GROWTH, ECONOMIES OF SCALE, AND TARGETING IN JAPAN (1955–1990)

Richard Beason and David E. Weinstein*

Abstract—This paper explores the usage of various industrial policy tools in Japan. Contrary to the conventional wisdom, we find that a disproportionate amount of Japanese targeting occurred in low growth sectors and sectors with decreasing returns to scale. In addition, we find no evidence that productivity was enhanced as a result of industrial policy measures.

I. Introduction

IT is commonly argued that Japanese industrial policy targeted high growth or high productivity growth sectors.[1] In fact, it is the success of Japanese targeting that is often used as the justification for targeting in the United States. The literature on Japanese targeting, however, is largely based on case studies suggesting that government policy in high growth sectors raised the rate of return in those industries and thereby enhanced overall economic growth. The methodology underlying this viewpoint is problematic because it ignores the fact that many of the targeting programs that allegedly caused resources to shift into high growth sectors were actually used far more frequently in low growth sectors. After adjusting for average levels of intervention, we find that to the extent that Japanese policies favoring certain sectors did increase growth and investment rates, it did so in Japan's low growth and declining industries. Furthermore, our empirical analysis suggests that Japanese industrial policy had no significant impact on productivity growth in mining and manufacturing.

One of the most striking features of the political-economy literature dealing with Japan is that the Ministry of International Trade and Industry (MITI), which was the main body regulating Japan's mining and manufacturing sectors, has often been seen as relatively free of special interest influence (see, for example, Johnson (1982); Tyson and Zysman (1990)).[2] Industrial targeting in Japan, it is argued, was carried out by identifying promising industries with high growth potential and assisting in their development. For example, Dosi, Tyson, and Zysman write, "a key feature of Japan's development strategy is the targeting of industries on the basis of their perceived potential for economic growth and technological change." (p. 4) These authors are not alone. Over the last twenty years, a fairly large body of literature has developed that maintains that this dispassionate targeting of industries led to rapid reallocations of resources from declining industries into high growth and high productivity growth sectors.[3]

The major problem with much of the previous work on Japanese targeting is its lack of a systematic framework.[4] In the sordid reality of industrial policy, virtually every sector was given something. It is therefore almost impossible to look up, say, the level of low interest Japan Development Bank (JDB) loans given to automobiles in the 1960s and infer anything about the government's intentions toward that sector. Unless one is willing to argue that higher government taxation in order to provide every sector with more low-interest loans is a good policy, it is clear that what is important in the targeting debate is not absolute sums but relative sums.

Seen in this context, it seems reasonable to define industrial targeting as benefits given to certain sectors that are not given to all sectors. In other words, while an investment tax credit given to a particular industry constitutes targeting, investment tax credits given to all industries do not constitute targeting even though capital intensive sectors are more likely to benefit than other sectors. Although broad industrial or macroeconomic policies can clearly have important implications for the growth of particular sectors, these policies should not be considered targeting per se because in general these policies do not discriminate explicitly across sectors. Hence, with the exception of effective rates of protection, which we examine both in terms of deviations from average rates and overall levels, we consciously ignore how macroeconomic policies—such as the management of the money supply, fiscal policy, exchange rate interventions, secular changes in tax rates, etc.—affected various sectors differently.

Instead, we explore how trade protection (tariffs and quotas), net transfers to sectors (subsidies less indirect taxes), sectoral corporate tax breaks, and government loans have been used as targeting measures in the post-war period. Our choice of policy tools is motivated by a number of factors.

Received for publication November 4, 1993. Revision accepted for publication August 8, 1994.

* University of Alberta and Harvard University, respectively.

We would like to thank Dale Jorgenson and Masahiro Kuroda for graciously providing us with some of the data used in this project. The authors would also like to thank Bennett McCallum, Saadia Mahtia, and seminar participants at the University of Tokyo and Bank of Japan for helpful comments. David Weinstein would like to thank the Abe Fellowship Program for providing financial support for this project. Richard Beason was a Visiting Scholar at the Bank of Japan's Institute for Monetary and Economic Studies, and David Weinstein was a Visiting Scholar at the University of Tokyo when this manuscript was prepared.

[1] See, for example, Borrus, Tyson and Zysman (1986), Carliner (1986), Freeman (1987), Johnson (1982), Dosi, Tyson, and Zysman (1990), and Nester (1990).

[2] Various authors have already documented how the economic policies of other Japanese ministries have been strongly influenced by political concerns. The protection of agriculture in order to ensure rural support for the Liberal Democratic Party is well known. See McMillan (1991) and Woodall (1993) for an excellent treatment of the impact of politics on the policies of the Ministry of Construction.

[3] Ramseyer and Rosenbluth (1993) are a clear exception to this strain of literature. They argue that Japanese politics can best be understood as the product of politicians seeking personal gain.

[4] Notable exceptions are Vestal (1987), Noland (1993), and Lee (1993). Vestal examines the impact of government support on trade in technology and finds that most support went to importers of technology. Noland examines the impact of protection, low interest loans, and R&D subsidies on Japanese net exports and finds that R&D subsidies are associated with higher export levels while the other variables appear to have little impact. Lee attempts to estimate the impact of industrial policy using a CGE model. Although the scale of his study is quite ambitious, his assumption that industrial policy had little impact on the Japanese economy in the early 1960s is problematic. See Noland (1993) for a more detailed critique.

First, nearly all authors writing on Japanese targeting identify some, if not all, of our tools in their analyses of industrial policy.[5] Second, we have a clear understanding of how these tools might be used to produce growth, and it is relatively straightforward to obtain data on these tools that is consistent with growth data. Third, these policies are costly for the government to implement and are more likely to represent a serious intervention than relatively costless measures such as conferences and "administrative guidance."[6] Fourth, to the extent that Japanese industrial policy was coherent, one should expect the same sectors that received conventional targeting to have received much of the unconventional targeting, and hence, our targeting measures should pick up much of the impact of these less conventional policies.

Our motivation for excluding non-traditional interventions from consideration also stems from the fact that we could find no empirical examination of these policies which found them to be effective. Weinstein (1995) could find no evidence that administrative guidance orders to industries changed industry behavior. Saxonhouse (1985) rejected the hypothesis that government sponsored joint research ventures affected the profitability of member-firms. Similarly, Sakakibara (1994) found that participation in R&D consortia was concentrated among firms in low growth sectors and that the sharing of fixed costs was not an important factor in determining participation. Finally, Dick (1992) and Weinstein (1995) rejected the hypothesis that export and domestic cartels significantly changed firm pricing decisions.

Ideally, we should include the impact of government support for private R&D efforts as a potential tool of industrial policy. Unfortunately, detailed sectoral data on public R&D support are difficult to find. However, the available literature suggests that the public role in this area was quite limited. Okimoto and Saxonhouse (1986) present evidence that public sponsorship of R&D in Japan is substantially below that of her trading partners. For example, publicly financed research and development in the United States is approximately 50% of gross expenditure in the United States versus only 20% in Japan. Even more striking, are the numbers on government support of industrial R&D. In 1986, the U.S. government funded 35% of industrial R&D as compared to only 2% in Japan, and for earlier years the difference is even more striking, with only 1% of industrial R&D being supported by the Japanese government in 1970 as opposed to 43% in the United States.[7] While the U.S. numbers are inflated by defense related expenditures, the very low Japanese numbers suggest that it is unlikely that R&D subsidization was crucial for Japanese performance. Furthermore, Griliches and Mairesse (1990) find that the sectoral distribution and intensity of R&D expenditure across sectors and between countries is remarkably similar.[8]

Although it is generally taken for granted that targeting can affect sectoral growth rates, the main question in the debate over the impact of targeting is whether it affected productivity. Productivity is important because of its implications for welfare and competitiveness. The fact that Japan is self-sufficient in rice production is clear evidence that the right combination of protection and subsidies can have important implications for industry growth. However, the fact that Japanese rice sells at several times the world price suggests that these policies have not led to sufficient advances in productivity to make Japanese rice competitive on world markets. Automobiles, on the other hand, were a heavily protected sector in the 1950's and 1960's and grew sufficiently in terms of productivity to become internationally competitive. This raises the question of whether there is a causal link between productivity and targeting or whether cases such as automobiles simply reflect spurious correlations.

There are a variety of theoretical reasons to suspect a connection between targeting and competitiveness. Most of these arguments can be classified into three categories: Schumpeterian (subsidization of technological development), Marshallian (economies of scale/infant industry), and strategic trade arguments (e.g., import protection as export promotion). Authors who emphasize Japanese targeting of high technology generally postulate that a combination of protection, subsidies, tax breaks, and low interest loans gave Japanese industries greater incentives to invest in new technologies and processes. This, in turn, led to rapid growth in productivity and hence welfare and competitiveness. Those who stress the Marshallian arguments or the strategic trade theory approach argue that Japanese targeting of sectors with economies of scale enhanced productivity growth by raising output in those sectors.

It is not surprising that previous authors have focused on these arguments in explaining Japanese targeting. Much of the rationale for industrial policy used by Japanese bureaucrats at the time was remarkably similar to the modern arguments. The problem is that while MITI White Papers often stressed the right industries, the stylized facts which describe how the policies were actually used tell a different story: a story of a government which served the interests of large and politically important, but declining, industries.

II. Stylized Facts

The first issue that we seek to explore is whether Japan's high growth sectors seem to have received disproportionate levels of government intervention. Table 1 presents all thirteen mining and manufacturing sectors listed in order of

[5] See Johnson (1982), Okimoto (1989), Carliner (1986), Yamamura (1986), Borrus, Tyson and Zysman (1986), Okuno-Fujiwara (1991), Saxonhouse (1983), Eads and Yamamura (1986), Ostrom (1984), and Komiya, Okuno, and Suzumura (1988).

[6] Administrative guidance is an informal, legally non-binding means of issuing regulations.

[7] The source for these numbers is National Science Foundation (1989) *International Science and Technology Data Update: 1988* (NSF 89-307) Washington, D.C.

[8] Noland found a positive effect of R&D on net exports, but since he was measuring the impact on net exports (a measure of output), this is very much in line with our growth regressions presented toward the end of the paper.

TABLE 1.—RELATIVE LEVELS OF TARGETING AND GROWTH RATES OF JAPANESE INDUSTRIES

Industry	*Growth*[a]	*JDB*[b]	*Subsidies*[c]	*Tariff*[d]	*Tax*[e]
			1955–1990		
Electrical Mach.	12.17	1.32 (8)	−2.28 (9)	−5.9 (8)	−0.403 (8)
General Mach.	11.39	0.75 (12)	−1.34 (4)	−8.4 (11)	−0.403 (8)
Trans. Equip.	10.76	1.82 (7)	−2.54 (11)	1.4 (4)	−0.403 (8)
Fabricated Metal	10.07	1.02 (10)	−1.51 (6)	−9.3 (12)	−0.069 (7)
Pet & Coal	9.78	13.05 (2)	−15.56 (13)	−4.8 (7)	−0.009 (3)
Precision Inst.	9.33	0.40 (13)	−2.46 (10)	−4.4 (6)	−0.403 (8)
Cer/Stone/Glass	8.66	3.14 (5)	−1.79 (8)	−7.2 (9)	−0.009 (3)
Pulp & Paper	7.66	2.25 (6)	−1.38 (5)	−8.1 (10)	−0.891 (13)
Chemicals	7.64	4.85 (3)	−1.57 (7)	−2.6 (5)	−0.009 (3)
Basic Metals	7.17	3.77 (4)	−0.99 (2)	8.5 (3)	−0.069 (6)
Processed Food	6.29	1.11 (9)	−10.67 (12)	44.7 (1)	−0.736 (12)
Mining	3.83	15.95 (1)	0.25 (1)	−20.9 (13)	6.658 (1)
Textiles	2.73	0.95 (11)	−1.24 (3)	17.0 (2)	0.719 (2)
			1955–1973		
Electrical Mach.	17.94	0.70 (13)	−2.51 (10)	−1.6 (7)	−0.26 (8)
General Mach.	17.35	1.41 (7)	−0.97 (5)	−5.0 (8)	−0.26 (8)
Fabricated Metal	16.93	0.78 (10)	−1.08 (6)	−7.5 (11)	−0.13 (7)
Trans. Equip.	16.75	1.82 (6)	−2.21 (9)	15.9 (2)	−0.26 (8)
Pet & Coal	15.47	4.87 (2)	−22.37 (12)	−6.7 (10)	0.30 (3)
Precision Inst.	14.93	0.78 (11)	−24.91 (13)	−2.5 (5)	−0.26 (8)
Cer/Stone/Glass	14.89	1.98 (4)	−1.24 (8)	−5.1 (9)	0.30 (3)
Basic Metal	13.16	1.98 (5)	−0.59 (2)	4.2 (4)	−0.13 (6)
Pulp & Paper	12.32	1.34 (8)	−0.91 (4)	−9.5 (12)	−1.72 (13)
Chemicals	11.13	4.23 (3)	−0.12 (7)	0.5 (6)	0.30 (3)
Processed Food	8.56	0.75 (12)	−12.13 (11)	19.7 (1)	−1.52 (12)
Textiles	7.48	0.98 (9)	−0.80 (3)	14.2 (3)	0.92 (2)
Mining	7.27	28.10 (1)	0.77 (1)	−21.4 (13)	11.68 (1)
			1974–1990		
Electrical Mach	6.06	1.60 (8)	−2.59 (9)	−10.8 (8)	−0.56 (10)
General Mach.	5.07	0.47 (12)	−1.08 (3)	−12.1 (10)	−0.56 (10)
Trans. Equip	4.42	1.83 (7)	−7.64 (12)	−14.9 (12)	−0.56 (10)
Chemicals	3.94	5.17 (3)	−1.71 (6)	−6.0 (5)	−0.35 (8)
Processed Food	3.88	1.27 (9)	−10.09 (13)	72.7 (1)	0.14 (3)
Pet & Coal	3.77	15.95 (1)	−6.30 (11)	−2.6 (4)	−0.35 (7)
Precision Inst.	3.39	0.29 (13)	−2.45 (8)	−12.1 (11)	−0.56 (10)
Fabricated Metal	2.80	1.10 (10)	−2.10 (7)	−11.2 (9)	0.00 (5)
Pulp & Paper	2.72	2.70 (6)	−1.57 (4)	−6.5 (6)	0.04 (4)
Cer/Stone/Glass	2.05	3.60 (5)	−0.56 (2)	−9.6 (7)	−0.35 (8)
Basic Metal	0.82	4.57 (4)	−3.03 (10)	13.4 (3)	0.00 (5)
Mining	0.19	8.68 (2)	−0.09 (1)	−20.3 (13)	1.04 (1)
Textiles	−0.23	0.93 (11)	−1.62 (5)	20.2 (2)	0.50 (2)

[a] These are average annual rates of growth calculated as the difference of logs of real gross output for each sector.
[b] *JDB* is the sum of real *JDB* loans divided by the sum of total loans to a sector for each period. This can be interpreted as the share of borrowing which was obtained at a subsidized rate.
[c] The measure here is the sum of real net subsidies (subsidies less indirect taxes) divided by real gross output in the sector multiplied by 100. The numbers indicate net transfers to the industry as a percentage of output.
[d] The tariff measure is based Shouda's (1982) estimated effective rates of protection. We modified this by subtracting yearly average rates from the sectoral measure to give an indicator of deviations in protection for the various sectors.
[e] Taxes are calculated as taxes received from a particular sector divided by the taxable component of corporate earnings (profits). As the numerator will be reduced by any special administrative tax relief measures (such as accelerated depreciation, special deductions, etc.), our calculated tax rates should reflect all special sectoral tax treatment. This number is subtracted from the calculated overall effective tax rates to give an indicator of the sector tax relief. Identical tax rates occur where the tax data were defined on broader categories than the ones we used.

industry growth rate. The following columns contain data on how that industry fared in terms of various industrial policy tools. The data are organized globally for the sample period together with two subsamples (before and after the oil shock) in order to capture any possible change in the focus of industrial policy over the period.[9] The first column, containing the amount of real JDB loans as a percentage of total loans for each sector, gives an indication of how much each industry's cost of capital was reduced by low interest loans (ranks are provided in parentheses). The next column presents data on the rate of subsidization or real net subsidies (subsidies less indirect taxes) as a percentage of real output for each sector. Our measure of the application of tariff protection for each sector and our measure of each sector's tax relief are expressed as deviations from the mean so that positive numbers imply higher than average protection or lower than average taxes and negative numbers imply less protection or higher taxes.

Table 1 makes it very clear that some of the poorest performing sectors in terms of growth rates were often among the biggest winners in terms of resource diversion. Indeed, one is immediately struck by the lopsided application of many of the policy tools in favor of two sectors: mining and

[9] The periods before and after the first oil shock are often regarded as different industrial policy regimes (see Okuno-Fujiwara (1991) for a more detailed discussion).

textiles. From the global data, it is clear that mining was the biggest winner in terms of JDB loans, net subsidies, and tax relief. It may at first be surprising that mining did not fare as well in terms of tariff protection. This probably was because resource-poor Japan simply could not afford to protect extraction industries, since large quantities of raw materials had to be imported to satisfy the manufacturing sector.

Similarly, the fastest growing sectors do not appear to be very consistent beneficiaries of the tools of targeting measures. The three fastest growing sectors, electrical machinery, general machinery, and transportation equipment, almost always received lower benefits than the average sector. In fact, despite all that is written about the targeting of Japan's semiconductor industry, electrical machinery overall received so little in benefits that it seems hard to argue that Japanese industrial policy did not raise its cost of capital and drain money out of the sector in the form of higher taxes. Of course, we cannot completely dismiss the possibility that at our level of aggregation, very tightly focused policies for small subsectors are not identifiable. However, since the typical sector in table 1 accounts only for approximately 4% of Japanese output (and the largest sector is under 7%), it seems unlikely that the peculiar performance of subsectors, not captured at our level of aggregation, is likely to be important in understanding Japan's overall growth.

The application of tools across the sectors does not appear to have been very systematic. Some sectors that received very high levels of one targeting measure are well below average on the other measures. In addition to the disparity between protection and subsidies in mining, petroleum and coal were given large amounts of low interest loans but were forced to pay extremely high indirect taxes. Textiles, on the other hand, received substantial protection, subsidies, and tax breaks but had very few low interest loans. As Saxonhouse (1983) has suggested, this lack of coherence in Japanese industrial policy may have resulted in simple transfers of resources across sectors with no clear winners emerging.

As the magnitudes presented in table 1 suggest, the hypothesis that MITI targeted high growth sectors does not seem to fit the data very well. This can be seen even more clearly in table 2, which displays correlation coefficients between the application of the policy tools and sectoral rates of growth.[10] For the entire sample period, as well as both subsamples, the correlation coefficient between sectoral growth rates and each policy tool is negative, suggesting that in actuality the Japanese seemed to have targeted low growth sectors more than high growth sectors. Particularly notable is the relatively large and negative correlation coefficient between the application of tax relief and sectoral rates of economic growth.[11] If Japanese bureaucrats were really trying to target high growth sectors, as suggested by Johnson (1982), these data would imply that they did a rather poor job.

TABLE 2.—CORRELATION COEFFICIENTS: GROWTH AND INDUSTRIAL POLICY

1955–1990	
Growth, JDB loans	−0.31
Growth, subsidies	−0.13
Growth, tariffs	−0.31
Growth, tax relief	−0.55
1955–1973	
Growth, JDB loans	−0.48
Growth, subsidies	−0.05
Growth, tariffs	−0.11
Growth, tax relief	−0.47
1974–1990	
Growth, JDB loans	−0.07
Growth, subsidies	−0.34
Growth, tariffs	−0.14
Growth, tax relief	−0.77

These data do not, however, negate the existence of special measures in high growth sectors. Rather, the data suggest that high growth sectors simply did not get as much favorable treatment as low growth sectors. Aside from pork-barrel politics, there are two reasons that are usually given for the high levels of transfers to declining sectors. The first is that the government sought to offset economic dislocation that might arise due to the collapse of industries. The second is that the government sought to raise productivity in these sectors in order to maintain their competitiveness. The first hypothesis is somewhat suspect given the inordinately long time that certain sectors have been the recipients of government intervention. Furthermore, as we will see in the next sections, it seems unlikely that these policies had much impact on productivity either.

III. Modeling Productivity Growth

Most of the literature on industrial policy implicitly or explicitly postulates the existence of a targeting relationship between various policy variables and growth. We therefore begin by assuming the existence of a targeting function $\psi(\mathbf{p})$ which maps a vector of lagged policy variables, $\mathbf{p}$, into some industry performance variable. Our targeting function can be thought of as the reduced form of an industrial policy game. Specifically, in this paper we will consider cases in which lagged policy variables can explain growth rates of total factor productivity, net capital accumulation, or overall sector growth. In addition, much of the strategic trade literature has been concerned with the advantages of protection and promotion of sectors with increasing returns to scale (Krugman (1984)). Hence, a second objective of this analysis

[10] The tables do not present data on quota measures because we were not able to find time series quota data for the entire period. However, it is unlikely that data on NTBs would have differed greatly from the data on ERPs. For example, the correlation between quota coverage ratios and growth was −0.3.

[11] At first glance, there appears to be a shift in the usage of JDB loans and tax relief over the two subsamples with JDB loans being more negatively correlated with growth in the early period and tax relief being more negatively correlated with growth in the later period. One possible interpretation of this is that this reflects an overall shift in Japanese industrial policy over the two periods. Table 1 reveals that much of the difference in the behavior of JDB loans in the two periods is due to changes in the treatment of mining. If mining is dropped from the sample, loans are uncorrelated with growth in both periods ($|\rho| < 0.1$). However, the negative correlation between growth and other targeting measures remains robust even to the exclusion of mining, possibly indicating an increased tendency to help declining sectors in the later period.

is to examine whether the Japanese government actually tried to promote those sectors with scale economies more than sectors with decreasing returns.

Clearly, the accurate measurement of productivity growth and economies of scale is one of the necessary preliminary steps in the analysis. We begin by postulating that output in sector k can be represented by the familiar translog production function:

$$\begin{aligned}\ln Q^k_T &= F^k\,(X^k_{1T}, X^k_{2T}, X^k_{3T}, T)\\ &= \alpha^k_0 + \beta^k_T T + \sum_{i=1}^{3} \alpha^k_i \ln X^k_{iT}\\ &\quad + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3} \gamma^k_{ij} \ln X^k_{iT} \ln X^k_{jT}\\ &\quad + \sum_{i=1}^{3} \tau^k_i \ln X^k_{iT} T + \frac{1}{2}\tau^k_{TT} T^2 \qquad (1)\end{aligned}$$

where Q^k is total output, T is a trend that represents technological change, and X^k_{1T}, X^k_{2T}, and X^k_{3T} represent total consumption of labor, materials, and capital. The choice of the translog structure is motivated because it can be thought of as a second order approximation of an arbitrary production function.

We now impose a bit more structure on the production process by making a few more assumptions. By Young's theorem, we know that $\gamma^k_{ij} = \gamma^k_{ji}$. Following Chan and Mountain (1983), we assume that production is homogeneous of degree θ^k in the inputs, and hence the following conditions will hold:

$$\sum_{i=1}^{3} \alpha^k_i = \theta^k,$$

and

$$\sum_{i=1}^{3} \gamma^k_{ij} = \sum_{i=1}^{3} \tau^k_i = 0, \text{ for all } j. \qquad (2)$$

If θ^k is equal to one then production displays constant returns to scale, if θ^k is less than one then production displays decreasing returns, and if θ^k is greater than one then production displays increasing returns.

Assuming that industries minimize costs and that factor markets are perfectly competitive, we can write each factor share, S_i, as

$$\begin{aligned}S_{iT} &\equiv \frac{p_{iT}X^k_{iT}}{\sum_{i=1}^{3} p_{iT}X^k_{iT}} = \frac{F^k_{iT}X^k_{iT}}{\sum_{i=1}^{3} F^k_{iT}X^k_{iT}} = \frac{F^k_{iT}X^k_{iT}}{\theta^k F^k_T}\\ &= \frac{1}{\theta^k}\frac{\partial \ln Q^k_T}{\partial \ln X^k_{iT}} = \frac{1}{\theta^k}\left(\alpha^k_i + \sum_{j=1}^{3} \gamma^k_{ij} \ln X^k_{jT} + \tau^k_i T\right) \qquad (3)\end{aligned}$$

where subscripts on the F^k_i's indicate partial derivatives with respect to input i and p_i is the cost of factor i. Substituting this into the total derivative of 1 produces,

$$d \ln Q^k = \theta^k \sum_{i=1}^{3} S^k_i d \ln X^k_i + \frac{\partial \ln Q^k}{\partial T} dT.$$

The rate of change of total factor productivity in this model can be defined as,

$$\frac{\partial \ln Q^k}{\partial \ln T} = \beta^k_T + \tau^k_{TT} T + \sum_{i=1}^{3} \tau_{iT} \ln X_i.$$

This can now be approximated in discrete time by

$$\begin{aligned}\psi &\equiv (\ln Q^k_t - \ln Q^k_{t-1})\\ &\quad - \theta^k \sum_{i=1}^{3} \frac{1}{2}(S^k_{it} + S^k_{it-1})(\ln X^k_{it} - \ln X^k_{it-1}). \qquad (4)\end{aligned}$$

In the case where the production function is homogeneous of degree one, $\theta^k = 1$, and this measure of productivity growth is identical with the conventional Tornqvist measure of growth.[12]

IV. Estimation and Results

In order to identify whether the Japanese government targeted increasing returns sectors, we must obtain estimates of θ^k. Equation (1) and equation (3) provide a list of four nonlinear equations for each industry that relate output and input shares to the various inputs. Cross-equation restrictions enable us to eliminate one of the share equations. This leaves us with three equations in each sector.

Since there is reason to believe that the error terms across equations are correlated both within sectors and across sectors, we stacked all the industry equations as a nonlinear system of seemingly unrelated regressions. We then obtained initial estimates of the parameters from least-squares estimates of the unrestricted production functions, and then used these initial "guesses" for nonlinear least-squares estimation of each set of three industry equations. These new parameter estimates then served as the starting values for the full system maximum likelihood estimation.[13]

Overall, this technique fit the output data extremely well. In every sector except mining, the production equation R^2 was greater than 0.99.[14] The share equations typically had

[12] We also used a translog index of growth based on the TFP residuals, but this did not change the results.

[13] Because convergence is extremely slow for large systems, we broke the system up into two systems of 15 equations. The first consisted of mining, food, textiles, paper/pulp, and chemicals, and the second consisted of basic metals, fabricated metals, general machinery, transportation equipment, and electrical machinery. While theoretically this creates an efficiency loss, in practice since there were no cross-industry constraints, coefficients were largely unchanged regardless of how we broke up the sample.

[14] In mining the R^2 was 0.86.

TABLE 3.—ESTIMATED SCALE PARAMETERS
1955–1990

Sector	θ^k
Mining	0.671
Processed Food	0.730
Textiles	0.556
Pulp & Paper	0.604
Chemicals	0.960
Basic Metals	0.893
Fabricated Metal	1.07
General Machinery	1.04
Transportation Equipment	1.08
Electrical Machinery	1.01

R^2s of around 0.5, and twenty-two of the thirty estimates of the α's were significant at the 5% level. Table 3 displays our estimates of the returns to scale parameter. For the four industries with estimated scale parameter greater than one, we cannot reject constant returns to scale.[15] For the six industries exhibiting decreasing returns, the parameters appear to be quite reasonable. We therefore find little support for the contention that economies of scale are critical to understanding the performance of Japanese industries. On the contrary, it seems that constant returns to scale or even decreasing returns to scale seem to be better descriptions of the technology present in Japanese industries.

We present the correlation coefficients between the estimated scale parameters and our measures of the industrial policy tools in table 4. While the results are not perhaps so striking as those for the growth rates, they certainly do tell a similar story. It seems clear that the authorities did not systematically apply tools to industries with greater returns to scale, except perhaps to tax sectors with increasing returns more heavily.

The next issue that we sought to explore was whether industrial policy seemed to have had an impact on total factor productivity growth in the targeted sector. Using 4 we formed a panel data set containing our estimates of total factor productivity for each sector as well as a series of industrial policy measures. Since the exact way in which industrial policy is likely to affect productivity growth generally depends on the exact framework used, we decided to postulate an industrial policy "impact function" of the form:

$$\psi_t = f(L(DTAX)L(DJDB), L(DSUB), L(DTAR), L(TAR), L(NTB)), \tag{5}$$

where $L(\cdot)$ is a lag field of policy variables. For the sake of convenience, we estimated a first order approximation of 5 using one and five year lags of each of the variables. Our measure of tax relief (*DTAX*) equals the mean ratio of tax revenue to earnings less each sector's ratio.[16] For our measure of JDB loans (*DJDB*) and our measure of subsidies (*DSUB*), we used the variables described in table 1 but subtracted off the yearly average JDB loan rate or subsidy rate in order to focus on relative movements of these variables rather than overall trends in subsidization or low interest loans. We used three different variables to examine import protection. *DTAR* equals the difference between the sectoral tariff rate and the average tariff rate for that year. In addition, in order to capture the potential impact of overall tariff protection, we also used *TAR*, the effective rate of protection in the sector. Finally, our *NTB* measure was the percentage of subsectors within a given sector covered by quotas. For all of our variables, positive values represent promotional intervention, and negative values represent discriminatory intervention.

Column 1 of table 5 displays the results of estimating equation (5) over the full sample using fixed effects estimation (i.e., assuming that each sector has a different underlying rate of technological progress). Overall, these policies do not seem to explain productivity growth very well. Our equation explained only 7% of productivity growth and hence considerably less of total growth. The only variable that seems to have a significant impact is JDB loans. Interestingly, virtually all of the deviation in JDB loans appears to have occurred in mining where JDB loans constituted 16% of all loans. Sectors such as general machinery, transportation equipment, and electrical machinery received less loans than the average sector (as a share of output) and hence the Japanese government's loan policy seems to have correlated negatively with their productivity growth.

One possible explanation for our results might be that the impact of industrial policy differed across sectors or across time. We decided to test this hypothesis in four ways. First, we estimated equation (5) separately for each sector and conducted an F test of whether all coefficients were zero. In every sector we could not reject the null-hypothesis that all industrial policy variables had no impact on productivity

[15] In fact, in general, we could not reject constant returns to scale even in the sectors which seem to have decreasing returns. Overall, our estimated parameters were extremely close to estimates in other papers. Nakamura (1993) estimated Japanese scale parameters using a cost function approach for chemicals, general machinery, electrical machinery, and transportation equipment. His estimates were (1.232, 1.007, 1.103, and 0.9664, respectively).

TABLE 4.—CORRELATION COEFFICIENTS: SCALE PARAMETERS AND POLICY TOOLS

1955–1990	
Scale, JDB	−0.29
Scale, subsidies	0.14
Scale, tariffs	−0.27
Scale, tax relief	−0.34
1955–1973	
Scale, JDB	−0.31
Scale, subsidies	0.08
Scale, tariffs	0.02
Scale, tax relief	−0.28
1974–1990	
Scale, JDB	−0.26
Scale, subsidies	0.10
Scale, tariffs	−0.39
Scale, tax relief	−0.76

[16] All ratios were expressed in percentage terms.

TABLE 5.—IMPACT OF TARGETING ON PRODUCTIVITY GROWTH
DEPENDENT VARIABLE IS TORNQVIST MEASURE OF TFP GROWTH

Period	1960–1990	1960–1990 Slow Growers	1960–1990 Fast Growers	1960–1990	1960–1973	1974–1990
DTAX (−1)	−0.00409	−0.00523	0.00435	−0.00395	−0.00005	−0.00401
	−2.880	−3.051	1.097	−2.800	−0.022	−1.715
DTAX (−5)	0.00003	0.00060	−0.00776	0.00017	0.00459	−0.00016
	0.023	0.421	−2.224	0.143	2.110	−0.094
DJDB (−1)	0.00396	0.00469	−0.00616	0.00403	−0.00163	−0.00296
	3.670	3.900	−0.973	3.740	−0.734	−0.479
DJDB (−5)	0.00032	0.00032	−0.00223	0.00003	−0.00246	0.00168
	0.250	0.224	−0.405	0.025	−1.127	0.577
DTAR (−1)	−0.00088	−0.00033	−0.00003	−0.00016	0.00088	−0.00438
	−1.120	−0.707	−0.033	−0.355	0.855	−2.719
DTAR (−5)	−0.00004	0.00014	0.00030	−0.00004	0.00031	−0.00019
	−0.081	0.324	0.446	−0.083	0.327	−0.226
DSUB (−1)	0.00295	0.00256	0.00498	0.00272	0.00208	0.00193
	0.882	0.790	0.534	0.813	0.338	0.329
DSUB (−5)	0.00104	0.00092	−0.00028	0.00152	0.00129	−0.00131
	0.394	0.676	−0.040	0.581	0.268	−0.259
TAR (−1)	0.00075	0.00064	−0.00075	—	−0.00156	0.00441
	1.123	1.468	−0.982	—	−1.996	3.058
TAR (−5)	0.00000	−0.00073	0.00053	—	0.00000	−0.00001
	−0.050	−1.38	0.904	—	−0.029	−0.114
NTB (−1)	—	—	—	—	—	—
	—	—	—	—	—	—
NTB (−5)	—	—	—	—	—	—
	—	—	—	—	—	—
N	310	155	155	310	140	170
R^2	0.06788	0.13574	0.06636	0.06381	0.07072	0.10082
Adjusted R^2	0.00681	0.04931	−0.02700	0.00931	−0.07641	−0.01308

Note: *t*-statistics are below coefficient estimates.

growth. Second, in order to ensure that no particular sector was driving the results, we re-estimated the system of equations ten times dropping one sector each time. The results of these regressions were qualitatively the same as those in table 5.[17] Third, in order to verify that industrial policy had an equally small impact on productivity growth in both low and high growth sectors, we re-estimated equation (5) using two subsamples of industries with growth rates either above or below the median. As one can see from table 5, there appears to be no systematic difference between the impact of targeting on productivity growth in low growth versus high growth sectors. Fourth, to test whether there was some type of regime change, we estimated (5) using data from 1960 to 1973 and from 1974 to 1990. This structural break corresponds to the first oil shock, which is often seen as a watershed in Japanese development. Each subsample produced results similar to the full sample. In the earlier period there appears to be even less of a relationship between productivity growth and targeting. In the later sample, tariffs seem to be more closely related to productivity growth, but virtually all of the variation in tariff rates arises from extremely low tariffs in mining and extremely high rates of effective protection in processed foods.

We were also concerned that potentially our relaxation of the assumption of constant returns to scale had reduced the efficiency of our measurement of total factor productivity. We therefore decided to also re-estimate equation (5) using Jorgenson and Kuroda's (1990) estimates of total factor productivity growth. The Jorgenson and Kuroda methodology differs from ours in a number of respects. In addition to imposing the assumption of constant returns to scale, Jorgenson and Kuroda measure productivity growth using a capital stock measure that is based on National Wealth Survey benchmarks and investment series rather than relying on the Economic Planning Agency statistics. The Jorgenson and Kuroda estimates of TFP cover a shorter time period but allowed us to estimate the model over all 13 sectors. As the first column of table 6 shows, even using the Jorgenson and Kuroda data, there does not seem to be a relationship between productivity growth and targeting.

A third potential problem with our results is that by focusing on tariff protection, we ignore quota protection. Since 1965 is the earliest year that coherent quota data exist we tested whether productivity growth after 1970 could be explained if we added quota coverage ratios as an explanatory variable (table 6).[18] Neither of the lagged quota variables came up significant in the regression and their inclusion left

[17] The results from these estimations are not reported, but are available from the authors.

[18] Ideally, we would have used a quota index that was weighted by imports. Unfortunately this was not possible because the categories used for determining quotas by the Ministry of Finance did not correspond exactly to the import categories. Even so, this measure did identify food, transportation equipment, and petroleum and coal as the sectors with the three highest coverage ratios in 1965. Since all of these sectors are known to have had significant NTBs in them, it's likely that the rank order of our measure does not deviate too much from the actual rank order of NTBs.

TABLE 6.—ALTERNATIVE ESTIMATES OF IMPACT OF TARGETING ON PRODUCTIVITY

Period	Jorgenson-Kuroda Measure of TFP Growth 1961–1985	Tornqvist Measure of TFP Growth 1970–1990	Simultaneous Estimates 1960–1990	Unconstrained Estimation 1960–1990
DTAX (−1)	−0.00108	−0.00382	−0.00009	0.00199
	−0.795	−1.599	−0.277	0.313
DTAX (−5)	0.00148	−0.00086	0.00003	−0.01203
	1.120	−0.490	0.124	−2.189
DJDB (−1)	0.00049	0.00230	0.00022	−0.00185
	0.460	1.314	0.490	−0.382
DJDB (−5)	−0.00109	0.00133	−0.00063	0.00086
	−0.834	0.594	−1.703	0.152
DTAR (−1)	−0.00119	−0.00023	−0.00032	0.01182
	−1.511	−0.173	−1.716	3.364
DTAR (−5)	0.00038	−0.00035	−0.00008	−0.00315
	0.685	−0.473	−0.321	−1.383
DSUB (−1)	0.00164	0.00589	−0.00016	−0.02471
	0.800	1.150	−0.455	−1.650
DSUB (−5)	0.00042	0.00048	0.00083	−0.00339
	0.222	0.100	1.486	−0.287
TAR (−1)	0.00085	0.00092	0.00014	−0.01019
	1.378	0.760	1.036	−3.418
TAR (−5)	0.00003	−0.00002	0.00025	0.00020
	0.300	−0.136	1.243	0.467
NTB (−1)	—	0.08802	—	—
	—	0.939	—	—
NTB (−5)	—	0.00653	—	—
	—	0.175	—	—
N	325	210	310	310
R^2	0.02375	0.04670	—	0.1036
Adjusted R^2	−0.04737	−0.05979	—	0.0449

Note: *t*-statistics are below coefficient estimates.

the regression fits virtually unchanged. While it is possible that quantitative restrictions might have had a more important relationship with productivity prior to 1970, we think that it is highly unlikely. First, to the extent that Japanese protection was coherent, i.e., sectors with high rates of tariff protection also were protected with NTBs, much of the impact of this protection should already be captured in the tariff variables. Second, during much of the 1960s, Japanese effective rates of protection were very high by today's standards. Thus, it is hard to believe that additional quota restraints applied on top of effective tariff rates amounting to 40% in the case of transportation equipment were likely to have greatly altered Japanese industrial structure.

Implicitly we assume that our measures of industrial policy are not directly part of the production process. This potentially could bias our estimates of the impact of industrial policy downward if industrial policy was highly correlated with factor inputs. Noland (1992) argues that Japanese protection of specific factors as opposed to final goods may be an important reason why some studies of Japanese trade patterns have failed to find evidence of a distinctive pattern. Looking at correlations between factor usage and intervention, we find mixed evidence for the hypothesis that certain factors were targeted. Protection is completely uncorrelated ($\rho = 0.03$) with capital intensity and negatively correlated with labor shares ($\rho = -0.64$). Net subsidies were positively correlated with labor shares ($\rho = 0.40$) but negatively correlated with capital shares ($\rho = -0.40$). Taxes and loans, however, appear to be positively related to labor and capital shares with correlations around 0.5. These correlations seem to be most important in the earlier part of our sample. After 1973, the correlations between industrial policy and factor shares seem to all but disappear. Even so, the data seem to suggest that with the notable exception of protection, there appears to be some positive relationship between sectors with high labor shares and levels of assistance between 1955 and 1973.

We decided to correct for these potential biases in two ways. First, we first-differenced equations (1) and (3) and then added the terms on the right hand side of equation (4) to the production function equation and re-estimated the system. The results of this procedure are reported in table 6 for the period 1960–1990.[19] Once again, we found that targeting does not appear to have affected total factor productivity growth even after controlling for the targeting of specific factors. Second, since it is also possible that the targeting of certain inputs may have altered their effective factor prices, our measures of TFP might be biased because marginal products may not have equaled wages. In order to correct for this possibility, we dropped the share equations from our system of equations and re-estimated TFP using the residuals from the production function and the time trend terms. The results from our estimates of the impact of industrial policy on these revised TFP measures are in the last column of table 6. These results are consistent with our results for the case in which the share equations are imposed.[20]

[19] In order to facilitate convergence, we limited iterations on the residuals matrix. This renders our estimates consistent but not efficient.

[20] Note that the positive impact of *DTAR* (−1) is completely offset by the negative impact of *TAR* (−1).

TABLE 7.—IMPACT OF TARGETING ON GROWTH AND CAPITAL ACCUMULATION

Period	Growth Rate 1960–1990	Capital Accumulation 1960–1990
DTAX (−1)	−0.00428	−0.00321
	−1.66083	−2.01585
DTAX (−5)	0.00064	−0.00194
	0.28606	−1.40366
DJDB (−1)	0.00400	0.00336
	2.03922	2.77253
DJDB (−5)	−0.00129	−0.00050
	−0.55980	−0.35052
DTAR (−1)	−0.00485	−0.00294
	−3.39704	−3.33518
DTAR (−5)	−0.00063	−0.00042
	−0.68598	−0.73845
DSUB (−1)	0.01210	−0.00066
	1.99041	−0.17652
DSUB (−5)	0.00723	0.01300
	1.50299	4.37317
TAR (−1)	0.00511	0.00310
	4.21619	4.14249
TAR (−5)	0.00003	0.00002
	0.14961	0.19525
N	310	310
R^2	0.13718	0.18250
Adjusted R^2	0.08065	0.12894

Note: *t*-statistics are below coefficient estimates.

One final concern about the lack of a relationship between industrial policy and productivity growth is whether our measures of industrial policy are too crude to produce effects. In a growing economy, there seems to be reason to suspect that the provision of low interest loans, subsidies, and tariff protection should produce expansions in output in those sectors that benefited from government intervention. In order to see if this relationship held, we regressed changes in output and net capital formation on the same industrial policy measures (see table 7). While we do not have much confidence in the magnitudes of the coefficients, the results of these regressions are suggestive of the fact that there were strong positive relationships between growth, capital formation, and industrial policy. Although the tariff differential coefficient had the wrong sign, the much larger positive impact of effective protection implies that overall protection correlates with expansions in output. Similarly, low interest loans and tariff protection seem also to be strongly positively correlated with capital formation. The lack of a significant positive impact of corporate tax rates may arise from the fact that with the exception of mining, which was targeted in a host of other ways, corporate taxes hardly varied across sectors (see Saxonhouse (1983)).

These results seem to suggest that while the Japanese government may have been able to influence investment and growth, there seems to be little evidence that they were able to affect productivity and hence competitiveness. Growth through industrial policy seems to have been achieved simply by using more raw materials but not by improving on their usage. Furthermore, it is important to emphasize that the vast majority of non-agricultural targeting seems to have occurred in Japan's low growth sectors. In non-agricultural sectors, most of Japan's JDB loans, tax relief, and subsidies went into mining, and most tariff protection was heavily concentrated in processed food and textiles. To the extent that our coefficients measure causality rather than merely correlation, Japanese industrial policy seems to have transferred resources out of high growth sectors and into low growth sectors. This seems to have enhanced the rate of capital formation and growth in mining and textiles with small or mildly negative effects in most other sectors.

V. Conclusions

We draw a number of conclusions from this analysis. First, policies that divert resources to a sector may affect growth rates, presumably by increasing utilization of productive factors or by protecting market share. However, it appears that in the Japanese case, resources were not diverted to the high growth industries. One interpretation of this result is a failure on the part of the authorities to target properly. Another interpretation is that industrial policy considerations were dominated by the desire to aid declining sectors or protect the interests of large unproductive industries. The final, and in our view, most important, conclusion is that targeting did not positively affect the factor productivities of the industries considered in this study.

DATA APPENDIX

GROSS OUTPUT BY SECTOR: From *Annual Report on the National Accounts*, Economic Planning Agency. Data are deflated by the appropriate sector specific domestic wholesale price index available in the *Price Indexes Monthly* of the Bank of Japan.

CAPITAL STOCK BY SECTOR: From *Capital Stock of Private Enterprises*, Economic Planning Agency. Data are in real terms, and progress base is used.

CONSUMPTION OF RAW MATERIALS BY SECTOR: From *Annual Report on the National Accounts*, Economic Planning Agency. Data are deflated by the intermediate materials price index.

LABOR INPUT is the product of the sector-specific employment index and the sector-specific average hours worked per month. The sector-specific employment index is from the *Monthly Labor Survey* of the Ministry of Labor. Sectoral data on hours worked are from the *Yearbook of Labor Statistics*.

FACTOR SHARES are calculated as the factor compensation divided by sectoral gross output. Data on both are from the *Annual Report on the National Accounts* from the Economic Planning Agency.

JAPAN DEVELOPMENT BANK LOANS data are available on a sectoral basis from the *Economic Statistics Monthly* of the Bank of Japan. These data were normalized as reported in the text using data on total sectoral loans and the wholesale price index from the same data source.

SUBSIDY data were obtained from the *Annual Report on the National Accounts* from the Economic Planning Agency. For the stylized facts, these data were normalized as reported in the text.

TARIFF data were based on each sector's effective rate of protection as calculated by Shouda (1982). Although Shouda's piece was written in 1982, he includes estimated effective rates of protection through 1987 based on Tokyo round reductions. Since Shouda's data are only for five year periods, we extrapolated the tariff rates between years. Tariff rates prior to 1963 and after 1987 were calculated by adjusting the effective rates of protection by the weighted average tariff rate available in the *Annual Report on the National Accounts*.

QUOTAS for the various sectors are calculated as the ratio of the total number of individual items subject to quota divided by customs product classifications. These data are from *Genko Yunyu Seido* (Current Import System).

EFFECTIVE TAX RATES are calculated as the ratio of actual sectoral receipts of corporate income taxes divided by the taxable sectoral income (accounting profits). Any tax relief or incentives measures employed via the tax code or administration of the tax code will be captured as a reduction of the numerator of this measure. Our measure of tax relief in this study is the deviation of this ratio for each sector from the overall effective tax rate. Data are from the *Kokuzei-cho Tokei Nenpo-sho* (National Tax Office).

REFERENCES

Borrus, Michael, Laura Diandrea Tyson and John Zysman, "Creating Advantage: How Government Policies Shape International Trade in the Semiconductor Industry," in P. Krugman (ed.), *Strategic Trade Policy and the New International Economics* (Cambridge, MA: MIT Press, 1986).

Carliner, Geoffrey, "Industrial Policy for Emerging Industries," in P. Krugman (ed.), *Strategic Trade Policy and the New International Economics* (Cambridge: MIT Press, 1986).

Chan, M. W. Luke, and Dean C. Mountain, "Economies of Scale and the Tornqvist Discrete Measure of Productivity Growth," this REVIEW 65 (Nov. 1983), 663–667.

Dick, A., "The Competitive Consequences of Japan's Export Cartel Associations," *Journal of the Japanese and International Economy* 6 (1992), 275–298.

Dosi, G., Laura D'Andrea Tyson and John Zysman, "Trade, Technologies and Development: A Framework for Discussing Japan," in C. Johnson, L. D. Tyson and J. Zysman (eds.), *Politics and Productivity: The Real Story of Why Japan Works* (New York: Ballenger, 1990).

Eads, G. C., and K. Yamamura, "The Future of Industrial Policy," in K. Yamamura and Y. Yasuba (eds.), *The Political Economy of Japan*, Vol. I (Stanford: Stanford University Press, 1986).

Freeman, C., *Technology, Policy and Economic Performance: Lessons from Japan* (New York: Pinter Publishers, 1987).

Griliches, Zvi, and Jacques Mairesse, "R&D and Productivity Growth: Comparing Japanese and US Manufacturing Firms," in C. Hulten (ed.) *Productivity Growth in Japan and the US* (Chicago: The University of Chicago Press, 1990).

Johnson, C., *MITI and the Japanese Miracle* (Stanford: Stanford University Press, 1982).

Jorgenson, Dale W., and Masahiro Kuroda, "Productivity and International Competitiveness in Japan and the United States, 1960–1985," in C. Hulten (ed), *Productivity Growth in Japan and the United States* (Chicago: University of Chicago Press, 1990).

Komiya, R., M. Okuno and K. Suzumura (eds.), *Industrial Policy of Japan* (New York: Academic Press, Inc., 1988).

Krugman, Paul, "Import Protection as Export Promotion" in H. Kierzhowski (ed.) *Monopolistic Competition and International Trade* (Oxford: Oxford University Press, 1984).

Lee, Hiro, "General Equilibrium Evaluation of Industrial Policy in Japan," *Journal of Asian Economics* 4 (1993), 25–40.

McMillan, J., "*Dango*: Japan's Price Fixing Conspiracies," *Economics and Politics* 3 (Nov. 1991), 201–217.

Nakamura, S., "Explaining the Japan and US TFP Difference," *The Economic Studies Quarterly* 43 (1993), 326–336.

Nester W., *Japanese Industrial Targeting: The Neomercantilist Path to Economic Superpower* (London: Macmillan, 1991).

Noland, Marcus, "Public Policy, Private Preferences and Japanese Trade Patterns," mimeo, Johns Hopkins University and Institute for International Economics (1992).

———, "The Impact of Industrial Policy on Japan's Trade Specialization," this REVIEW 75 (May 1993), 241–248.

Okimoto, D., *Between MITI and the Market* (Stanford: Stanford University Press, 1989).

Okimoto, D., and Gary R. Saxonhouse, "Technology and the Future of the Economy," in K. Yamamura and Y. Yasuba (eds.), *The Political Economy of Japan*, Vol. I (Stanford: Stanford University Press, 1986).

Okuno-Fujiwara, Masahiro, "Industrial Policy in Japan: A Political Economy View," in P. Krugman (ed.), *Trade with Japan* (Chicago: NBER, University of Chicago Press, 1991).

Ostrom, Douglas R., *Postwar Japanese Industrial Policy and Changes in Industrial Structure*, Ph.D. dissertation, University of Michigan (1984).

Sakakibara, Mariko, "Evaluating Government Sponsored R&D Consortia in Japan: Who Benefits and How?" Harvard University, mimeo (1994).

Saxonhouse, Gary R., "Tampering with Comparative Advantage," *Testimony Presented before the United States International Trade Commission Hearings on Foreign Industrial Targeting* (1983).

———, "Japanese Cooperative R&D Ventures: A Market Evaluation," The University of Michigan, Research Seminar in International Economics, No. 156 (1985).

Tyson, Laura D'Andrea, and John Zysman, "Development Strategy and Production Innovation in Japan," in C. Johnson, L. D. Tyson and J. Zysman (eds.) *Politics and Productivity: The Real Story of Why Japan Works* (New York: Ballenger Press, 1990).

Vestal James E., "Evidence on the Determinants and Factor Content Characteristics of Japanese Technology Trade 1977–1981," this REVIEW 71 (Nov. 1989), 565–571.

Weinstein, David E., "Evaluating Administrative Guidance and Cartels in Japan (1957–1988)," *Journal of Japanese and International Economies* 9 (1995), 200–223.

Woodall, B., *Political Clientelism in Japan: Public Works in a Dual Political Economy* (Berkeley: University of California Press, 1993).

Yamamura, Kozo, "*Caveat Emptor*: The Industrial Policy of Japan," in P. Krugman (ed.), *Strategic Trade Policy and the New International Economics* (Cambridge: MIT Press, 1986).