive some benefits from the existence of local producers.[31] The neglected sector may derive greater benefits if there are few imports which constitute an alternative source of specialized inputs. Thus, the lower is m_{ij} relative to a_{ij}, the larger the potential impact of the availability of local production.

Several measures of the magnitude of interaction between the promoted and neglected sectors in Korea are presented in Table 5 and those for Japan are presented in Table 6. First, in both countries the average input-output interaction between favored and neglected sectors is quite small. The favored sectors account for a very small portion of the domestically purchased inputs of most neglected sectors. Second, the heavy industries purchase extensively from one another. Third, the imports of the neglected sectors in Korea are, on average, twice the size of the combined purchases from the favored domestic sectors (.134 vs. .068). In Japan, imports constitute a smaller percentage of total purchases. Whether this is due to the non-traded characteristics of Japanese production or to the restrictive trade regime is not clear (Noland 1997).

[31] It is possible to test whether indirect interactions mediated through other sectors have an effect by using the inverse coefficients of the Leontief matrix. But the sources of real external economies enumerated above are not

These patterns suggest the following probable effects on non-promoted sectors:

- It is unlikely that the promoted sectors were quantitatively critical in increasing the range of available inputs. Although industrial policies may have encouraged the domestic production of some unique, non-traded inputs, the overall impact was small relative to all domestic and foreign purchases. Unless there was very low substitutability between local and foreign inputs, the quantitative effect of local supply of such inputs was limited. Rosenberg (1976) cites the importance of local interactions where both user and producer were themselves at the world frontier and there were no suppliers in other countries. In contrast, Korean and Japanese firms in the periods considered were not at the world frontier in the neglected sectors and had many opportunities for obtaining specialized inputs from abroad.
- Insofar as movement of workers and managers transmitted important knowledge, the small purchases from the promoted sectors imply that such knowledge transmission would have been limited. Any tacit knowledge brought by worker mobility, about the special properties of purchased inputs or how to use them more effectively, would affect only a small component of total costs. While one can posit, as in the case of specialized inputs, that there is a critical piece of knowledge whose possession has exceptionally high marginal productivity for the recipient sector, the quantitative case does not seem plausible. Moreover, such knowledge could have been obtained from technology licensing agreements and consultants from abroad.
- Promoted sectors are substantial purchasers of one another's inputs, at least in the metal based sectors. Any externalities from such interaction are thus already accounted for in the calculations shown in Table 6 insofar as they employ the observed values of TFP growth which includes any benefits from the posited spillovers the among sectors.

Some interactions are not captured by input-output transactions shown. In particular, the interactions between the producers and final purchasers of machines are not given as investment is a final demand. Table 7 shows the ratio of imports to domestic production of machinery. In Korea, imports of non-electrical machinery were three times that of domestic production. It is difficult to argue that there were no imported substitutes or that special adaptations to local conditions were quantitatively significant. Even if locally produced equipment conferred some cost reductions on its users that would not have been available from internationally available equipment, it would have affected only one quarter of annual general machinery investment as late as 1985.

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easily extended to indirect interactions.

In Japan, the evidence is more ambiguous. In machinery, as in other industrial sectors, Japan imports very little relative to domestic production. It is thus possible that domestic production may have generated specialized equipment, not available from imports, that increased productivity through interactions of producers and final purchasers.

4B. Politics and Implementation

There is less evidence on the impact of IP on growth in the case of Korea than in the case of Japan. However, if anything, the Korean case underlines the problematic nature of the actual implementation of IP. There have been two interrelated problems. First, the involvement of the state in both the implementation of IP and the financial sector that financed it gave rise to enormous problems of moral hazard and the socialization of risk. The *chaebol* could use capital from favored projects to cross-subsidize other ventures, confident that the government would not allow them to fail. The result was investment without regard to rates of return and weak corporate balance sheets. Without workable bankruptcy or "exit" policies to discipline failures, management strategy amounted to unlimited expansion or what Yoo (1999) called "survival of the fattest." Statistics on *chaebols* do not exist for the 1960s (because of lack of balance sheet data), but Sakong (1994) documents that the share of the top ten *chaebol* in South Korean GDP rose from five percent to 23 percent in the decade between 1973 and 1982.

According to the OECD, "shareholder value was systematically destroyed from the late 1980s onwards" (OECD, 1998, p. 23). The events of recent years are a testimony to this weakness – the $73 billion bankruptcy of Daewoo, the country's second-largest *chaebol*, was the largest corporate failure in world history, and Hyundai, the country's largest, is literally disintegrating under market pressure.

Second, the availability of subsidized resources and the centrality of government relations to corporate success gave rise to an orgy of rent-seeking and corruption that continues to bedevil Korean business-government relations.[32] In the 1999 Transparency International "corruptions perceptions index," South Korea ranked 50th out of 99, tied with Jamaica and Lithuania. In the more narrow "bribe payers index," a measure of bribe-taking by senior public officials, South Korea ranked 18th of 19, surpassed only by China on the sleaze meter. This lack of transparency imposes a penalty on financial transactions in the South Korean market, increasing investor hurdle rates, and inhibiting the ability of good firms to access capital. The transparency risk premium, separate from and in addition to conventional country and currency risk, inhibits investment in the South Korean economy.[33]

4C. Conclusions

Korea was a former colony of Japan, and inherited certain Japan institutions and tendencies in the economics sphere. Like Japan, it suffered significant devastation through war, and its level of human capital and social capacity in the 1950s was high relative to contemporaneous income. IP policies were pursued even more intensely than in Japan.

Most of the evidence on resource channeling suggests that it did not have a major impact on growth. If anything, the impact appears to be negative. If one is to look for a positive impact of IP, it would have to be in the sort of coordinating functions identified by Pack and Westphal and others. This sort of IP is

[32] For an entertaining account of business-government relations through the early 1990s, see Clifford (1994). For more recent material, see Noland (2000).
[33] See Noland (2001) for more details.

difficult to model empirically, and probably the most that can be said, is that there is little evidence as to its impact on growth, either pro or con.

However, there is bountiful evidence of the detrimental impact that IP has had on business-government relations and corporate governance. As state intervention into the economy grew in the 1970s, political connections became increasingly important relative to business acumen in determining success. Korea still lacks viable "exit" mechanisms for failing firms, and business-government relations remain seeped in non-transparency and corruption.

5. INDUSTRIAL POLICIES IN TAIWAN

Like Korea, Taiwan is a former Japanese colony, and like Japan and Korea, it also had an Olsenian upheaval, in this case associated with the conclusion of the Chinese revolution, and the decampment of the Nationalist government and thousands of its supporters to Taiwan at the end of 1948.

There has been considerable analysis of Taiwan's experience with industrial policy. The standard neoclassical interpretation (Little, [1979]) has been that Taiwan's development was primarily attributable to a low level of trade protection, the availability of inputs to exporters at international prices, a conservative macroeconomic policy manifested in limited inflation, and factor markets that were competitive. The last points are suggested by positive real rates of interest and the absence of duality in the wage structure, either by size of firm or by sector. Detailed analysis by Wade [1990] and others contend that a critical component of Taiwan's success was its industrial policy that helped to establish new and successful manufacturing

sectors.[34] These studies have documented the extensive employment of tariffs, quantitative restrictions, and selective credit policies and argue that Taiwan's success in the period considered was attributable to an intensive effort by the government to direct the sectoral evolution of the economy. This was implemented by a variety of means: (1) the establishment of public enterprises when private initiative was not forthcoming or the capital markets were reluctant or unable to fund very large projects; (2) extensive employment of tariffs and quantitative restrictions on imports; (3) direction of credit to preferred industrial sectors through the highly controlled financial sector. The view that Taiwan approximated the laissez faire environment of Hong Kong is untenable in light of the carefully accumulated facts. Moreover, the data on which earlier interpretations were based on fairly low effective protection rates that were estimated in the late 1960s.

There was also another set of policies conducive to the development of the manufacturing sector, namely, the establishment of a large number of institutions that were designed to identify, transfer, diffuse, and efficiently absorb foreign industrial technologies and then to undertake innovation. These latter policies were largely introduced in the late 1970s and 1980s though precursors existed in the 1960s and included the Hsinchu Science Park and the Industrial Technology Research Institute, ITRI.[35] These efforts reflected the fact that unlike Korea and Japan, Taiwan's policies were more neutral with respect to firm size. Much of its industrial development was based on firms with fewer than 100 employees. Centralized research (ITRI) could be justified on standard grounds that social rates of return to R & D exceed private returns while the science park could be viewed as a means of generating economies of scope in the use of critical services such as accounting and consulting that were provided by the park. Moreover, part of the rationale of the

[34] See, for example, Clark [1989], Gold [1986] and the papers in Winckler and Greehalgh [1989].
[35] The most thorough analysis of these institutions is contained in Dahlman and Sananikone, 1995.

science park was to demonstrate to expatriate Taiwanese, largely in the U.S., that Taiwan was committed to a serious effort in high technology. Whether this was as important as the high salaries in luring engineers back to Taiwan is unknown.

As in the case of Japan and Korea, a variety of studies have been carried out on the effectiveness of policies in stimulating more rapid growth. Smith (1992) surveys several of these. The studies consider correlations between rates of TFP growth by sector and either effective rates of protection, ERP, or effective rates of subsidies, ERS, the latter calculated by Smith. In all cases, the correlations are low. An alternative method (Pack and Lin, 2001) follows a different strategy assuming there are non-measured forms of stimulation such as the subsidy equivalent of the establishment of industrial parks, centralized research institutes, and centralized productivity centers. These may be large and have a limited correlation with the ERP or ERS. It then assumes that any exceptional growth in the favored industrial sectors was due entirely to industrial policy and that the TFP growth rate in such sectors was doubled. With these assumptions that are very favorable to finding a positive role industrial policy, they find that industrial policy could have added 2 percentage points of TFP growth in manufacturing. Given that manufacturing accounted for about 30 percent of GDP, this would have increased aggregate TFP by roughly .6 per year out of a total GDP growth rate of 10 percent per year in the period 1962-89, not trivial but hardly the entire story of Taiwan's development. The high rate of TFP growth in all sectors, even neglected ones, the high rate of saving and investment, even apart from the higher levels induced by industrial policy, and the acquisition of skills through education all played a significant role. Industrial policy was of significance but far from the entire story.

The preceding assumes that the impact of selective industrial policies benefited only the promoted sectors and that the high rates of productivity growth in the neglected sectors was not affected by spillovers. If, however, the rate of TFP growth in neglected sectors was increased indirectly by the growth of the favored sectors, the calculated increment to TFP may underestimate the impact of industrial policy. Indeed proponents of the benefit of industrial policies often argue that some of its major effects are manifested indirectly in other sectors, and dismiss as inconsequential evidence about the limited impact in the targeted sectors.

Thus it is necessary as in the case of Japan and Korea to obtain some measure of the potential indirect impact of the promoted sectors. Following the input-output table based tests outlined above, Tables 8 and 9 show intersectoral interaction in Taiwan.

We first consider the magnitude of interaction between the promoted and neglected sectors. Several measures are derived from the Taiwanese input-output tables for 1976 and 1991, years in the middle and at the end of the period of intensive industrial policy are shown in Tables 8 and 9. Column 1 in both tables shows the total purchases, $\Sigma_i a_{ij,}$ of domestically produced intermediate goods by all of the industrial sectors. These include inputs purchased from both neglected and promoted sectors. Column 2 shows the total direct purchases of inputs by the jth sector, $\Sigma a_{MME,j,}$ from favored domestic metal, machinery, and electronics sectors, MME (iron and steel, non-electrical machinery, electrical machinery, household electronics, electronics, and transport equipment). Column 3 shows the purchases by sector j from the three chemical sectors that were also promoted, $\Sigma_i a_{Cj}$. The two groups of favored sectors are separated as they sell to quite different domestic purchasers. Column 4 shows the value of all manufactured imports purchased by

sector j, $M_j = \Sigma_i m_{ij}$.

Several features of Tables 8 and 9 stand out. In both years the direct input-output interaction between favored and neglected sectors is quite small with a few exceptions such as the purchase of chemicals by the textile sector. The promoted sectors account for a very small portion of the domestically purchased inputs of most neglected sectors. For example, in 1976 chemicals accounted for an average of 6 percent of purchases by the non-promoted sectors and the machinery and electronics group 2 percent of their total purchases.

The promoted industries make extensive purchases among themselves, chemicals constituting 29 percent of total purchases by the chemicals sectors, and MME buying 24 percent of its total needs from itself in 1976 and 41 percent in 1991. The imports of the neglected sectors are substantial, the average in 1976, .075, being almost equal to the combined purchases from the favored domestic sectors, .085 (.0209+.0638).

These patterns suggest the following observations:

(a) Given the small domestic intermediate purchases by the neglected sectors from the promoted sectors and their access to imported inputs, it is implausible that the promoted sectors were quantitatively critical in increasing the range of input availability. While domestic production of some unique, non-traded inputs may have been generated by industrial policies, these were small relative to the entire set of domestic and foreign purchases. Unless there is a very low elasticity of substitution between special local inputs and more generally available inputs, the quantitative effect of local supply of such inputs is likely to have been small. Although interactions between local producers and users of intermediates may generate benefits, it

would require strong assumptions about the quantitative importance of the purely local interaction to argue that a significant part of the observed values of A_i^* in the neglected sectors stemmed from the promoted industries. If there were highly valuable missing intermediate inputs, many could have been obtained by imports. Instances cited by economic historians of the importance of local interactions describe situations when both user and producer were themselves at the world frontier and there were no suppliers in other countries. In contrast, Taiwanese firms in the periods considered were not at the world frontier in the neglected sectors and had many choices for obtaining specialized inputs from abroad.

(b) Insofar as movement of workers and managers transmitted important knowledge, the small purchases from the promoted sectors implies that such knowledge transmission would have had limited effects. For example, the Taiwanese wood products sector was purchasing very small amounts of inputs from the promoted sectors, .0564 of gross output. Any tacit knowledge brought by workers and managers who had formerly been in the promoted sectors and then sought employment in wood products about the special properties of purchased inputs or how to use them more effectively, would affect only this small component of total costs. While one can posit, as in the case of specialized inputs, that there is a critical piece of knowledge whose possession had exceptionally high marginal productivity for the recipient sector, the case seems implausible. Moreover, there would have been other channels by which to obtain such information such as technology licensing agreements and foreign consultants.

c) Interactions across sectors are important in the case of the promoted sectors themselves as they are substantial purchasers of each others' inputs, at least in the metal based sectors. Any externalities from

such interaction are already included in the Pack-Lin estimates of the benefits from IP insofar as they utilize the observed values of A_i^* which include any benefits from the posited spillovers within the sectors.

Some interactions are not be captured by input-output transactions shown in Tables 8 and 9. In particular, the interactions between machine producers and final purchasers of machines are not given by the input-output coefficients, investment being a final demand. One measure of the potential magnitude of such interactions is $I_D/(I_D + I_M)$, where I_D denotes final sales of domestically produced machinery and I_M denotes imports of machinery. These values are shown in Table 7.

In 1976, domestic production accounted for 53 percent of the total availability of general industrial machinery, machine tools, and specialized industrial machinery, 63 percent of other machinery and 77 percent of electrical machinery. Except for the decline in electrical machinery, these had not changed much by 1989. Thus, even as late as 1989, Taiwan's local production was supplemented by extensive imports. It is difficult to argue that there were no imported substitutes or that special adaptations to local conditions are likely to have been quantitatively significant. Even if locally produced equipment conferred some cost reductions on its users which would not have been available from internationally available equipment, it would have affected about half of annual machinery investment as late as 1989 and none of the local construction costs. If a typical share of value added in gross output is 20 percent, of which 40 percent is the capital share, and if specialized machinery reduced capital costs by 25 percent, the typical reduction in overall cost (or increase in the level of TFP) would have been 2 percent. Thus, to come up with a significant impact from local production in the machinery sector would require that such equipment is also

more productive in utilizing specialized intermediates and raw materials. But this is stretching a causal link much further than available evidence will permit.

6. Latin American Experience

In the 1950s while Korea and Taiwan were quite poor and often exhibited incoherent economic policies, many Latin American economies embarked on systematic import substitution (ISI) programs reflecting the regnant view of Raul Prebisch and the U.N.'s Economic Commission for Latin America. In some cases ISI was initiated well before ECLA was established, partly out of disillusion with world trade prospects during the depression of the 1930s and the disruptions of World War II. Insofar as this policy, by definition, discriminated among industrial sectors, it constituted a systematic attempt to pursue industrial policy. As is well known, the attempt failed, at considerable economic cost. As it is always tempting to revert to earlier policies, especially if the world economic climate changes, it may be helpful to briefly consider why Latin America experienced failure while in Asia, the policies appears not to have damaged the economies during their high growth period and may even have had slight benefits as indicated above.

The answer to the question has two strands, initial conditions and the mechanism for monitoring the progress of industries benefiting from government encouragement. As has been emphasized in numerous studies, Korea and Taiwan exhibited higher literacy rates and arguably better infrastructure such as roads and ports at the beginning of their high growth episode. Even a brilliantly designed economic program would have floundered if exports, an important component of the success of Korea and Taiwan, could not have been moved to ports and if the ports had themselves not been fairly efficient. On the other hand, too much

can be made of such differences and of the purported benefits of the long Japanese occupation that had been responsible for education and infrastructure, if only for their own benefit. Neither country had the university education levels nor the health care system of an Argentina or Chile (Table 1). And both of the latter had sufficiently good transportation and ports to have engaged in significant primary product exports.

Some authors have argued that Latin America had the luxury of attempting sustained ISI as it could fall back on natural resource exports. Moreover, its endowments would militate in favor of natural resource based exports and against labor intensive exports. Scatterplots of data on labor, physical capital, human capital, and arable land endowments for a number of countries in 1968 are shown in Figures 4A-D. In each panel of figure 4 shows a barycentric projection of three endowments. Every endowment point on a ray emanating from one corner of the triangle has the same ratio of the other two factors; points lying closer to the corner of the triangle have a larger relative endowment of that factor. The point in which the three rays emanating from each vertex intersect in the middle of the triangle indicates the average endowment bundle of the sample.

So, for example, in figure 4A, Taiwan (TAI), Korea (KOR), Hong Kong (HK), and Singapore (SNG) are arrayed across the bottom of the triangle far from the land endowment vertex, in order of increasing physical capital-labor ratios. The point is that the land scarce countries of East Asia tend to cluster in each scatterplot, across the bottom (indicating land scarceness) in figure 4A, near the human capital vertex in Figure 4B, and so on. In contrast, the Latin American countries tend to reveal relatively large endowments of land and low endowments of physical capital with Argentina (ARG) being a clear outlier in Figure 4A. In Figure 4B, the large Latin American countries cluster near the arable land vertex

with similarly situated countries such as Tunisia (TUN), Turkey (TUR), Spain (SPA), Thailand (THA), and to a certain extent Pakistan (PAK) in the subsequent panels. Chile (CHI), with its lower arable land abundance, differs somewhat from Argentina, Brazil (BRA), and Mexico (MEX) in this respect.

These multifactor starting points are important, as Leamer (1987) shows there is some econometric evidence that land-scarce countries (such as those of East Asia) will tend to specialize in manufactures earlier (i.e. at lower levels of per capita income) and more intensively (i.e. exhibit higher output per worker ratios) than economies with more diversified resource bases. Moreover, while economies along the bottom of figure 4A will almost surely experience rising wages as physical capital is accumulated and capital-labor ratios rise, generating "growth with equity." In contrast, in economies with larger natural resource bases, the rents generated by resource extraction will retard specialization in manufacturing, and increase the likelihood that the theoretical possibility that capital accumulation might not be accompanied by rising wages ("growth without development") might obtain.

While a full evaluation of this perspective would require examining the entire trade bundle, some insights can be obtained by looking at the composition of manufacturing. This issue has been investigated by the Inter-American Development Bank and the results do not quite conform to simple expectations though other tests of the hypothesis can be constructed. Table 11 shows the revealed comparative advantage (RCA) in 1988-90 in manufacturing for Latin America (LA), the OECD countries, and "industrializing Asia. (IA)." Latin America's RCA in all manufacturing was slightly less, 1.62, then IA. While IA did exhibit a greater RCA in unskilled labor intensive than LA, 3.38 vs 2.51, it also had a greater RCA in natural resource intensive products, 1.91 vs. 1.15. Thus, IA was able to import, process, and export resource

based manufactured products. The latter is a surprising result given the costs of importing raw materials. It implies that even in resource based sectors, the efficiency of LA manufacturing was low. This implies that ISI probably had the effect of discouraging those sectors in which LA had a comparative advantage because of transportation costs with the reverse holding true in Asia. This is simply another instance of the perverse effects of the LA's efforts at selective promotion via ISI.

An interesting parallel to Latin America is the experience of the Philippines. It began the post-war period with many advantages including high education (Table 1), a large number of English speakers (conducive to trade relations), and close affiliation with the U.S. Nevertheless, despite predictions in the 1950s that it would be the success story in Asia (Morawetz, 1980), its dismal performance reflected import substitution policies similar to those of Latin America. Most of the standard empirical studies of the impact of ISI, one version of industrial policy, bracket the Philippines with Latin American countries (see, for example, Little, Scitovsky, Scott, 1970). The correct latitude and longitude placing a country in Asia was hardly a guarantor of growth – correct basic policies matter.

Hence to point solely to initial conditions is inadequate – the differences in the nature of the industrial policies and their implementation is critical. Extensive protection was given to many sectors in Latin America as evidenced by the high rates of effective protection calculated for all of the countries for which such estimates were made. While the general characteristic was that protection rates were highest for consumer goods and lowest for machinery, they were nevertheless high for most sectors. Firms in inefficient sectors could earn significant profits and their employees high wages (paid out of the rents collected from

consumers) and faced little credible prospect that protection would be contingent on improved efficiency. There was simply no monitoring mechanism – once protection was granted, there was little reduction in its level until crises occurred in the 1980s and later.

In contrast, in Japan, Korea, and Taiwan there was continuous monitoring of the progress of firms. The clearest example is provided by Korea in which subsidized credit and protection in the domestic market were contingent on export performance. Exports became the numeraire by which the progress of individual firms was measured. Current data on exports of individual firms were presented at quarterly meetings at the Blue House, the seat of the executive, with all of the firms in a given promoted sector. The information was obtained not from companies but from bills of lading at Korean ports. Realized exports were compared with targets set by the Economic Planning Board for each firm. As the export targets were constantly increased, firms were forced to improve their productivity in order to lower marginal costs, the alternative being lower profits over time. While many firms initially subsidized their unprofitable exports by cross-subsidies from their profitable (protected) domestic market, clearly this could not be a long term solution as the export targets were increased considerably faster than the growth of domestic sales. Firms were thus forced to concentrate on improving productivity, hence the enormous efforts to import and assimilate foreign technology. (Dahlman and Westphal, 1985 and Kim, 1999 on Korea; Dahlman and Sananikone, 1997, and Pack, 2001on Taiwan). Despite controversies about the precise levels of TFP growth in Korea and Taiwan, it is clear that their rates were far above those in Latin America during its import substitution phase. (Bosworth and Collins, 1996; Nelson and Pack, 1999). In contrast, in Latin America there was no attempt to combine a stick of control with the carrot of protection. There are no instances in the literature with which

we are familiar, of a government's actually reducing protection to sectors that did not perform well.

As noted above it is impossible to confirm substantial benefits from industrial policies in Asia. But as contrasted with the Latin American experience in ISI, no major short term damage was done. Korea and Taiwan did experience fairly high TFP growth rates compared to Latin America though much of this according to all calculations would have accrued without selective intervention. The major difference we believe is the use of some numeraire, particularly exports, to measure success rather than the provision of open ended protection for inefficient sectors. Nevertheless, even the benign experience in Korea and Taiwan during the heady days of intervention and growth may have had unfortunate long term consequences. Again emphasizing Korea's experience, many problems that have been experienced in recent years may have their origin in the policies pursued. The suppression of the financial system and the use of directed credit to individual firms discouraged the accumulation of normal financial evaluation skills and may have affected the quality of financial intermediation in Korea. Low cost loans clearly encouraged many firms to expand beyond their core competence – capable manufacturing firms entered the resort industry.

While a full scholarly understanding will take some time to emerge, it may be the case that any benefits of industrial policy were eventually partly offset by the unforeseen consequences set in motion. Having pursued the earlier policies with care about implementation, Japan, Korea, and Taiwan did not suffer and may have extracted some small benefit for several decades though some would argue they could have done still better given their high saving and investment rates. Latin American nations on the other hand suffered almost immediately from protection combined with overvalued exchange rates that discouraged

exporting. Thus the Asian countries were able to zoom past their initial Latin per capita income peers (or superiors) such as Argentina and Chile. But to benefit from ISI would have required a much different economic outlook, including a focus on some measure of efficiency, exports or other, and a political system capable of enforcing the need to improve productivity in order to receive the rents extracted from households as consumers and taxpayers.

Perhaps one advantage of Japan, Korea, and Taiwan lay in the traumatic experiences following World War II. For reasons that differed in each case, the governments had little legitimacy. Japan had suffered a traumatic defeat after initiating the Second World War in the Pacific. Korea had gained independence from its Japanese colonial ruler but had then been partitioned and a devastating three year war destroyed much of the infrastructure and caused enormous casualties during 1950-52. Taiwan was the base of the defeated Kuomintang government that had hastily left the mainland in 1949. In each case, the government eventually tried to establish its legitimacy by emphasizing economic growth in the 1950s in Japan and early 1960s in Korea and Taiwan. In all three a land reform had overcome one set of opponents to policies that were conducive to growth with equity; in turn this sharing in rapid growth may have led to a perception that government policies benefited the general population. Thus, the IP followed in these countries which required a quid pro quo and in which exports were accepted as the numeraire may have been easier to follow and permitted the avoidance of protection without time limits and without the forced benefits of learning to compete internationally.

7. Conclusions

We believe that the weight of the evidence marshaled in this paper suggests that at most industrial policy made a minor contribution to the growth of East Asia. A large part of the "Asian Miracle" was attributable to non-miraculous good macro-economic policy including limited government deficits, low rates of inflation, and very stable real exchange rates. These were conducive to high rates of saving and investment, important components of the growth story. Another aspect, not discussed earlier, was a bias towards exporting that may have generated some benefits that would not have accrued from domestic sales. (Pack, 1997)

Secondly, the Asian path is more likely to generate "growth with equity" as capital is accumulated, and less likely to run into problems with allocating natural resource derived rents. The politics of IP are likely to be less contentious, and as they are implemented in the manufacturing sector they are more likely to be "leaning with the wind" of comparative advantage.

In any event, the strategy may be irreproducible: some of the subsidies carried out by the East Asians in the past can no longer been pursued. The end of the Cold War and the concomitant willingness of the US and other major trading powers to assert their economic interests, together with the existence of a stronger subsidies code and dispute settlement in the WTO may foreclose options that existed in the past.

Countries that have experienced slower growth than expected despite relatively good macroeconomic policies may be tempted to pursue industrial policies. The large number of experiments with ISI suggest this has not been very successful. The Asian experience, especially in Korea and Taiwan provide some guidelines to avoiding some of the potential harmful consequences if industrial policy is nevertheless pursued. Yet even in these successful nations the evidence suggests that the benefits were

limited. Countries with less dedicated and competent bureaucracies and more amenable to lobbying pressures could expect even smaller net benefits.

The difficulty of demonstrating that the major source of either manufacturing or aggregate economic growth was sectorally targeted industrial policies is not equivalent to denying the importance of a significant government role other than macroeconomic management in stimulating economic growth. Growth enhancing measures that did not differentiate among sectors included large expenditures on primary and secondary education, the building of large and efficient social infrastructure, a favorable attitude towards international technology transfer including both technology licensing and direct foreign investment, and a substantial investment in public technology institutions. The credible commitment of government to rapid development may itself have a positive effect on risk taking in the private sector and have led firms to choose product or processes that promised greater return. Governments seeking a more active role in accelerating growth should consider these policies rather than selective industrial policies.

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Table 1

Human Capital and Per Capita Income, mid-1950s, selected Asian and Latin American countries

Country	Year	Human Capital Index	Per Capita Income	Ratio of Human Capital Index to Per Capita Income
Japan	1955	1673	519	3.2
Korea	1955	494	217	2.3
The Philippines	1956	738	277	2.7
Malaysia	1957	334	351	1.0
Argentina	1955	760	1059	0.7
Mexico	1955	352	637	0.6

Note: Human capital index is educational expenditure embodied in the labor force. See Psacharopoulos (1974). Values for Japan and Mexico interpolated from observations for 1950 and 1960; value for Argentina interpolated from observations from 1947 and 1960.

Per capita income is purchasing power adjusted figure in international dollars from the Penn World Tables.

Table 2

Capital Subsidy-Investment Ratio – Japan

Industry	1968			1976			1984		
	Loan	Tax	Total	Loan	Tax	Total	Loan	Tax	Total
Mining	9.38	1.36	10.74	13.28	1.48	14.76	3.83	1.29	5.12
Food processing	0.65	0.49	1.14	1.24	0.81	2.05	0.51	0.46	0.97
Textiles	0.66	1.60	2.26	2.59	0.88	3.47	0.22	0.51	0.73
Pulp and paper	0.01	0.26	0.27	0.03	0.66	0.69	0.03	0.42	0.45
Chemicals	0.71	0.54	1.25	1.63	0.39	2.02	0.44	0.17	0.61
Petroleum and coal products	0.00	NA	NA	NA	NA	NA	2.83	0.14	2.97
Nonmetallic products	NA	NA	NA	0.72	0.11	0.83	0.44	0.13	0.57
Iron and steel	0.50	0.87	1.37	1.39	0.58	1.97	1.52	0.96	2.48
Nonferrous metal	0.48	0.46	0.94	8.40	0.34	8.74	0.62	0.35	0.97
Metal products	0.85	1.16	2.01	1.52	0.75	2.27	0.57	0.63	1.20
General machinery	0.35	0.50	0.95	2.02	0.43	2.45	0.28	0.20	0.48
Electrical machinery	0.37	0.84	1.21	1.25	0.47	1.72	0.39	1.45	1.84
Transportation machinery	2.95	0.79	3.74	3.76	0.71	4.47	0.56	0.20	0.76
Precision instruments	NA	NA	NA	0.54	0.47	1.01	0.05	NA	NA

Note. Figures are in percentages
Source. Noland (1993).

Table 3

Government Subsidy Share of Total R&D

Industry	1968	1976	1984
Mining	3.2	3.2	14.0
Food processing	0.0	0.1	0.4
Textiles	0.7	0.2	1.1
Pulp and paper	0.8	0.3	0.0
Chemicals	0.5	0.3	0.8
Petroleum and coal products	1.0	0.3	7.2
Nonmetallic products	1.0	0.8	1.8
Iron and steel	0.2	0.6	1.7
Nonferrous metal	0.8	1.5	2.9
Metal products	0.1	0.2	0.2
General machinery	1.4	2.2	1.2
Electrical machinery	1.7	1.5	1.4
Transportation machinery	1.0	4.4	4.7
Precision instruments	1.8	0.3	0.1

Source. “Kagaku Gijutsu Kenkyu Chosa Hokoku” [“Report on the Survey of Research and Development”], various issues.

Table 4

Effective Rates of Protection for Japan

Industry	1968	1975	1987(Est.)
	24.9	19.3	15.8
Traded Goods			
Primary	5.9	5.5	4.5
Agriculture	7.6	9.4	7.6
Forest	-1.0	-0.1	-0.1
Fishery	13.9	8.2	6.7
Mining	-0.6	-0.7	-0.5
	26.7	20.6	16.9
Manufacturing			
Food processing	45.4	55.6	54.1
Textile spinning	21.0	10.8	12.5
Textile weaving	33.6	92.6	94.2
Textile products	41.0	35.4	35.1
Wooden products	18.7	8.9	6.6
Pulp and paper	21.9	21.9	13.5
Publishing	-3.4	-3.3	-2.3
Leather and rubber	26.0	23.5	22.0
Chemicals	18.9	15.7	12.3
Petroleum and coal products	10.9	6.7	7.0
Nonmetallic mineral products	17.7	8.8	6.4
Iron and steel	28.9	20.8	14.9
Nonferrous metals	31.0	32.2	20.1
Metal products	18.7	8.6	6.3
General machinery	17.9	8.2	6.2
Electrical machinery	21.0	13.4	6.5
Transport machinery	45.4	5.4	1.4
Precision machinery	27.3	8.7	7.2
Miscellaneous products	28.0	20.4	9.9

Source. Shouda (1982).

Table 5

Intersectoral Purchases - Korea, 1985

	Purchases from:			
	(1)	(2)	(3)	(4)
purchasing sector:	all domestic sectors	"heavy" industries	chemical industry	foreign suppliers
Neglected Sectors:				
food	.147	.007	.021	.029
beverages	.290	.025	.012	.019
tobacco	.048	.002	.006	.009
textiles & cloth.	.522	.007	.125	.099
leather	.319	.003	.055	.355
wood & wood products	.240	.026	.043	.060
paper	.422	.019	.044	.183
printing & publ.	.408	.017	.042	.039
petroleum & coal	.053	.003	.003	.009
rubber products	.373	.025	.121	.124
non-metallic min.	.293	.029	.020	.029
misc. mfg.	.402	.096	.087	.123
average	0.293	0.021	0.047	0.134
Favored Sectors:				
chemicals	.357	.010	.249	.209
heavy industries				
iron & steel	.542	.466	.009	.131
metal products	.412	.335	.031	.143
non-elec. mach.	.387	.334	.016	.163
elec. machinery	.324	.245	.034	.272
transport equipment	.388	.332	.015	.173
heavy industry average	0.411	0.342	0.021	0.176

Source: Calculated from input-output tables contained in Bank of Korea, Monthly Statistical Bulletin , various issues.

Table 6

Intersectoral Purchases -Japan, 1980

purchasing sector:	Purchases from:			
	all domestic sectors	"heavy" industries	chemical industry	foreign suppliers
Neglected Sectors:				
food	.2066	.0042	.010	.102
beverages, tobacco	.1587	.0056	.010	.031
textiles	.4542	.0057	.121	.053
clothing	.4257	.0043	.001	.033
wood & wood products	.1599	.0052	.016	.206
furniture	.4141	.0259	.024	.035
pulp and paper	.5782	.0030	.023	.057
printing & publ.	.3901	.0054	.036	.023
leather	.5036	.0013	.006	.066
rubber products	.3772	.0105	.200	.042
petroleum and coal pr.	.0631	.0035	.005	.621
non-metallic min.	.2777	.0388	.017	.046
non-ferrous met.	.4549	.0125	.020	.310
precision instrum.	.3921	.0855	.003	.038
misc. mfg.	.4513	.0228	.223	.032
average of non-promoted sectors	.3538	0.0156	0.048	0.113
Favored Sectors:				
chemicals	.5322	.0106	.356	.051
heavy industries				
iron & steel	.6304	.5338	.006	.081
metal products	.4178	.2728	.006	.015
non-elec. mach.	.5100	.4369	.004	.019
elec. machinery	.4802	.2954	.012	.026
transport equipment	.5597	.4256	.012	.021
heavy industry average	.5217	.3292	.008	.035

Source: Calculated from input-output tables contained in Bank of Japan, Japanese Economic Statistics, various issues.

Table 7

Purchases of Domestically Produced and Imported Machinery

Sector	Ratio of Imports to Domestic Production	
	Korea - 1985	Japan - 1980
General Machinery	3.04	.06
Electrical Machinery	.27	.04

Source: See Tables 5 and 6.

Table 8

Intersectoral Purchases - Taiwan, 1976

Purchasing Sector	Purchases from:			
	(1)	(2)	(3)	(4)
	all domestic sectors ($\Sigma_i a_{ij}$)	primary metals, machinery, electronics ($\Sigma a_{MME,i}$)	chemical Sectors ($\Sigma_i a_{cj}$)	foreign suppliers ($M_j = \Sigma_i m_{ij}$)
Neglected Sectors:				
food	.1555	.0033	.0117	.0178
bev. tob.	.1602	.0027	.0281	.0424
textiles	.5206	.0046	.1659	.0620
clothing	.5251	.0054	.0993	.0897
wood & products	.2167	.0107	.0457	.0195
pulp,paper, print.,publ.	.4558	.0080	.0554	.0696
non-met. min.	.2121	.0280	.0268	.0309
metal products	.3341	.0955	.0267	.2202
misc. mfg.	.3758	.0298	.1143	.1245
average	.3284	.0209	.0638	.0752
Promoted Sectors:				
Chemicals				
chem.material	.3474	.0115	.2724	.1127
plastics	.4294	.0059	.3509	.1623
misc. chem.	.3487	.0115	.2457	.1948
average	.3752	.0096	.2897	.1566
Metal and Electronics				
iron & steel	.4090	.3441	.0071	.2597
nonelec. machinery	.4107	.3400	.0115	.1295
elec. mach.	.3197	.1375	.0595	.2507
household elec.	.3566	.2511	.0223	.1787
electronics	.3153	.2141	.0260	.3355
transport equipment	.3054	.1905	.0469	.2489
average	.3528	.2462	.0289	.2338

Source: Calculations from DGBAS tapes.

Table 9

Intersectoral Purchases - Taiwan, 1991

Purchasing Sector	Purchases from:			
	all domestic sectors ($\Sigma_i a_{ij}$)	primary metals, machinery, electronics ($\Sigma a_{MME,j}$)	chemical Sectors ($\Sigma_i a_{cj}$)	foreign suppliers ($M_j = \Sigma_i m_{ij}$)
Neglected Sectors:				
food	.1988	.0024	.276	.0499
bev. tob.	.2491	.0028	.0498	.0488
textiles	.5770	.0067	.2165	.0665
clothing	.5431	.0044	.0602	.1305
wood & products	.3675	.0126	.0425	.1456
pulp,paper, print.,publ.	.4582	.0068	.3923	.1358
non-met. min.	.4326	.0387	.0452	.0655
metal products	.5212	.1975	.0369	.1701
misc. mfg.	.4233	.1104	.1400	.1744
average	.419	.0425	.1399	.1097
Promoted Sectors:				
Chemicals				
chem.material	.5802	.0100	.4322	.2329
plastics	.6157	.0092	.5307	.1799
misc. chem.	.5014	.0114	.2282	.2259
average	.5658	.0102	.397	.2129
Metal and Electronics				
iron & steel	.6194	.5104	.0060	.1930
nonelec. machinery	.5251	.3977	.0174	.1272
elec. mach.	.6305	.3259	.0703	.2628
household elec.	.5391	.3229	.0916	.1638
electronics	.6364	.4823	.0765	.3736
transport equipment	.5549	.4289	.0227	.1669
average	.5842	.4114	.0474	.2146

Source: Calculations from DGBAS tapes

Table 10

Domestically Produced Machinery Relative to Domestic Production plus Imports

Sector	1976	1989
General Industrial Machinery and Machine Tools	.53	.58
Specialized Industrial Machinery	.53	.57
Other Machinery	.63	.60
Electrical Machinery	.77	.57

Source: See Tables 8 and 9.

Table 11
Revealed Comparative Advantage (RCA) in Manufacturers
By Factor-Intensity Category

Category	Latin America		Industrial Countries		Industrializing Asia		Ex-CPEs	
	RCA 1988-90	Change from 1978-80	RCA 1988-90	Change from 1078-80	RCA 1988-90	Change from 1978-80	RCA 1988-90	Change from 1978-80
Total Manufacturing exports	**1.62**	**0.08**	**1.02**	**0.01**	**1.86**	**-0.8**	**1.21**	**0.04**
Human capital/technology-intensive	**1.49**	**0.44**	**1.04**	**0.01**	**1.18**	**-0.05**	**1.19**	**0.00**
Iron and steel	3.42	2.26	0.99	-0.01	0.70	0.15	1.57	0.43
Chemical elements and compounds	1.98	-0.05	1.03	0.02	0.32	0.12	0.73	0.32
Explosives, pyrotechnic products	1.61	-1.36	0.90	0.11	0.19	-0.12	1.11	-0.83
Rubber manufactures	1.16	0.22	1.03	0.03	0.87	-0.25	0.84	0.08
Plastic materials	1.12	0.72	1.06	-0.03	0.57	0.35	0.66	0.25
Manufacturers of metal, n.e.s.	1.05	0.10	1.01	0.01	0.80	-0.12	1.00	0.37
Chemical materials and products, n.e.s.	0.99	-0.50	1.06	0.02	0.40	0.22	0.69	0.16
Dyeing, tanning and coloring materials	0.91	-0.21	1.06	0.03	0.33	0.09	0.89	-0.29
Plumbing, heating, and lighting equipment	0.84	-0.03	1.04	0.03	0.63	-0.46	1.14	0.37
Essential oils, perfume materials, etc.	0.84	-1.34	1.05	0.04	0.42	-0.02	0.35	-0.48
Transport equipment	0.83	0.13	1.08	0.03	0.29	-0.00	0.79	-0.16
Nonelectrical machinery	0.75	0.05	1.05	0.01	0.64	0.39	1.62	0.02
Medicinal and pharmaceutical products	0.60	-0.67	1.05	0.05	0.17	-0.21	1.66	-0.12
Misc. manufactured goods	0.46	-0.41	0.97	0.00	1.53	-0.53	0.47	-0.03

Electrical machinery and appliances	0.43	-0.09	0.97	-0.02	1.89	0.12	0.66	-0.24
Prof., sci., and control instruments	0.37	0.05	1.03	0.01	0.88	-0.56	0.53	-0.09

Table x Cont.

Unskilled labor-intensive	**2.51**	**-0.58**	**0.80**	**-0.03**	**3.38**	**-1.54**	**1.41**	**-0.32**
Leather and leather manufacturers	5.50	-1.91	0.88	0.08	1.02	0.65	0.54	0.30
Footwear	3.74	0.48	0.71	-0.08	3.40	0.68	2.61	-0.71
Textile yarn and fabrics	1.14	-0.60	0.85	-0.05	1.78	-0.21	0.97	0.16
Travel goods and handbags	1.10	-1.64	0.72	0.05	4.54	-2.91	2.02	0.38
Clothing	0.85	-0.69	0.63	-0.03	4.23	-2.28	1.07	-0.46
Furniture	0.36	-0.14	1.04	0.03	0.68	0.01	1.48	0.06
Natural resource-intensive	**1.15**	**-0.09**	**1.00**	**0.04**	**1.91**	**-0.34**	**0.95**	**0.40**
Wood and cork products	1.48	-0.79	0.81	-0.01	3.38	-0.45	1.40	0.81
Manufactured fertilizers	1.22	0.37	0.95	0.01	0.68	-0.55	1.04	0.46
Nonmetallic mineral manufacturers	1.11	0.12	0.97	0.05	0.52	-0.01	0.95	0.36
Paper manufacturers	1.07	0.14	1.08	0.01	0.30	0.07	0.26	0.04
Mineral tar and crude chemicals	0.71	-0.50	0.86	0.34	2.64	-0.56	0.00	-0.94

Note: The totals for the three factor-intensity categories are trade-weighted averages of the individual product divisions, and the total for manufacturers is calculated as the trade-weighted average of the three factor intensity categories. The ordering of product divisions within the three categories is based upon the ranking of the product divisions in the Latin American region during 1988-90. a = Based on regional RCA index values at the 2-digit SITC code level for 1988-90 and changes from 1978-80.

b = Industrializing Asia includes Hong Kong, Singapore, South Korea, Malaysia, Indonesia, Thailand and the Philippines.

c = The ex-CPEs (centrally planned economies) consist of Hungary, Poland, and Czechoslovakia, due to lack of available data for the remaining countries in this category.

Source: Inter-American Development Bank 1992, p. 204.

Figure 1

Mean Total Years of Education

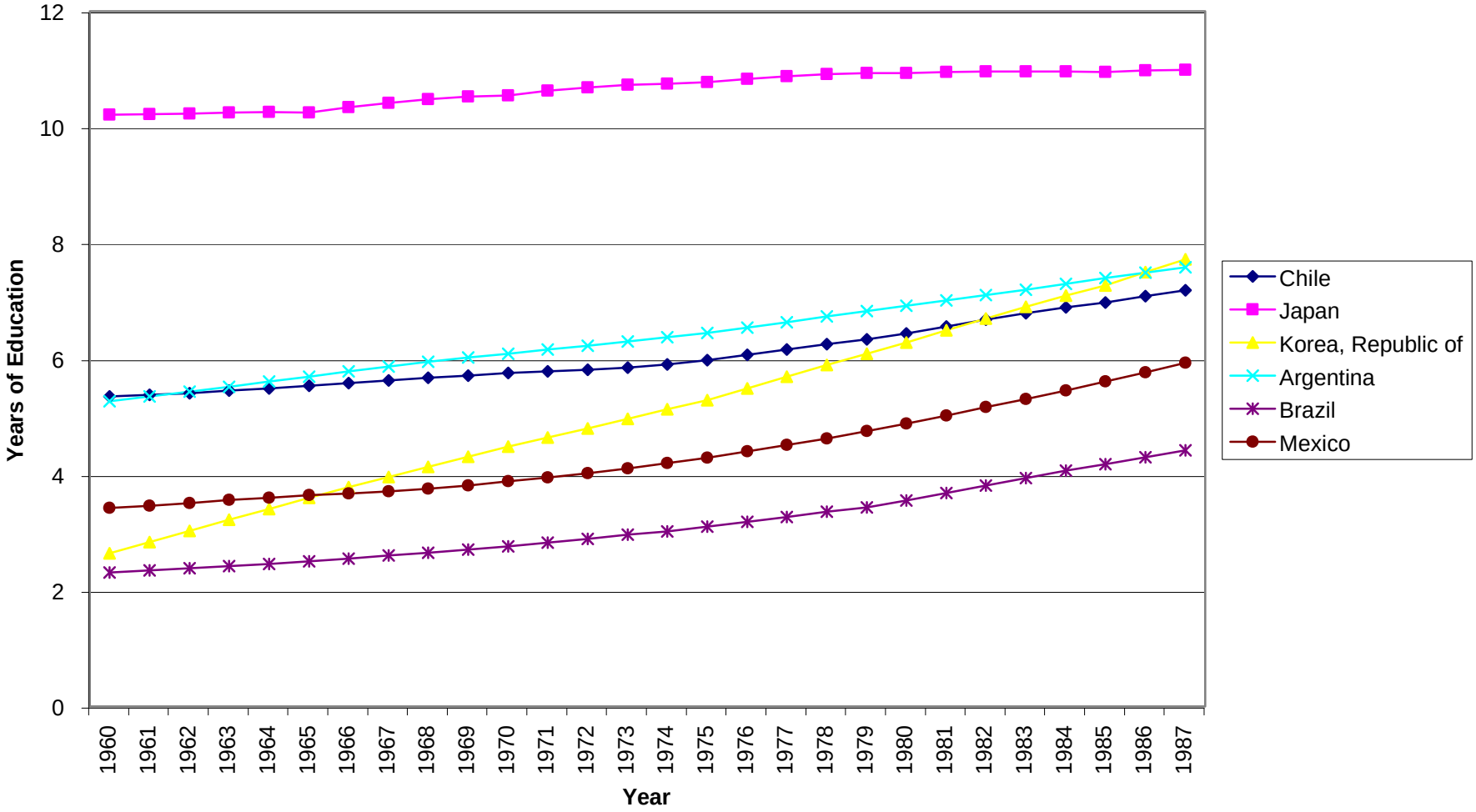

Figure 2
Capital Stock per Capita

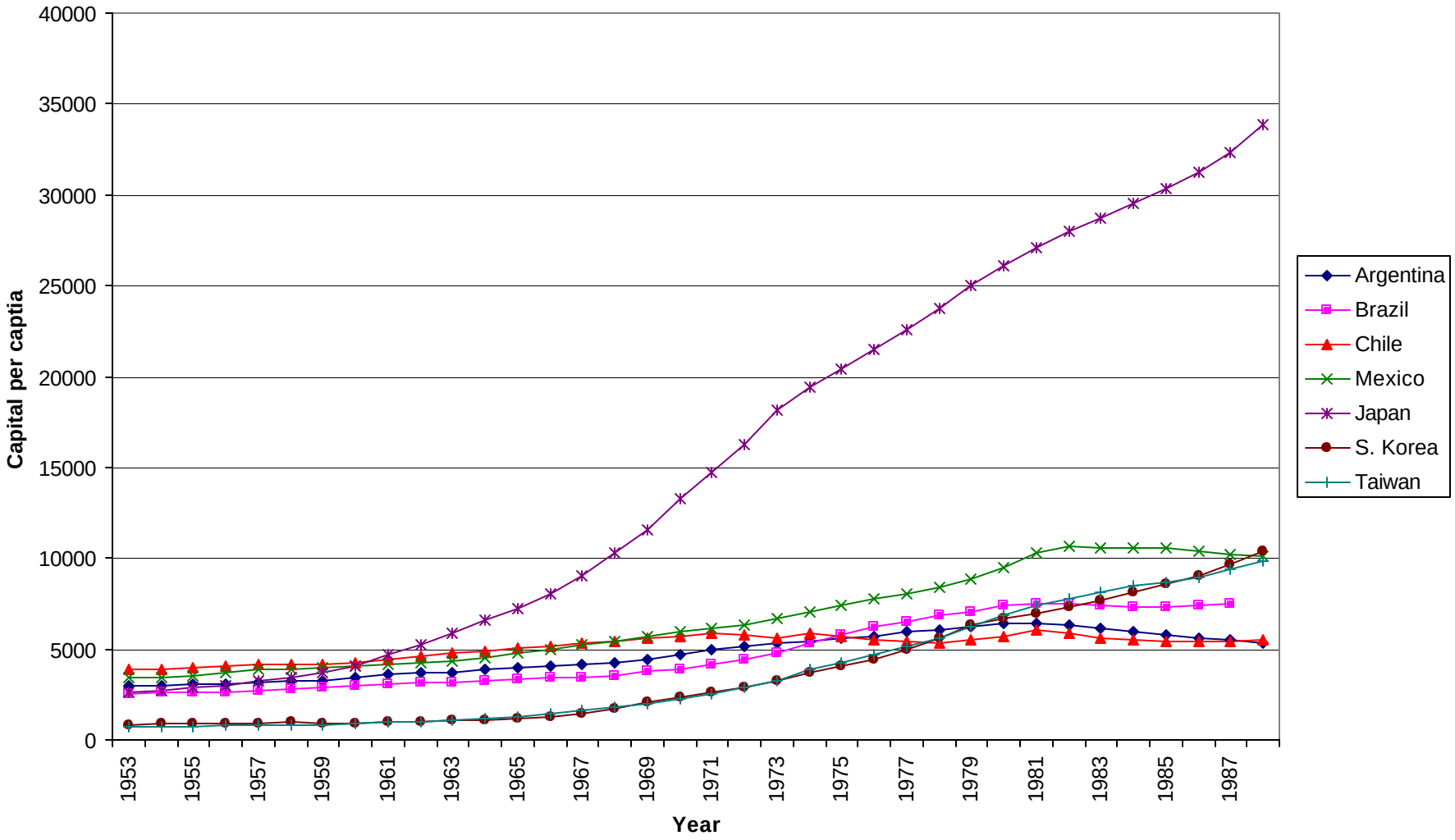

Figure 3
Mean Total Years of Education

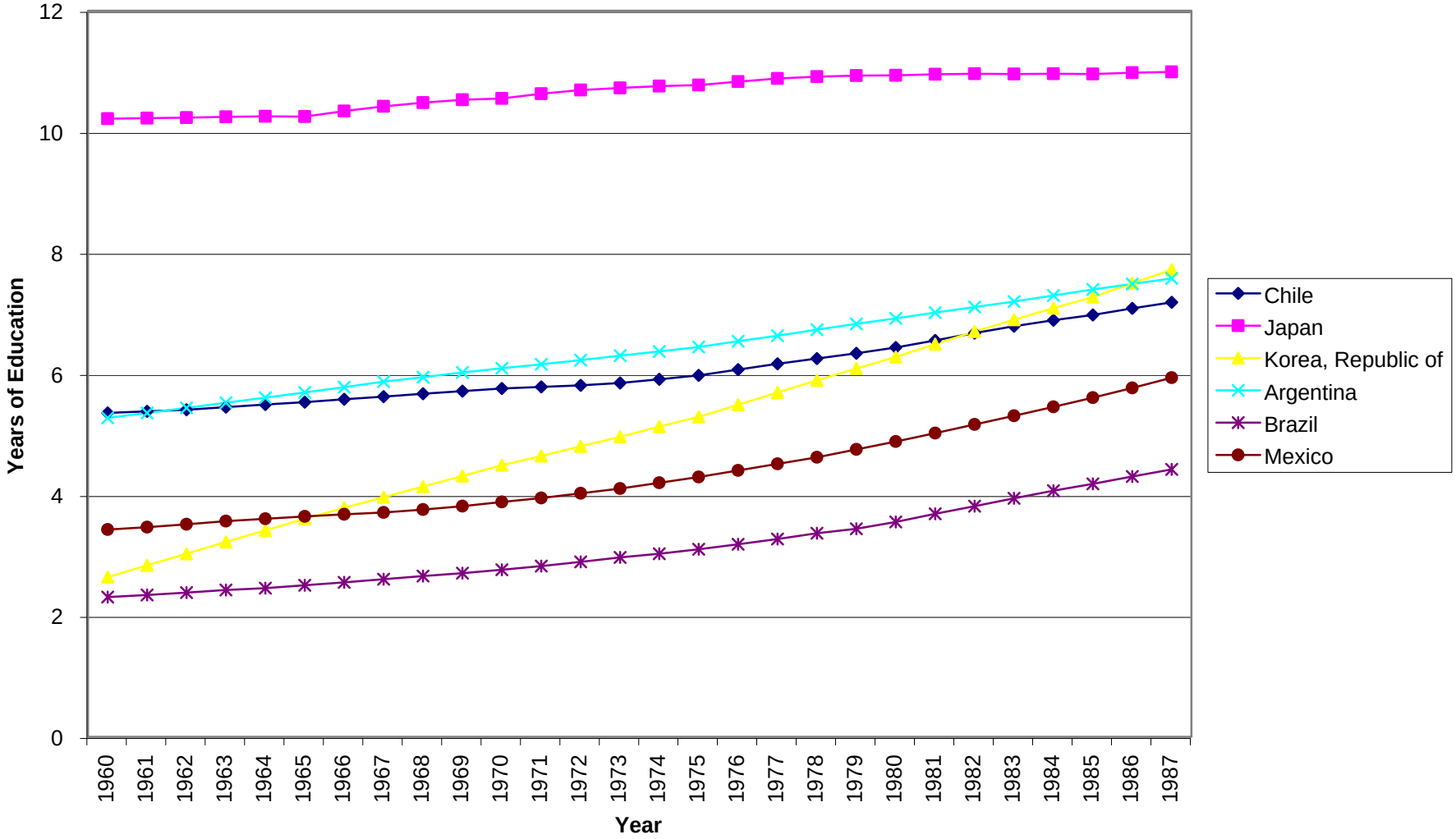

Figure 4A
Endowment Triangle
Labor, Physical Capital, Land ('68 data)

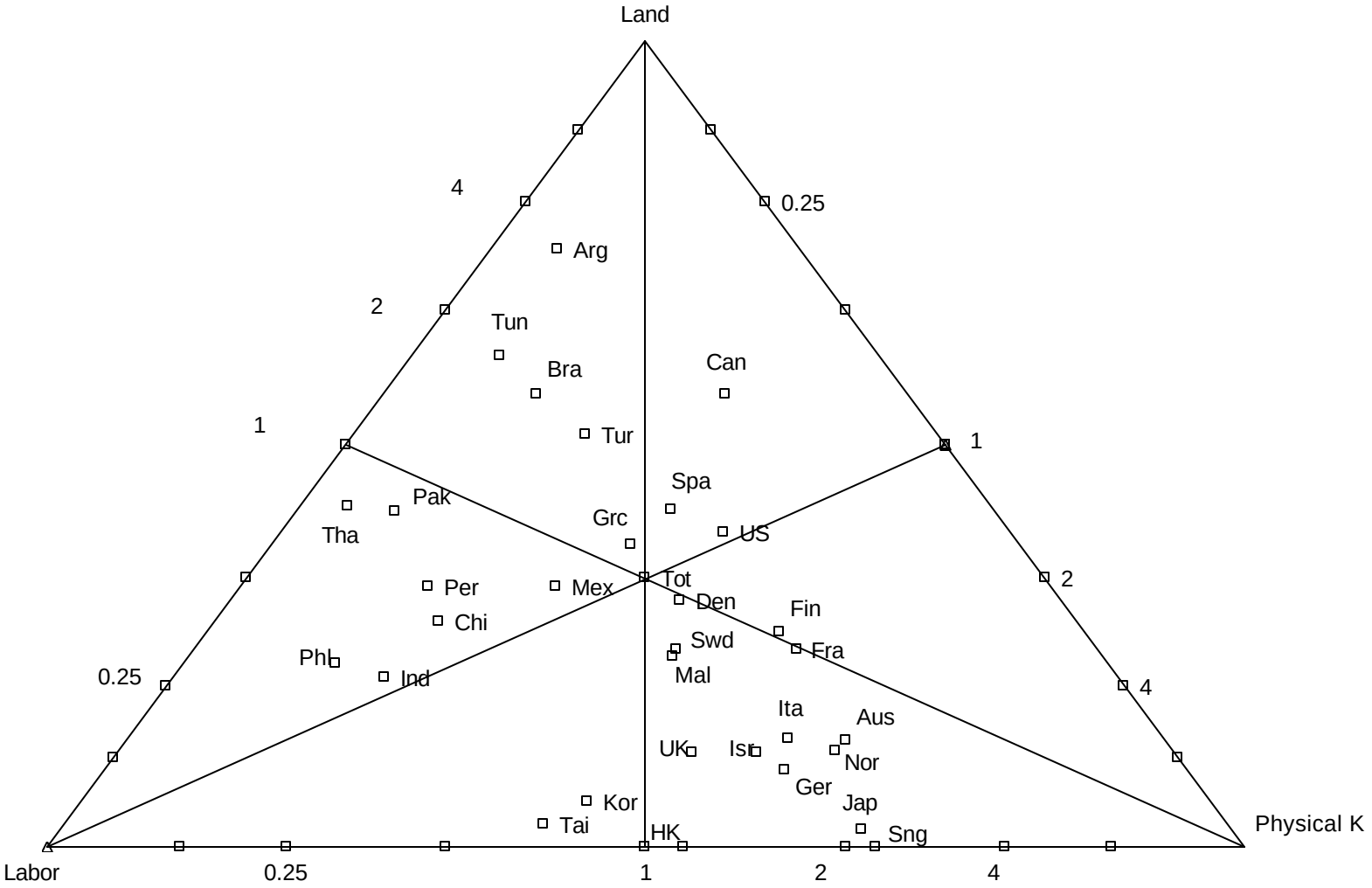

Figure 4B
Endowment Triangle
Labor, Human Capital, Land ('68 data)

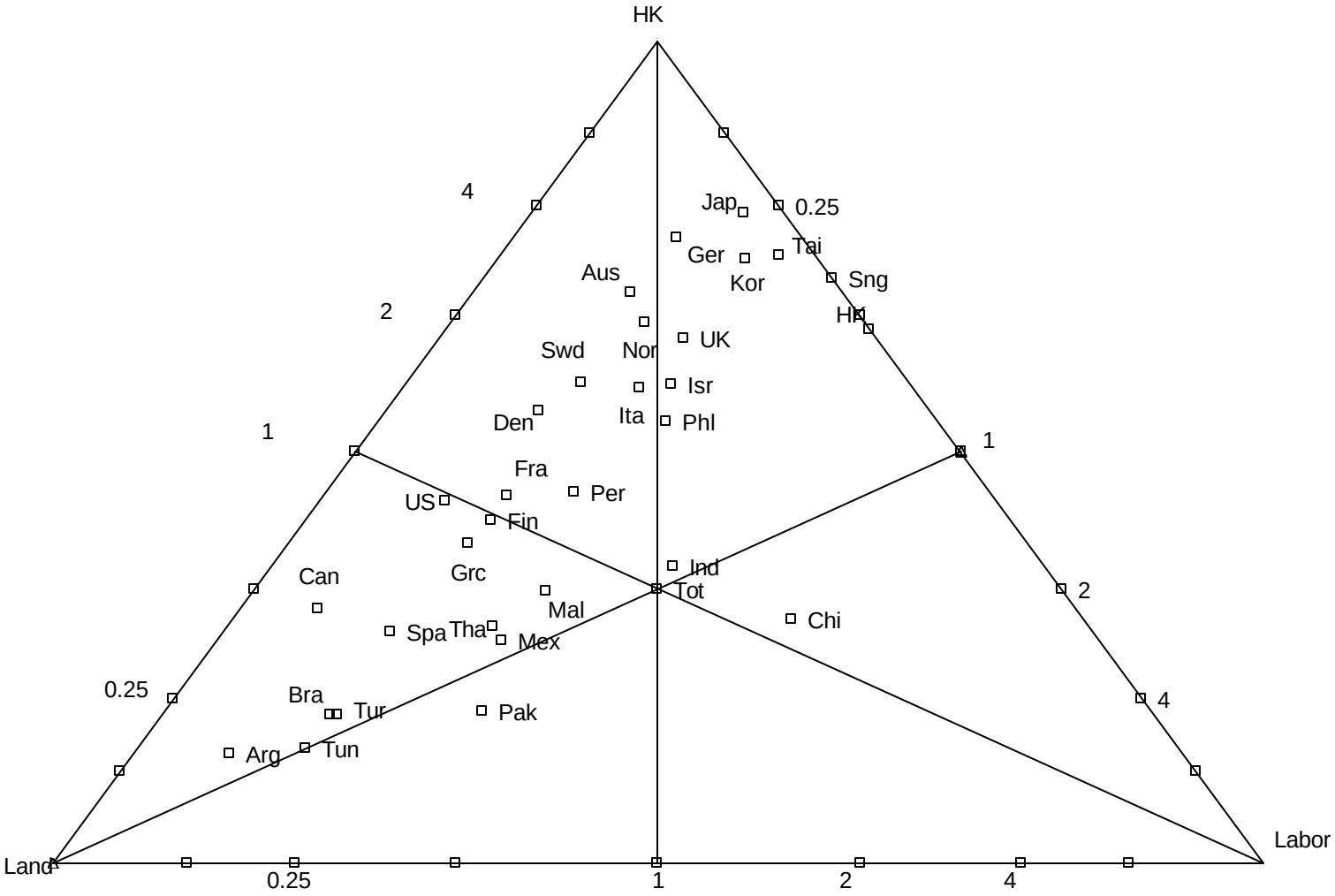

Figure 4C
Endowment Triangle
Land, Physical Capital, Human Capital ('68 data)

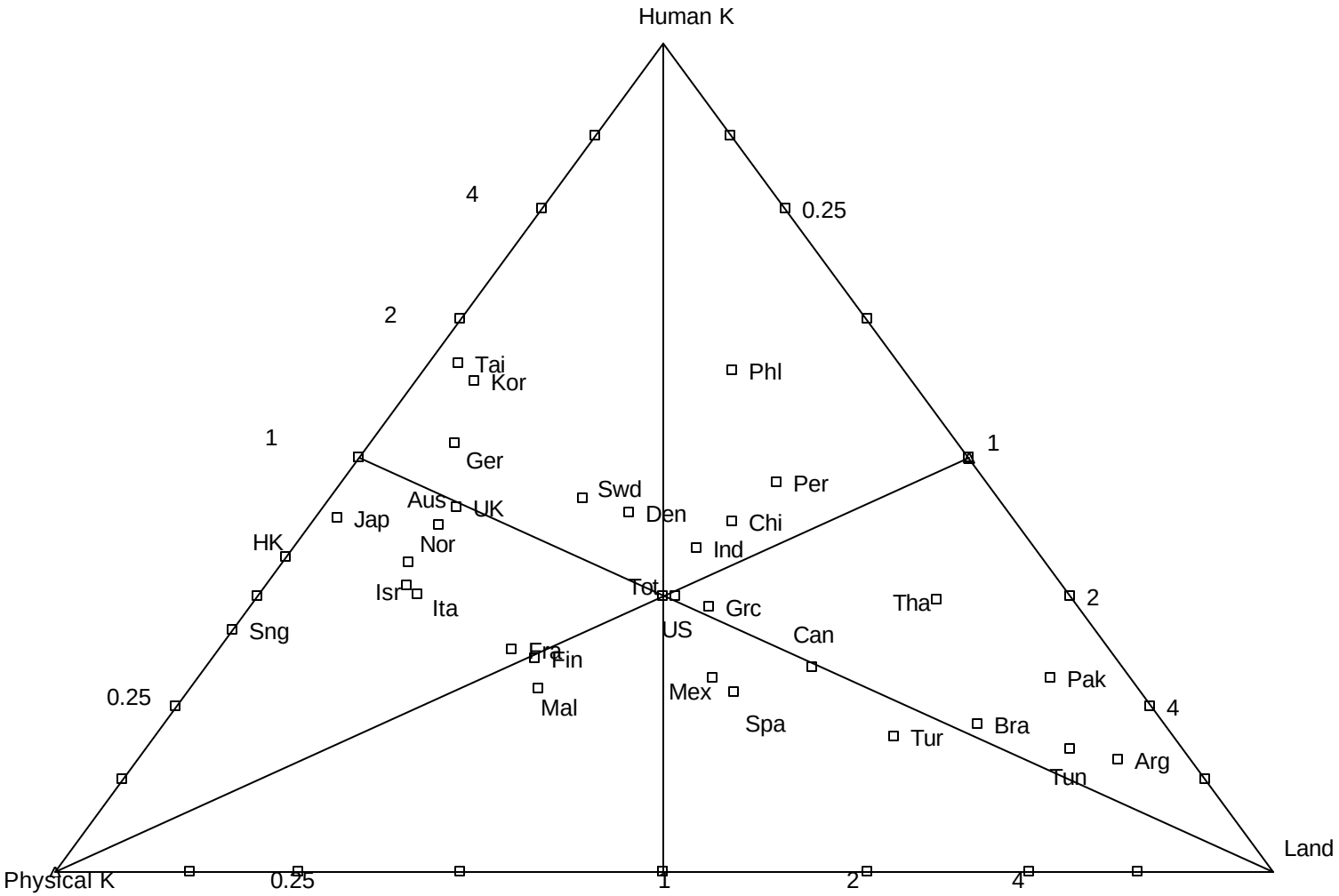

Figure 4D
Endowment Triangle
Labor, Physical Capital, Human Capital ('68 data)