CENTER FOR INSTITUTIONAL REFORM AND THE INFORMAL SECTOR

University of Maryland at College Park

Center Office: IRIS Center, 2105 Morrill Hall, College Park, MD 20742
Telephone (301) 405-3110 • Fax (301) 405-3020

THE POLITICS OF NUCLEAR POWER IN JAPAN AND THE UNITED STATES

May, 1995

Linda Cohen, Mathew D. McCubbins, Frances Rosenbluth

Working Paper No. 161

This publication was made possible through support provided by the U.S. Agency for International Development, under Cooperative Agreement No. DHR-0015-A-00-0031-00.

The views and analyses in the paper do not necessarily **reflect the** official position of the IRIS Center or the U.S.A.I.D.

Authors: Linda Cohen, University of California, Irvine, CA.
Mathew D. McCubbins, University of California, San Diego, CA.
Frances Rosenbluth, Yale University, New Haven, CT.

The Politics of Nuclear Power in Japan and the United States

Linda Cohen
Mathew McCubbins
Frances Rosenbluth*

October 1994

* Respectively, Associate Professor of Economics, University of California, Irvine; Professor of Political Science, University of California, San Diego; and Professor of Political Science, Yale University. Frances Rosenbluth thanks the Soka Foundation for its support of this research. This publication was made possible through support provided by the U.S. Agency for International Development under Cooperative Agreement No. DHR-0015-A-00-003 l-00 to the Center on Institutional Reform and the Informal Sector (IRIS) and administered by the Office of Economic and Institutional Reform, Center for Economic Growth, Bureau for Global Programs, Field Support and Research.

The Politics of Nuclear Power in Japan and the United States

Linda Cohen
Mathew D. McCubbins
Frances Rosenbluth

Abstract

In this paper we attempt to explain the differences in the outcomes of utility regulation in two advanced countries, the United States and Japan. We find that in Japan, national regulation serves to subsidize electric utilities and electrical-equipment manufacturers. In the United States, with a much more decentralized regulatory structure, utilities face much greater impediments to making large capital investments, such as building new generating capacity. A glaring example of the differences between the two countries is their current treatment of nuclear power. Japan has a vigorous and expansive program to build nuclear power plants, while in the U.S. the nuclear power industry is moribund.

We find that the structures of governance and electoral institutions shape the outcomes of regulation. The end of nuclear power plant construction in the United States follows as a result of checks and balances, in terms of state-federal relations, and of the multiplicity of veto gates that policy must negotiate strictly at the national level. Each veto point provides prospective opponents of a policy change an arena in which to make their case. And, because of the different modes of election to the various veto offices, the probability of consensus among veto players is quite low. A great expansion in the number of veto points, caused by congressional action and court decisions, in the process for licensing nuclear power plants in the 1970s served to heightened the risks for utilities considering investments in nuclear power. Further, other changes at the national level in

the structure of nuclear power policy making led to sharp cuts in effective federal subsidies for new nuclear power capacity.

By contrast, the push for nuclear power in Japan is a result of policies to reward capital investment by utilities and to increase industrial demand for electricity. Importantly, the rewards to capital investment through utility regulation are assured because the regulatory process is controlled by the majority party in the Diet. The outcome of regulation there, which includes subsidies from consumers to utilities and equipment manufacturers, result from electoral incentives inherent in SNTV that lead the Liberal Democratic Party (LDP) and its successors to provide distributive favors to various well-organized interests. Further, investment risks to Japanese utilities are relatively small as a result of the majority party's ability to control all of a smaller number of veto gates in their parliamentary system.

1. INTRODUCTION

Japanese and American electric utilities have pursued sharply different nuclear energy policies since the mid-1970s. U.S. utility companies have all but abandoned nuclear power. They have ordered no new nuclear power plants since 1978. Moreover, they have cancelled all plants ordered after 1974 as well as one-third of those ordered before 1974. While nuclear power continued to grow as a percentage of both total electricity generation and installed capacity throughout the 1980s, that growth rate slowed markedly as the number of plants in the construction pipeline dwindled. Nuclear's share of power production is expected to begin declining as older plants are decommissioned without any new plants to take their place. All this, despite evidence that utilities had formulated ambitious plans in the 1960s and 1970s for its development.* Total net nuclear power design capacity (i.e., units licensed for operation, under construction or on order) declined from 163 gigawatts electric in 1980 (169 reactor units, 70 of which were then in operation) to 121 GWe (130 units) in 1985 and only 113 GWe (120 units, 111 of which are in operation) in 1990 (*World Almanac* 1992: 196).

In contrast, Japanese nuclear capacity has mushroomed. Utilities currently operate forty-one nuclear-powered plants (32.2 GWe capacity) generating 26 percent of electricity supply, up from 5 plants (1.8 GWe) in 1973. Japanese utilities also have another eleven plants (10.6 GWe) under construction and Japanese policy makers expect nuclear-generated electricity to make up thirty-five percent of capacity by the year 2000.

Economists have argued that the difference between United States and Japanese use of nuclear power plants follows from differences in construction and operating costs in the two countries. This is undeniably part of the explanation. Much of that cost difference can, however, be attributed to differences in government policy, which are a matter of choice. This paper offers an explanation for why nuclear power *policies* in the United States and Japan have diverged since the 1970s.

---

[1]. Policy makers in the United States anticipated that American utilities would eventually bring as many as five hundred light water plants on line, generating enough cheap power to render electricity "too cheap to meter."

In assessing policy choice, regulatory economists have observed that bureaucratic processes (such as licensing power plants) impose compliance costs on regulated industries and can change relative prices in an economy. To the degree that utilities cannot shift the costs of nuclear regulation to other parts of the economy, it follows, demand for nuclear power will be reduced. Both economists and political scientists have remarked on the myriad bureaucratic hurdles that utilities must overcome to build new nuclear power facilities in the United States (implying high compliance costs), whereas their Japanese counterparts face relatively few such impediments (implying relatively lower compliance costs). Simply put, the Japanese face less red tape, so their licensing process is cheaper than ours. It follows, *all* else ***equal,*** that Japanese utilities will place greater emphasis on new nuclear capacity than will American utilities. What is not explained is why government policies towards nuclear power differ in the two countries.

We argue that the policy differences largely follow from different constitutional structures (a federal, Madisonian system in the United States versus a parliamentary system in Japan) and different electoral systems (Japan's single, nontransferable vote -- SNTV -- system versus the United States's single member district, plurality elections). In the United States, the nuclear power plant construction industry is dead for two complementary reasons: first, environmentalists and not-in-my-back-yard (or NIMBY) citizens' groups gained a say at many levels (local, state, federal) in policy making. These groups' intervention slowed to a crawl the regulatory process in approving the siting, planning, construction and operation of nuclear power plants, and forced costly modifications of plant designs to reduce thermal and radiation pollution emissions and increase plant safety. Second, at a time when real incomes in the United States were stagnant or declining, political opposition to new, expensive generating capacity and congressional passage of the Public Utilities Regulatory Policies Act of 1978 (PURPA) gave utilities in high demand-growth areas strong incentives to abandon plans to build new capacity. Instead, they turned to policies to promote the more efficient use of existing capacity, including the creation of a nationally-integrated electrical grid to wheel power from areas of excess capacity and a variety of demand management policies intended to conserve energy and smooth

power use.' These two factors -- political opposition to new facilities and the availability of alternative supplies through wheeling and demand management -- sharply reduced utilities' short-term requirements for new generating capacity in the United States, both nuclear-powered and conventional (Joskow 1974).

Japanese utilities faced a much different environment. At the time of the first oil shock in 1974, more than 50 percent of installed generating capacity in Japan was oil fired. Policy makers responded to the economic crisis caused by the oil embargo by encouraging the diversification of the base generating capacity, including nuclear power.

Japan also has an environmentalist movement and NIMBY activists who oppose the development of nuclear power (McKean 198 1; Krauss and Simcock 1980; Tabusa 199 1; Donnelly 1991). But, Japan's regulatory process offers many fewer points at which opponents of nuclear power can intervene to stop or delay development of nuclear power (see Figure 1 below). This is a matter of political choice, however; the Japanese legislature can create as many (or few) checks on bureaucratic decision making as it desires. Nuclear regulation could have become just as complex in Japan as it is in the United States, but it did not. We argue that this difference in policy choices reflects not just a different constitutional system, but also the interplay between Japan's SNTV electoral system and the Liberal Democratic Party's electoral strategy. Major industrial supporters of the LDP demand policies that favor large construction projects; nuclear power plants are among the largest such projects. The potential opposition to nuclear power in Japan, on the other hand, consists of environmental groups, who tend to support opposition parties and thus are of little consequence in LDP electoral calculations; and NIMBY constituents, such as farmers and fishermen, whom the LDP placates with further side payment policies.

The plan of the paper is as follows: In section two we present the arguments and evidence regarding the relative costs of nuclear power plant construction and operation in the

---

[2]. Among other requirementa, PURPA rcquircn clectric utilitics to purchase the output of qualifying cogeneration and alternative energy generation facilities at rates no lower than the utility's incremental ("avoided") costs. This requirement raises the risk to utilities that any new power plant it might build would comprise excess capacity.

United States and Japan. Critical differences between the two countries include demand characteristics, the structure of utility rate regulation and risk factors faced by utilities in the two countries. The evidence clearly supports the claim that nuclear power is competitive (vis-a-vis alternative generating capacities, such as oil, gas, coal and conservation) in Japan but not in the United States. Our explanation for why this is so is presented in section three, where we trace the differences in the two countries' nuclear power market and regulatory structures. Section four concludes.

2. COMPARATIVE ELECTRICITY ECONOMICS: JAPAN AND THE UNITED STATES.

Why is Japan seemingly so successful at building and operating nuclear generating capacity, while in the United States nuclear economics no longer glows? In explaining the divergent records of nuclear programs in the United States and Japan, the economics literature has focused on construction costs for reactors in the two countries. Costs are indeed lower in Japan today. Japanese construction costs relative to U.S. costs dropped from rough comparability in the early 1970s to less than half of U.S. costs in the 1980s (on a per megawatt basis; based on comparisons of published U.S. figures with proprietary data obtained from Japanese utilities; see, e.g., Hinman and Lowinger 1987). Stated operating costs in Japan are approximately one-half U.S. operating costs (on operating costs see, e.g., Navarro 1988; 1989). Because of different nuclear cohorts, these comparisons overstate the cost differential. In particular, the Japanese did not begin building nuclear plants in earnest until just before the United States gave. up. Therefore, the oldest Japanese plants are the same cohort as the newest American plants. The construction and operating costs of similarly sized and aged plants are roughly similar in the two countries. Newer Japanese reactors, however, have no counterparts in the United States, rendering comparisons of construction costs impossible and operating costs problematic. Nevertheless, economists have argued that these cost differences arise from

construction delay, learning, management structure, and financing. We will deal with each of these in turn.

Much of the construction cost difference between U.S. and Japanese nuclear power plants is attributed to differences in construction lead times (the time required to build a plant). Plants that came on line in Japan in the first half of the 1980s had a construction lead time averaging 5.3 years; in the United States, the figure was 11.2 years (Hinman and Lowinger 1987). Longer lead times increase charges for borrowed capital. In the United States, it is not uncommon for 40 percent of the cost of a nuclear power plant to consist of interest charges on debt. Furthermore, unexpected delays involve additional charges, including contract penalties and substitute power purchases.

The learning and management differences in plant construction are apparent in the structures of both the utility industry and the construction industry. In Japan, there are only three vertically integrated vendors of nuclear plants serving only nine utilities. Japanese nuclear plants are standardized to a much greater extent than in the United States, as Japanese utilities buy nuclear facilities under turnkey contracts (in which the facility is to be delivered, ready for operation, at a set time for a set price). U.S. vendors, in contrast, ceased selling turnkey reactors in 1966 (Burness, Montgomery, and Quirk 1980; Montgomery and Quirk 1978). Thereafter, utilities assumed the risk of cost overruns for plants in which the multiplicity of vendors (architects, engineers, construction firms and balance-of-plant companies) results in an extraordinary degree of customization (Cohen 1979: 69). Since 1975, increased standardization has headed the list of every set of policy proposals intended to enhance the safety or economic competitiveness of nuclear power in the United States, reflecting the belief that customization has imposed a crushing penalty on the attractiveness of the technology.

Finally, the financing issue represents a fundamental difference between the two countries. In Japan, loans for nuclear power development are subsidized by the Japan Development Bank. Utilities pay the lowest interest rate that the JDB offers, which is on average

about a percentage point lower than the long-term prime rate offered by commercial banks.[3] By contrast, American utilities have had to compete for financing in the capital markets. This has resulted in relatively higher costs for loans and a higher risk burden for utilities.

A closer examination of these three cost components -- lead times, standardization and financing -- reveals their connection to policy choices. Administrative obstacles -- i.e., red tape -- can be every bit as costly as as economic ones (see DOE 1980: 145, Table 10).

The licensing requirements in the two countries diverged appreciably in the mid 1970s. One one side, the Japanese government streamlined its licensing procedures in 1977, dropping the potential number of required licenses from 160 down to only 66, stemming horn 33 different laws.

As outlined in Figure 1, in Japan, after a utility selects a location, its application for a site license, including an environmental impact report, is reviewed by the Science and Technology Agency (STA, a cabinet-level agency under the office of the Prime Minister). The Ministry of International Trade and Industry (MITI) then holds a public hearing to give notice to and hear comments from the local community.[4] The application then goes to the popularly-elected prefectural governor for approval, after which the Electric Power Development Coordinating Council (EPDCC[5]) offers a recommendation to the Prime Minister, who has the final word.

Once siting has been approved, the Atomic Energy Commission and the Nuclear Safety Commission -- panels of academics and industry representatives reporting to the STA -- undertake safety examinations.[6] MITI, with the approval of the PM, then may grant separate

[3]. For example, the average long-term prime rate offered by private banks in June, 1989 was 5.7 percent, while the rate at which utilities could borrow from the JDB fur investment in nuclear capacity was 4.85 percent. In June of 1990, the figures were 7.6 percent and 6.4 percent, respectively.

[4]. The administrative guidance governing these public hearings gives MITI a veto over who may attend and what issues they may address.

[5]. EPDCC is an "independent" ministerial body attached to the Economic Planning Agency, composed of representatives of eight ministries and eight outside members (usually academics); the Prime Minister is ex officio chair. The eight ministries and agencies reprencntcd arc; MITI, the ministries of Finance, Home Affairs, Construction, and Agriculture; and the Economic Planning, Environment, and Land agencies.

[6]. The Diet altered the mission of the NSC in 1978 following a radiation leak in the Japanese self defense force's nuclear powered ship, the *Mutsu*. The

licenses for construction, testing, and operation. MITI also inspects post-construction safety. It is important to note that all of the veto gates just described are subject to the continued pleasure of the majority party in the Diet.' Should a majority so choose, any or all of these stages could be eliminated, modified or replaced. We will return to this point in section three below.

[FIGURE 1 ABOUT HERE]

Compare this relatively streamlined Japanese process to the dozens of local, state, and federal agencies, as well as multiple levels of federal and state courts whose approval is needed in the United States to build and operate nuclear plants. The San Onofre plant on southern California's coast, for example, had to obtain over 200 separate licenses before it could go on line.

Power plant siting and utility generating capacity planning in the United States are subject to state and local regulation, whether the plant is to be nuclear or conventional. Several states, including California, Minnesota, Oregon, and Vermont, have legislated special restrictions on nuclear power plant construction on radiological health and safety grounds. In addition, the

---

Diet's intent was for the NSC to provide a "double check," along with MITI's check, on the safety of new plants (see the 1978 Amendment to Nuclear Power Commission and Nuclear Safety Commission Establishment Act of 1955, Law No. 188).

7. The Japanese judicial system hypothetically serves as an avenue for challenging the siting and operation of nuclear power plants. A person opposed to an administrative decision to license a nuclear power plant may file suit in court under the Administrative Legislation Act, pursuant to section 7 of the Nuclear Regulation Act. But in practice, no legal suit brought against a plant has ever prevailed, which is just as one should expect. Since the LDP's constituents can press their claims directly to the governing party, those who resort to the legal system tend to be outside the LDP electoral coalition. As is typical of parliamentary systems, Japan's judiciary (by being deliberately inhospitable to citizens with grievances) acts as a sort of screening device. The courts limit standing to residents in the neighborhood of the proposed plant site who can demonstrate damage to their person or property. Furthermore, courts limit their own scope for reviewing administrative action (Young; Upham 1987; Haley). Refusing to comment on scientific and technical issues of plant safety, the courts ask only whether the administrative agency granting a plant license met the procedural standards prescribed by law. The courts have found in favor of the agencies in all eight cases brought to date (unpublished, internal MITI document). See also Schoenbaum and Ainley.

National Environmental Policy Act (NEPA), the Federal Water Pollution Control Act (FWPCA) -- as amended in 1972 -- and Housing and Urban Development (HUD) 701 Comprehesive Planning Assistance all give the states powerful tools to check plans for development of nuclear power generating capacity, even to the extent of duplicating and perhaps challenging NRC reviews (DOE 1980: 35).

What makes the American system especially sticky is that federal licensing agencies and regulations all accord some form of participatory rights to parties (from state governments to local residents of proposed nuclear-plant sites) with an interest in the license. At the Nuclear Regulatory Commission (and its predecessor, the Atomic Energy Commission), for example, legal standing in the licensing process is virtually unlimited: any individual or group that files the appropriate papers receives intervention status. The only limit on standing is the extent of the Commission's own legal jurisdiction (for example, prior to 1969, potential environmental intervenors had almost no hope of gaining standing before the AEC). Intervenors may be eligible for federal financial assistance in order to hire legal counsel and they can introduce evidence, interrogate other parties, cross-examine witnesses, and present their own witnesses (Atomic Energy Act of 1954, P.L. 83-703, as amended). Finally, if unhappy with the initial permit or licensing decision they can appeal the whole business to the review levels within the NRC and from there to the federal courts and to Congress. With the construction permit process at the NRC, for example, there are six review stages, four appeals stages and six separate federal agencies (as well as state and local agencies) involved in making the permit decision.

Opponents of nuclear power often have complained that the structure and process isn't real because construction and operating plans almost always are approved. Cohen (1979), for example, found that 92 of 116 AEC/NRC construction permit application cases initiated between 1966 and 1974 had been resolved by 1977; all received approval by the commission. Out of 103 "substantive" issues raised in these licensing cases, Cohen found that applicants prevailed 87 times, intervenors only 16 (Cohen 1979: 86, table IV). But intervenors were much more

successful on "procedural" issues: for example, whether a particular topic could be discussed at the hearing or the granting of a delay for further preparation.

More important from our perspective are the dual effects of delay and anticipated response by utilities. Whether or not plant construction ultimately is approved, the effect of all this structure and process is to increase the cost of bringing a nuclear power plant on line. Following the 1971 D.C. Circuit Court decision in the Calvert Cliffs case, which forced the AEC (later, the NRC) to require permit applicants to comply with NEPA and file environmental impact reports (EIRs), all licenses were held up for over twelve months as applicants backtracked to complete environmental reviews. One of the effects of NEYA was to incorporate public concerns about the potential consequences of low-probability accidents into the licensing process. While the Atomic Energy Act allowed the AEC to ignore such events, NEPA required an environmental impact statement that characterizes all residual risks and includes them in an overall cost-benefit analysis.

In effect, the application of NEPA to the nuclear industry slowed by as much as two years the licensing of reactors (Cohen 1979). The timing was particularly unfortunate for American utilities (who, as we noted above, bore most of the risk of construction delays and cost overruns following 1966), as inflation and interest rates rose sharply in the late 1970s. Consequently, the procedural due process accorded opponents wound up imposing far greater costs on utilities than anyone had anticipated in the early 1970s. The Congressional Budget Office estimated in a 1979 study that financing problems were directly responsible for as much as 19 percent of total construction delay time at nuclear plants. A share of these financing problems probably resulted from previous delays resulting from regulatory activities. The CBO attributed another 19 percent of delay time directly to regulatory compliance (see DOE 1980: 145, table 10).

Why didn't the United States follow Japan in streamlining its regulatory process? This is especially interesting in light of the fact that in the early 1970s, utilities were still interested in building nuclear plants (as can be seen in the bulge in construction permit applications filed in 1973 and 1974), and were complaining vociferously about licensing delays. As Weingast **(1980)**

observed, Congress, which passed NEPA, could have acted to amend it if members of Congress had become unhappy with how the Act was applied after the D.C. Circuit Court handed down the 197 1 Calvert Cliffs decision. But to conclude from its inaction that Congress was antinuclear in 1972 is incorrect. The largest federal energy research and development program ever was concurrently getting underway at the AEC to develop breeder reactors, a technology that only makes sense if the country has a big light water reactor industry in need of fuel; indeed, the breeder program was justified on this basis (Cohen and Noll 1991). Further, public opinion polls indicate that the general population continued to support nuclear power development right up to Three Mile Island in 1979 (Fort and Hallagan 199 1).

Congressional ambivalence about nuclear power is apparent in the history of legislative efforts in the mid 1970s. First, the AEC was abolished in 1974, and a new regulatory institution, the NRC, was established that, divorced from the enormous nuclear weapons laboratory establishments of the AEC, was far more likely to be anti-nuclear than its predecessor.

Second, instead of streamlining, the United States government added layers into the licensing process, creating new avenues into the regulatory process for opponents of nuclear power. Since the dissolution of the Joint Committee on Atomic Energy (JCAE) in January 1977, attempts to streamline the regulatory process have failed to generate any steam. The JCAE had been established in 1946 as a joint House and Senate committee charged with overseeing the development and promotion of nuclear power. At the opening of the 95th Congress, a coalition of antiproliferation and environmentalist Democrats was able to include the demise of the JCAE in the rules of the House, passed by a straight party vote.[8]

The differences between standardization, financing, and lead times all lend credence to the claim that the gross costs to utilities of building nuclear plants are lower in Japan than in the

---

[8]. In the 94th Congress, the JCAE was moribund. It reported virtually no important nuclear legislation: dozens of bills were introduced calling for a curtailment or streamlining of regulation, dealing with nuclear waste policy, and considering international implications of the fuel cycle. The only nuclear power-related bill to pass (other than continuing authorizations) was an extension of the Price-Anderson Act, which limited utility liability in the event of a nuclear accident.

United States. But in large part the costs of constructing and operating nuclear plants themselves are the results of policy choices. In Japan, for example, the government chooses to subsidize interest expenses and quells potential opposition by compensating farmers, fishermen, and local governments.[9] Japan also streamlined its licensing process in 1977, the same year that the Congress dissolved the JCAE, and at the same time that the United States placed further licensing and legislative obstacles in the way of nuclear power development. Ease of financing is one component of leadtime determination, so that financing policies have a double effect on construction costs. Finally, a probable cause for the lack of standardization in the United States is the overall slowdown in nuclear orders -- had the industry continued to expand in the 1980s, U.S. utilities would probably have pushed towards more standardized designs, as has happened in Japan. Thus, rather than telling us about the actual costs of building nuclear power plants, cross-national cost comparisons reflect government policies toward nuclear power development.

More fundamentally, cost is not the determining factor for the success or failure of a nuclear energy program. Utilities in both countries are governed by rate-of-return regulation. This means that cost, as long as it can be included in the rate base, actually adds to a utility's profit and makes relatively costly nuclear plants potentially more attractive than, say, smaller oil-fired plants. What costs will be allowed into the rate base is, of course, a matter of policy choice. Note that U.S. utilities were already cancelling nuclear reactor orders from 1974 to 1978, when estimated construction costs in the United States were roughly similar to the estimated costs in Japan. Construction cost differential alone, therefore, is not a sufficient explanation of the different outcomes in the two countries. Subsequently, the relative cost of building a plant in the

---

[9]. The "dengen sanpo [three electricity generation laws]" for compensation of communities that host power plants were passed in 1974. The laws grovide funds that a host town can use for projects such as the construction of roads, schools, and civic centers. The money is raised through the assessment of a small tax (445 yen -- about $3.50 now -- per 1000 KWh) on all electricity consumption in Japan ("Hatsuden yo shisetsu shuhen chiiki seibi ho [The Law for Compensation of Areas Surrounding a Plant Site]"; "Dengen kaihatsu sokushin zei ho [Electric Power Development Tax Law]"; and "Dengen kaihatsu sokushin taisaku tokubetsu kaikei ho [Electric Power Development Special Account Law]").

United States rose to about twice the (per MW) cost of a comparable plant in Japan. The cost increase was after the plant cancellations had begun, however, and not before.

We have shown that the supply side differences between the U.S. and Japanese nuclear power industries are not sufficient to explain those industries' divergent results since the 1970s; we turn now to the demand side. Since 1975, electricity markets in Japan and the United States have experienced divergent patterns of demand growth and price regulation. The differences explain some of the discrepancies in nuclear plant construction schedules and costs in the two countries. In addition, they suggest that very different incentives exist for utilities to invest in new capital-intensive generating capacity, making nuclear power a more attractive investment in Japan than in the United States. In the next subsection, we give an overview of the critical contrasts, finding that the evidence suggests the standard view of the nuclear productivity gap between the two countries should be modified.

2.1 DEMAND FOR ELECTRICITY

In the last two decades, average annual real growth in total megawatt-hours in Japan was 48 percent higher than in the United States (3.45 percent per year versus 2.33 percent per year). Furthermore, as shown in Figure 2, for most Japanese utilities demand doubled from 1975 to 1990. The chart indicates that all Japanese utilities have experienced consistent growth in demand, marred only by two blips immediately following the first and second oil shocks.

At the same time, growth in peak summer demand (a measure of maximum demand) in the United States dropped. As shown in Figure 3, peak demand in the United States was growing at more than 8 percent prior to 1973; after 1973, growth averaged under 3 percent. Thus, the need for new capacity has fallen by over half in the United States since 1973.

FIGURES 2 AND 3 ABOUT HERE]

Moreover, as can be seen in Figure 4, U.S. projected growth in demand exceeded actual growth in demand by roughly 100 percent between 1978 and 1987. A dramatic fall-off in demand growth and persistently optimistic demand growth forecasts meant that utilities undertook far more capacity additions from 1970 to 1976 than proved necessary. Thus, as shown in Figure 5, as new plants came on line, U.S. capacity reserve margins grew from the 1970s into the late 1980s. Prior to 1974, utilities maintained on average 16 percent more generating capacity than they needed to meet their highest annual demand for electricity (the summer peak). When demand failed to materialize in the mid 1970s, additional capacity continued coming on line, and reserve margins increased to 25 percent. In Japan, by contrast, capacity reserve margins average about 13 percent.

[FIGURES 4 AND 5 ABOUT HERE]

The result of slackening demand in the United States was that virtually all new capacity under construction was delayed or abandoned and new orders were unnecessary. Indeed, utilities cite demand considerations as a cause in over one-fourth of the construction delays during this period (DOE 1980: 145). Of course, increases in delays lead to higher costs, especially interest charges, which make up about 25 percent of all costs for American utilities.

2.2 RATE REGULATION

In both countries, in setting electricity rates utilities are guaranteed a specified rate of return on their capital investments. The sum of the capital investment on which profit is made is called the rate base. Japan and the United States differ on what capital expenses can be included in the rate base, when they can be included, and for how long.

Japanese rate base calculations allow 50 percent of projected construction costs to be placed in the rate base at the beginning of construction (MIT1 n.d.: 9). Allowing such projected

costs into the rate base is known as "Construction Work-In-Progress" (CWIP) allowances." In the United States, 23 of 50 state public utilities commissions (PUCs) allow some CWIP, although the amount is typically quite limited (Goldman, Sachs and Co. 1982). Ohio, for example, allows twenty percent of previous expenditures on plants at least three-fourths complete. In general, U.S. utilities get an "allowance for funds used during construction." This means that interest charges during construction are added to other construction costs and included in the rate base after the plant is placed into service, to the degree allowed by the state PUC. The dramatic differences in rate-setting practices between the two countries makes cost comparisons, which are already skewed by subsidies and financial practices, all the more problematic.

2.3 REGULATORY RISK

In Japan, utilities commission the construction of nuclear reactors based on turnkey contracts. They purchase a reactor whole from the vendor, so they are quite certain from the outset of what it is they are buying and what it costs." Also, utilities in Japan are blessed with certainty as regards rate making. They know that all capital expenditures can be included in the rate base, when each portion of CWIP will be included, and for how long each will be counted.

In the United States, many utilities have had part of their expenses disallowed at the last minute. In some cases, such as the Shoreham plant on Long Island, a working reactor was not allowed to operate. In others, such as Diablo Canyon in California, operation was delayed for years. Such delays sometimes lead to cancelling the project altogether; for example, construction

[10]. Actually, the rate base does not change automatically every time a utility makes an investment. A utility must petition MITI when its profits have been squeezed by increasing costs, but MITI has proved generous in granting increases. Naturally, a major capital investment will cause such a squeeze and lead to a revision of the rate base before too long. The interval between rate base revisions has averaged about three years in the period under consideration (personal communications with MITI officials, 1992).

[11]. When the rate of return exceeds the interest rate (and by definition any "fair" rate of return allows a real return on capital) then the utility winds up ahead on any debt that can be accounted for under CWIP. From a financial viewpoint, lengthy construction schedules will not detract from company profits.

on the Cherokee Nuclear Station in Gaffney, S.C. was halted and its half-finished reactor containment vessel was converted into a gigantic swimming pool used to film the movie *The Abyss.*

Thus, in Japan there has been sufficient demand to warrant expansion of base load capacity and, because of the form of utility regulation, such expansion is profitable and virtually riskless. In the United States, by contrast, utilities were hit from both sides of the electricity supply equation. On one hand, growth in demand did not meet projections, so it was not as profitable to build new base load plants as it had been in previous decades. On the other hand, changes in the regulatory process and the decline in congressional support made it more expensive and riskier (with respect to the likelihood that the utility could earn a return on its investment) to build nuclear plants.

3. POLITICAL DETERMINANTS OF MARKET AND REGULATORY STRUCTURE

While Japanese utilities continue to order nuclear reactors, U.S. utilities do not. Furthermore, because of the regulatory atmosphere, even as the demand for electricity is again picking up in the United States utilities are still unwilling to order new nuclear capacity. We have identified four pertinent critical differences between the United States and Japan -- (1) cost, (2) demand, (3) utility regulation, and (4) risk with regard to rate and profit. The question is, why do these differences exist?

The United States has a system of separated and federated powers. Authority is divided among the House of Representatives, the Senate, the president, and the corresponding branches of state governments. Moreover, the constitutional structure of the United States was constructed on the principle that "Ambition must be made to counteract ambition" *(Federalist 5* 1). Not only is decision-making authority shared, it is shared by people who are elected at different times, from different constituencies, and by different rules, so that they often (and by design) have contrasting and conflicting incentives and goals. Each added player, responsive to his own electoral constituency, in the policy making process implies, *ceteris paribus*, that fewer policy

compromises will be reached. The multiplicity of such players collectively implies an increase in both the number of opportunities and the diversity of strategies available for access to and influence on policy making processes by the opponents of any prospective policy choice.

From a social choice perspective, all else constant, the greater the number of veto players and the greater the diversity of preferences among them, the less likely there exists a policy that is satisfactory to all players (Cox and McKelvey 1984; Hammond and Miller 1987). From a transactions costs approach, we learn that as the number of veto players increases so, too, do the transactions costs involved in striking deals among the players and, all else constant, the less likely it is that policy compromise will be reached. Thus, in policy areas such as nuclear power that have significant federal and state involvement, agreements will be difficult to strike and nearly impossible to maintain.

This multiplicity of veto gates means that the reversionary outcome -- i.e., the policy that prevails should no agreement be reached, is privileged.[12] Prior to 1969 and the passage of NEPA, the U.S. policy-making apparatus was biased in favor of promoting nuclear power. Environmentalists and prospective neighbors had few grounds on which to challenge proposed new plants; pro-nuke members of Congress populated the JCAE; and both electricity demand and demand expectations were growing, while the real cost of electricity to consumers was plummeting. Thus consumers wanted new capacity and hardly noticed the bite of paying for it, while utilities wanted to build new nuclear power plants.

The worm turned with NEPA and Calvert Cliffs. Suddenly, environmentalists and NIMBY activists had a seat at the table. The costs of buying these opponents off in the U.S. system quickly outstripped utilities' desire to build new nuclear powered capacity. Japan, on the other hand, has a system of unitary and fused powers, where executive and legislative authority reside in the same body, the Diet, which is sovereign at all levels of government. This means

[12]. For example, the reversionary outcome could be the maintenance of a program at the levels prescribed in the last voted budget, as in the cases of social security and agricultural subsidies, or, alternatively, it could be the termination of the program.

that the majority party in the Diet controls all levels of government, and that only one bargain need be struck for a policy decision to be reached.

Naturally, since policy is relatively easy to make it is also easy to change. This contrasts with the United States, where the same gauntlet of veto gates that renders original policy choice an arduous process awaits later attempts to change reversionary policies. So, with respect to the long-term continuity in Japanese nuclear energy policy, it is highly relevant that the majority party in Japan has remained the same for the entire period under consideration. Indeed, the LDP has held the reins of government continuously since 1955.[13] With this background in mind, we proceed to an explanation of the four crucial differences between U.S. and Japanese nuclear regulatory policy.

3.1 COST

In the United States, numerous distinct government authorities, each with a veto, establish regulatory processes for nuclear power. Because ambition is pitted against ambition, the regulators' interests often conflict. Conflict and delays increase with the number and diversity of interests represented in the process. Thus, costs to utilities -- primarily interest payments and foregone revenue -- are large and increasing. Such site-specific costs as environmental impact assessment and safety-related expenses are also larger, as there are more and more hoops through which the utilities must jump.

In Japan, there are many fewer veto gates and many fewer licenses, all of which are controlled by the same party. Although the description of the regulatory process represented in Figure 1 listed several government agencies, our point is that all of these bureaucrats serve one

[13] The LDP lost its majority in the Upper House for the first time in 1989, but because the Lower House is sovereign on budgetary decisions and the choice of the Prime Minister, this is not as important as it would be in the United States. In contrast to the United States, Japanese rules with respect to nuclear plant licensing do not require explicit actions by anyone other than Ministry officials, the Prime Minister, and the prefectural governor, all of whom in many prefectures remain under the control of the LDP. Further, since basic geographic and geologic facts constrain nuclear power plant siting to only a few areas in Japan, only a few of the prefectural governors are relevant to nuclear power policy.

political master -- the majority party in parliament. Once "party approval" is given, the remaining licenses should be pro forma. Thus regulatory costs are relatively small, as are site-specific costs.

A final word can bc said about thc different subsidies in the regulatory processes of the two countries. In Japan, we observe side payments that grease the wheels of regulation and administration. The "Three Laws" (see note 9) are but one example. In Japan, electricity rates are structured to favor industrial users, whereas in the United States, rates favor residential consumers, who are not generally considered to be a specific constituency group. The explanation for this discrepancy can oncc again bc found by looking at the relevant institutional structures. Since in the United States there are so many veto players without overlapping preferences, we expect the range of feasible alternatives to be quite limited. Further, as we expect fewer deals to be struck under the American than under the Japanese system, we also expect less compensation (fewer side payments) to be allocated.

3.2. DEMAND

In the United States, the response to the inflationary and environmental concerns of the 1970s was to discourage demand for electricity. In most states, increasing block rate structures were established for all users of electricity. Further, many states set up redistributive rate structurcs, so that industrial users paid a far greater share of the per unit costs than was true in Japan. Combined with PURPA policies, overconstruction in the early 1970s and a recessionary economy, utilities were therefore able to put off the need to build new electric generation capacity and allay some of the environmental concerns with regard to electricity generation.[14]

It is not clear that Congress could have encouraged the use of nuclear power by subsidizing it, even if it had wanted to do so. The actions of state legislatures and PUCs to

[14]. PURPA also helped in this regard, by creating large regional markets for electricity. Areas such as San Diego, in which the demand for electricity has actually grown over the last two decades, have met their increased demand by buying surplus electricity off the grid from other states and even other countries.

increase prices and to dampen the demand for electricity meant that utilities would not have been able to earn a return on investments in nuclear power plants. On the other hand, states like California and Texas, where demand for electricity was still growing, would have found it tough to encourage the building of nuclear power plants because support for nuclear power at the federal level had evaporated, Air, water, and waste disposal regulation, as well as other nuclear regulation would have made it impossible to meet increased demand using oil, coal, gas, or nuclear energy. Moreover, opposition to nuclear power at the federal level had become firmly entrenched in the regulatory process via NEPA and the Calvert Cliffs decision; and in the House and Senate committee systems, as jurisdiction over nuclear power issues was distributed to several committees in each chamber. Nuclear power advocates lost their privileged institutional position for good when House Democrats unilaterally dismantled the JCAE in 1977.

In Japan, oil was the issue (Samuels 1987; Eguchi 19801). At the time of the first oil shock, more than 50 percent of electric generating capacity was oil-based. By contrast, the United States relies very little on oil-fired electricity generation -- only 5.7 percent of net generation in 1989 (United States Department of Commerce 1991: 579, Table 972). The Japanese government sought to resolve its uncertainties with respect to energy supplies by reducing oil consumption. The question is, Why? There were many policy options available, from electricity conservation (as in the United States) to the purchase of long-term contracts for oil. The answer lies in the politics of LDP decision making.

In elections to the lower house, the Japanese use a single nontransferable vote (SNTV) system. Each district sends up to six representatives to the Diet; each voter gets only one vote to cast for an individual, and the top six *individual* (as opposed to party) vote-getters are elected; it is thus possible for a party to win almost all the votes cast but only take one seat, if all those votes were to go to a single candidate. In contrast, the United States uses a single-member district system, in which the candidate with the most votes wins.

The SNTV electoral system requires any majority-seeking party to run more than one candidate per electoral district. [15] Consequently, the party must engage in some form of vote division in order to spread the "party vote" optimally among its many candidates in each district. The particular solution used by the LDP is to subsidize its candidates' pursuit of personalistic votes while simultaneously marketing the party label as a public good for all endorsed candidates. Each candidate caters to a distinct bloc of voters, and dispenses various regulatory and budgetary favors as well as large sums of money to build up personal loyalty as a supplement to party loyalty (McCubbins and Rosenbluth this volume).

In Japan as elsewhere, a heavy reliance on particularistic politics implies the need for massive amounts of money. Indeed, election campaigns in Japan are four to eight times as costly as in the United States. For the LDP, a large share of campaign financing comes from domestic industry, the biggest consumers of electricity. Earlier, we suggested one possible response by Japanese utilities to the oil shocks of the 1970s could have been a turn toward longer term contracts for oil. However, MITI approved rate increases averaging 56.8 percent in June 1974, essentially passing through the oil price increases. A second major rate increase, averaging 2 1 percent, was approved in 1976 (Samuels 1987: 163). The brunt of these increases was borne by small businesses and residential customers, however, thanks to the use of a diminishing block rate structure and utility side payments to major customers (for example, when the utilities garnered windfall profits in 1986, due to changes in the exchange rate, they kicked back $6.2 billion to industrial customers; see Samuels 1987: 225).

Thus, it was relatively painless for the LDP to substitute away from oil. For electricity, the move has been to coal, gas, and nuclear power, as well as some price-induced conservation for small (residential) users. In keeping with the LDP's tradition of favoring its big contributors, the Japanese government also established a pricing system that discourages residential

[15] The 512 members of the Lower House in Japan are elected from 130 two- to six-member districts. Therefore, a majority of 257 implies an average of two seats per district for the majority party.

consumption and encourages industrial use of electricity with a declining block rate structure. Indeed, as shown in Figure 6, in some years, residential consumers subsidize business users.

[Figure 6 about here]

3.3. REGULATION

In the United States, PUCs are established and appointed by state governments and have long favored residential interests over those of the utilities. Prior to the advent of inflationary and environmental concerns after the 1973 oil shock, PUCs had quite cozy dealings with utilities that sought price decreases. Electoral competition in the states caused the PUCs to be opened up to consumer and environmental interests after the mid 1970s (Joskow 1974).

These new interests succeeded in establishing new regulatory requirements. The addition of new requirements to the regulatory process necessarily implies the creation of new potential bottlenecks, points at which the licensing process can grind to a halt. Furthermore, insofar as these new veto gates are placed in regulatory, political, or judicial arenas, they increase the number of points at which opponents of nuclear power may access the process and exert pressure for the exercise of one veto or another. It comes as no surprise, therefore, that utility regulation has become increasingly hostile to the utilities as new structure and process has been added to regulatory decision making.

The LDP's continuous domination of Japanese politics suggests that there has been no electoral pressure to change policy away from producers and big customers and toward residential consumers. Because the LDP's electoral strategy depends heavily on providing private goods, they are not seen as being as concerned with public goods issues as their opposition. The out parties, which are unable to provide particularistic goods, concentrate their electoral rhetoric on classic public goods issues, such as non-proliferation or environmentalism. Unitary government, parliamentarism, and majoritarianism combine to allow for only one access point to government decision making: the majority party. If Japanese opponents of commercial

nuclear power cannot get a hearing with the LDP, they are out of luck. Japan's political-institutional structure has allowed the LDP to ignore politically unimportant opponents of its policies.

It is understandable, then, that utility regulation has remained quite favorable to the utilities (and to industry in general), and that the costs of favorable treatment are not borne by the LDP's other important constituents. Industry does not subsidize residential consumption; rather, residential customers bear most of the costs of nuclear development. And farmers and fishermen, also traditional bastions of LDP support, actually are compensated by the LDP (see note 9); once again, residential consumers pay for these subsidies.

3.4 RISK

Finally, differences in profit risk follow from the differences in rate regulation and regulatory cost. PUCs and courts in U.S. states cannot commit years in advance to allow part or any of a utility's expenditures into the rate base. Because the numerous veto gates are controlled by institutionally distinct and often politically opposing agencies, the receipt of one license has no implications for success or failure in receiving other licenses further down the line. These battles will be fought at a later time by sides as yet to be determined. In other words, intervening elections at any level of government could alter the partisan control of certain veto gates, rendering prediction about probabilities of success a risky game. In Japan, as long as the LDP rules, there is no uncertainty. Of course, utilities and other beneficiaries of the regulatory structure do their best to ensure that LDP does in fact continue in power.

4. CONCLUSION

Electrical generating capacity in Japan has grown over the past fifteen years, with roughly equal contributions from the development of new capacity in gas and coal as well as nuclear power. In the United States, in contrast, electrical generating capacity has stagnated: part of the untold story of the demise of the nuclear power-plant construction industry in the United States is

that no new capacity has been added in coal, gas, or oil either. The number of licenses required to site, build, test, and operate a nuclear power plant in the United States is much higher than the number needed in Japan. Since each license requires an administrative decision, each is a veto gate. All else equal, the more veto gates there are, the greater are the costs of nuclear power, and the higher is the risk that the utility will not earn a return on its investments.

Indeed, the evidence shows that before nuclear power development in the United States ground to a halt, the lengths of delays at virtually every step of the process were growing, at great cost to the utilities in terms of interest charges and revenue foregone. Fully built plants have not been allowed to operate, and utilities did not know how much of their capital outlays would be included in the rate base by state PUCs. By contrast, the Japanese system is streamlined. Uncertainty is reduced, and utilities know that all of their costs will be allowed into the rate base.

This characterization, while accurate as far as it goes, begs the question of why the licensing procedures in the two countries are so different. Again, the answer lies in their different institutional structures. The large number of distinct, constitutionally defined players in the United States makes for a multitude of veto gates, often with contradictory goals and preferences. If one player or, alternatively, any number of players with identical preferences were in charge of issuing the more than two hundred licenses required to generate electricity in the United States, the number of steps would not necessarily imply long delays and uncertainty. Any proposal that survived the first step would not subsequently be stymied . This is basically the system in Japan, where all licenses are controlled by a single veto group -- the majority party. Only one gatekeeper need be satisfied for a proposal to go forward. Thus we find that the constant increasing trend of growth in nuclear capacity coincides with the continuance of LDP supremacy in the Diet. [16]

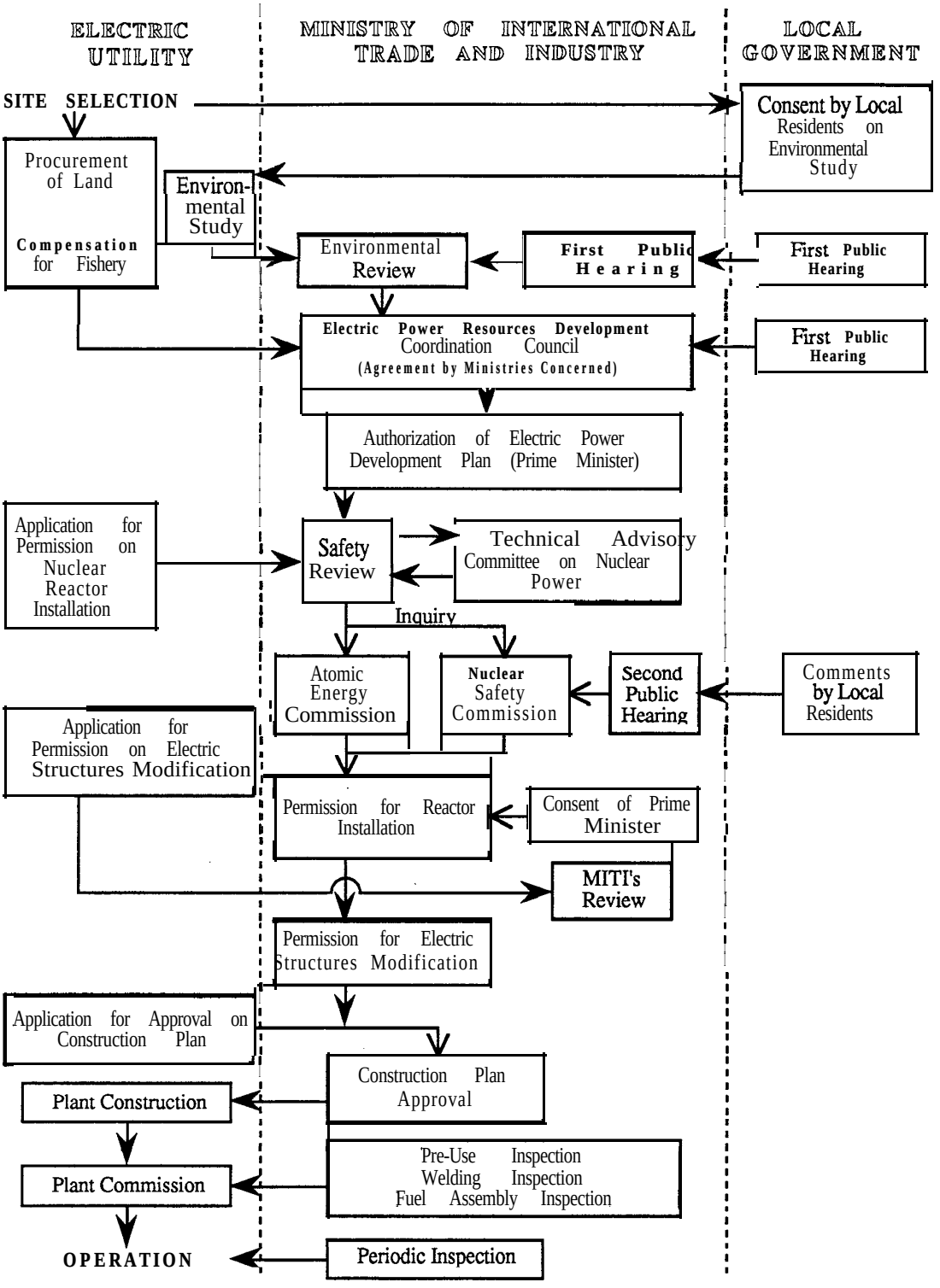
[16]. Additionally, almost all prefectures with nuclear power plants had LDP governors at the time of siting. Ultimately, though, the majority party in the Diet has the power simply to eliminate the prefectural governor's veto from the licensing process. Although other officials -- elected or not -- may have formal decision-making authority, all power under the constitution resides in the Diet. The same cannot be said about the U.S. House of Representatives.

Nuclear power plants are more attractive investments for Japanese utilities than for their American counterparts. This is unsurprising given the lower costs -- including subsidized financing, lower risk, a streamlined regulatory process, and a more favorable demand structure for electricity -- in Japan. All of these aspects of the cost-benefit analysis are endogenous to the political systems of the two countries, however. The Japanese and American governments decide what may be included in the rate and when, who will bear the risks, and whether to encourage or discourage demand. These governments are made up of a greater or smaller number of veto players, as determined by their respective constitutions, with more or less contradictory incentives. The divergence of policy with regard to nuclear power generation is the consequence of political choices made by actors in radically different institutional environments, and the decisions themselves are equilibria induced by those different structures.

Figure 1.

PROCEDURES FOR A NUCLEAR POWER PLANT

(FROM SITE SELECTION TO PLANT COMMISSION)



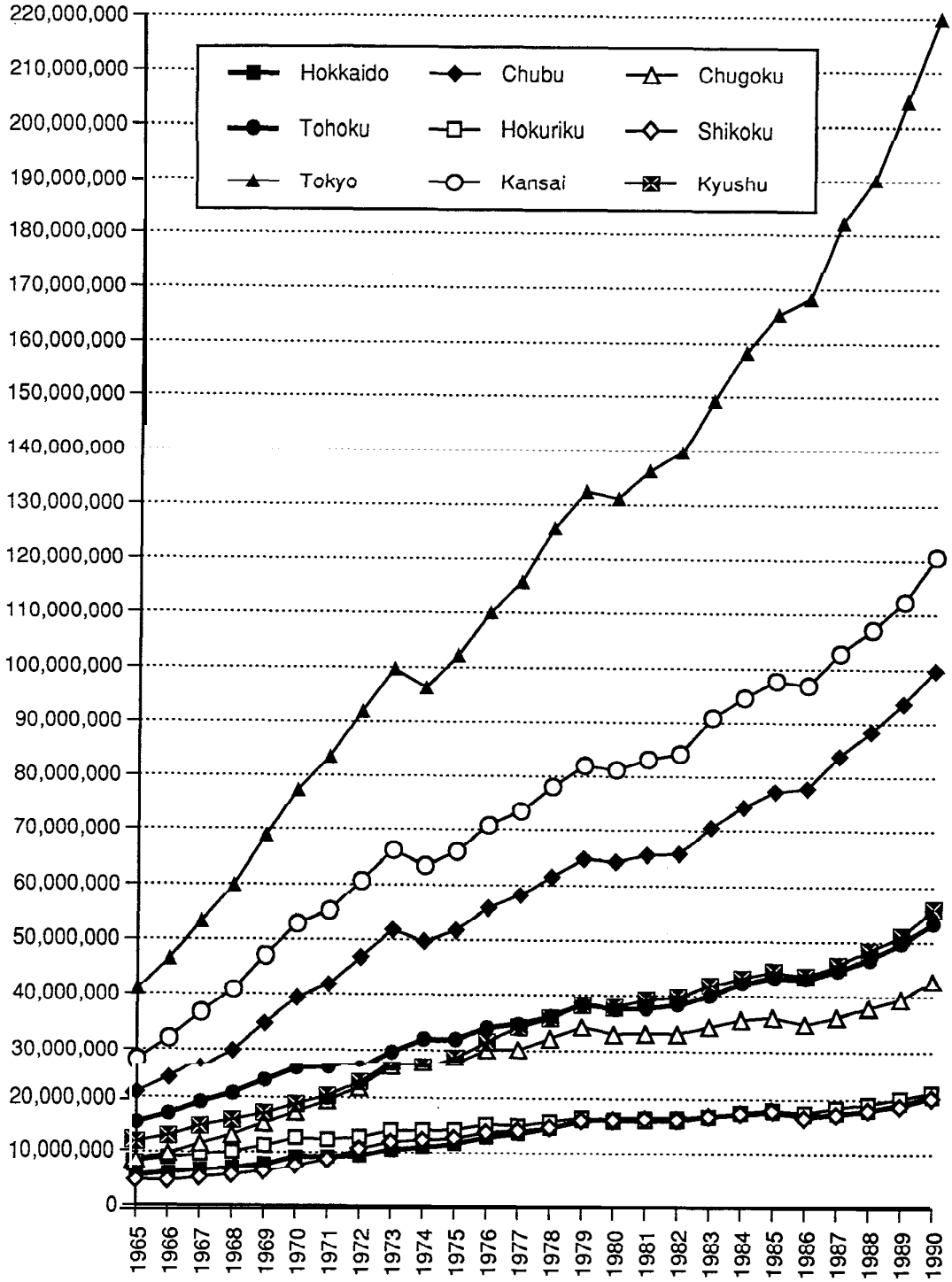


Figure 2.
Demand for Growth for Japanese Electric Utilities, 19651990.

Figure 3.

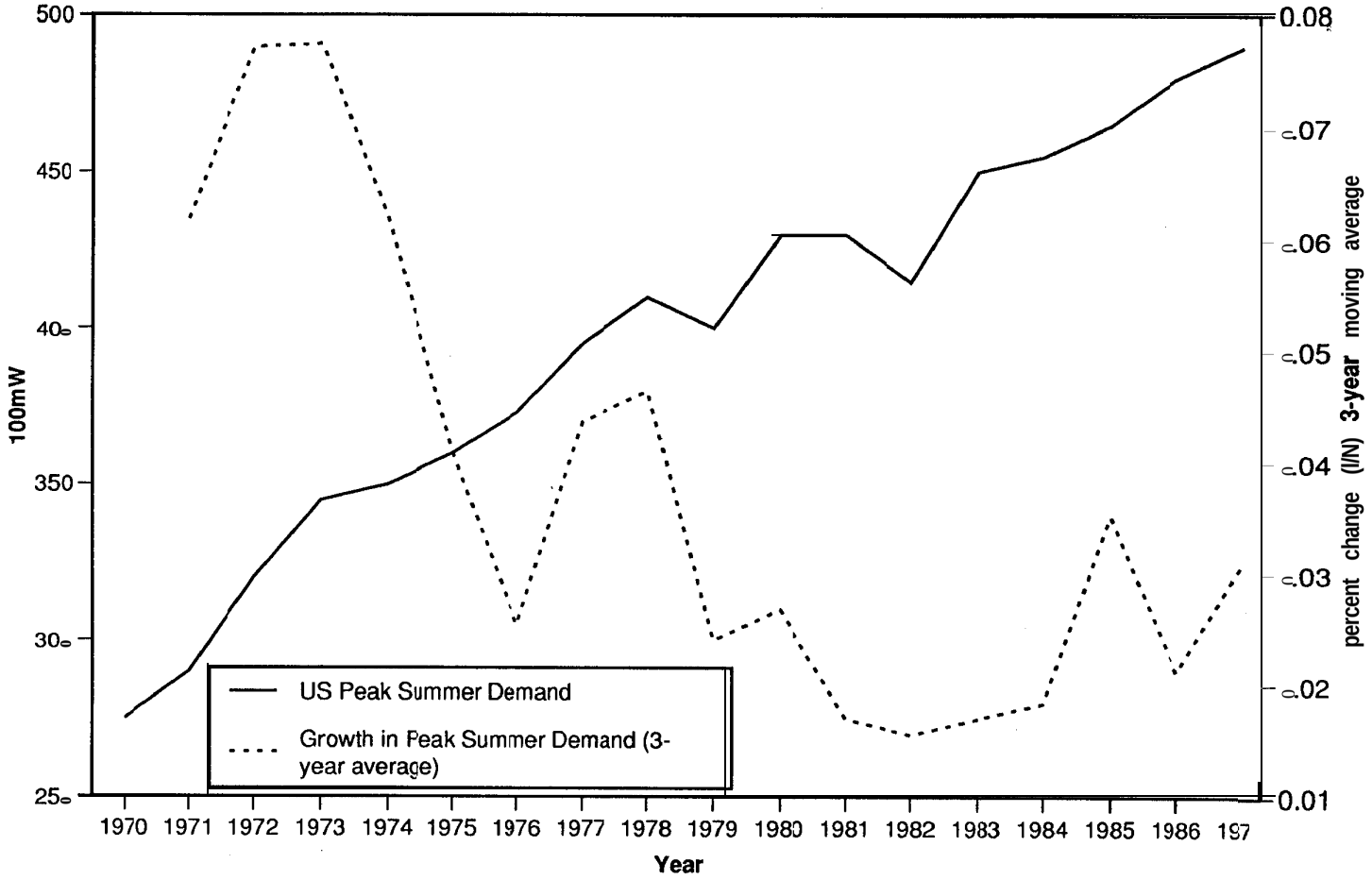

500
450
400
350
300
250
100mW
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
percent change (I/N) 3-year moving average
US Peak Summer Demand
Growth in Peak Summer Demand (3-year average)
1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 197
Year

Figure 4.
Comparison of Projected and Actual United States Peak Summer Demand for Electricity, 1978-1987.

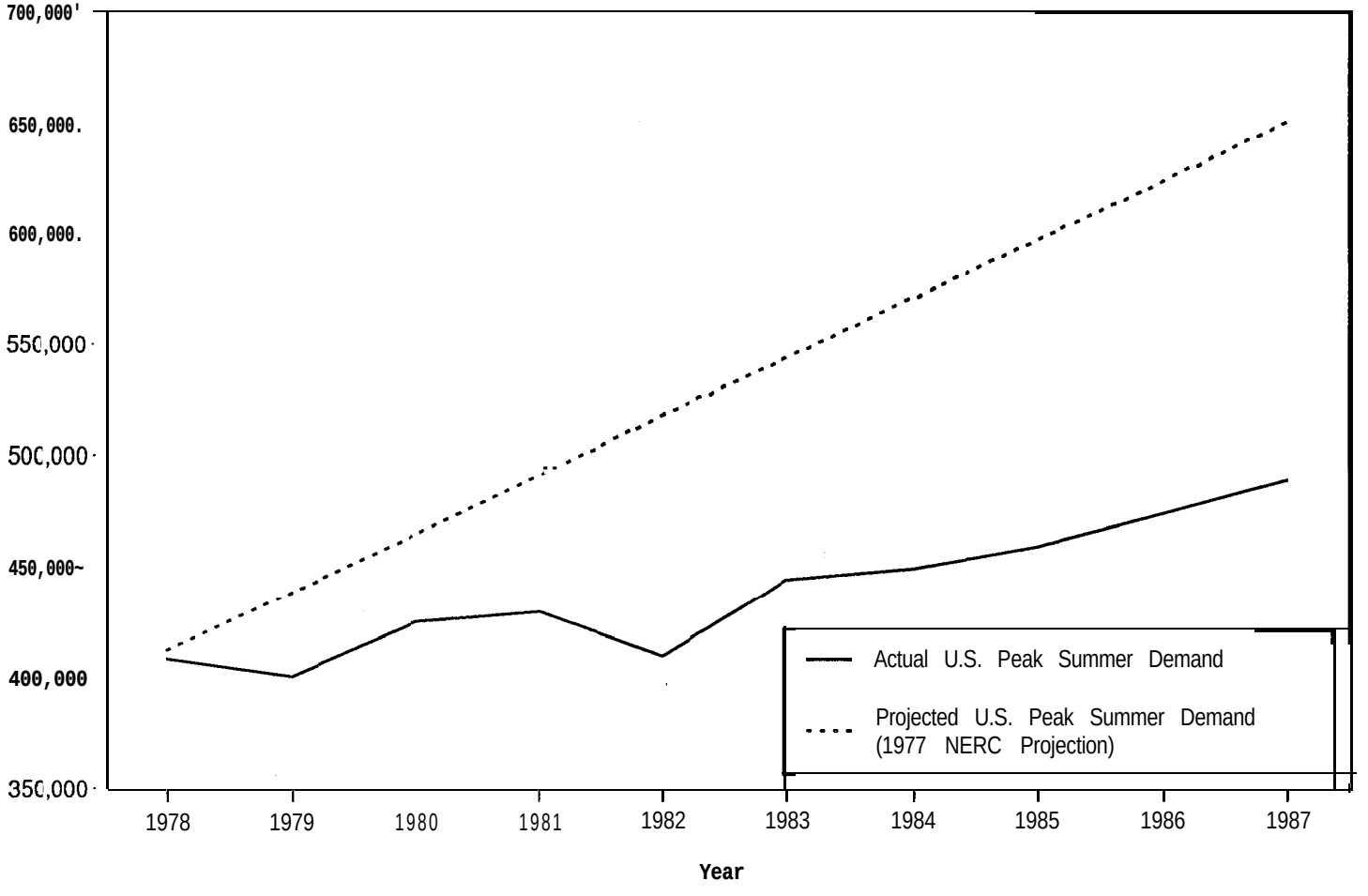


Figure 5.
United States Capacity Margins for Electricity, 1970-1987.

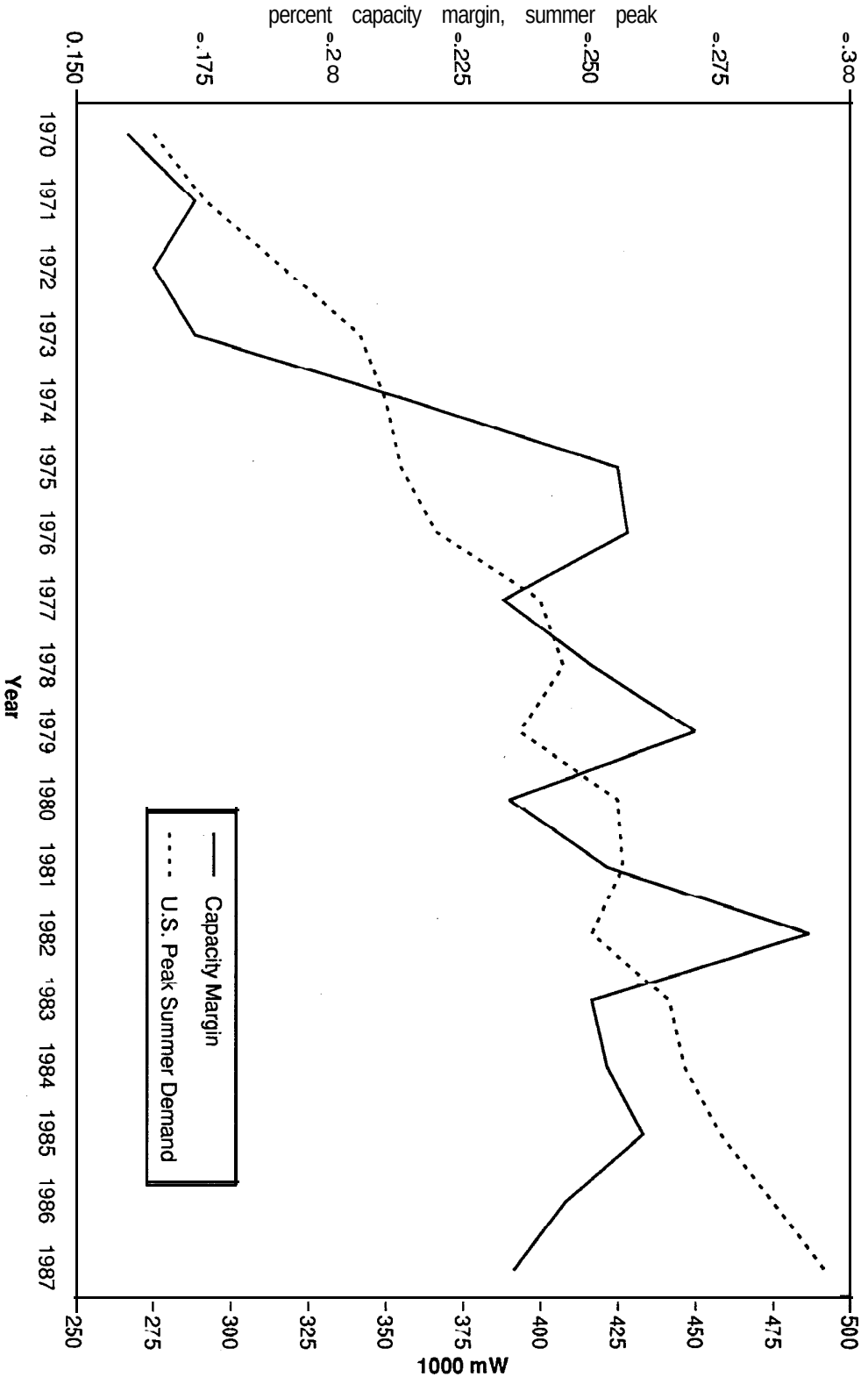
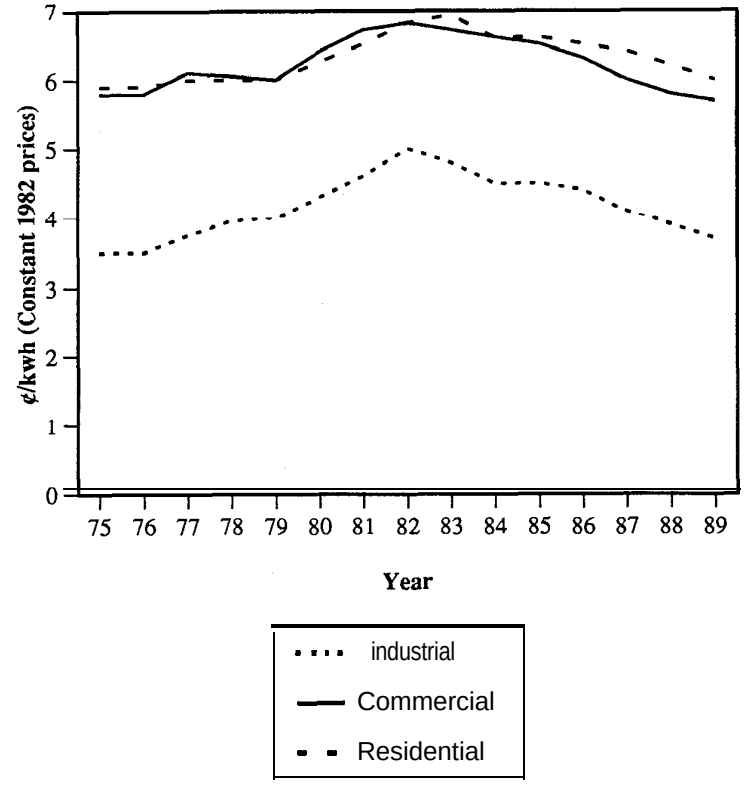
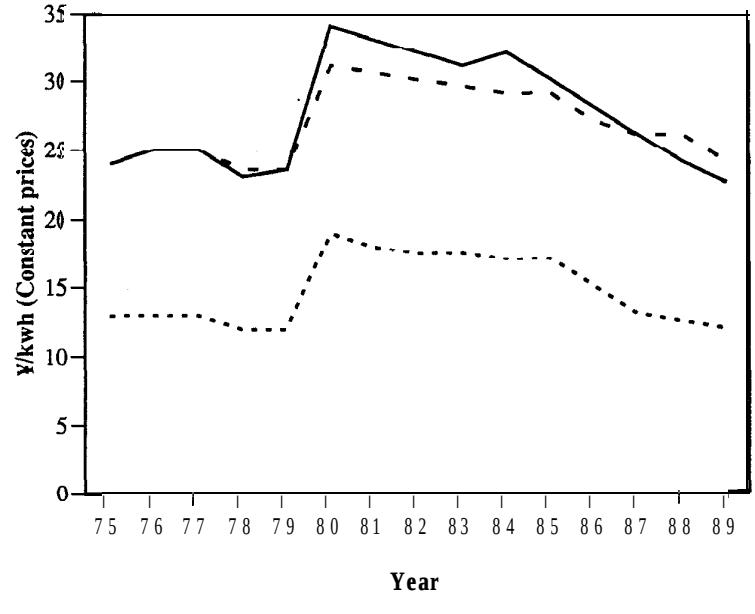


Figure 6.
Comparison of United States and Japanese Electricity Prices, 19751989.



U.S. average prices



Tokyo electric prices

REFERENCES

Burness, H., W. Montgomery, and J. Quirk. 1980. "The Turnkey Era in Nuclear Power." *Land Economics* 56(May 1980).

Cohen, Linda. 1978. *Essays on the Economics of Licensing Nuclear Power Plants.* Unpublished Ph.D. dissertation, California Institute of Technology.

Cohen, Linda. 1979. "Innovation and Atomic Energy: Nuclear Power Regulation, 1966-Present." *Law and Contemporary Problems 43: 67-97.*

Cohen, Linda, and Roger Noll. 1991. *The Technology Pork Barrel.* Washington: Brookings Institution.

Cox, Gary, and Richard McKelvey. 1984. "Ham Sandwich Theorems for General Measures." *Social Choice and Welfare* 1:75-83.

Donnelly, Michael. 199 1. "Japan's Nuclear Quest." Paper delivered at the Conference on **Japan's Foreign Policy, Grand** Cayman.

Eguchi, Yujiro. 1980. "Japanese Energy Policy." *International Affairs 3: 263-279.*

Fort, Rodney, and William Hallagan. 199 1. "Two Paths in the Woods: A Comparison of Public Policies toward Nuclear Power in the U.S. and Japan. Photocopy, Washington State University.

Goldman, Sachs and Co. 1982

Haley, John. **1978.** "The Myth of the Reluctant Litigant." *Journal of Japanese Studies 4 (2):* **359-390.**

Hammond, Thomas, and Gary Miller. 1987. "The Core of the Constitution." *American Political Science Review 8* 1: 1155-l 174.

Hinman, George, and Thomas Lowinger. 1987. "A Comparative Study of Japan and United States Nuclear Enterprise: Industry Structure and Construction Experience." *Energy Systems and Policy* 11: 205-229.

Japan Electric Power Information Centre. *1986. Nuclear Power in Japan.* Tokyo.

Japan Electricity Production Information Centre. 1988. *Electric Power Industry in Japan 1988.* **Tokyo.**

Joskow, Paul. 1974. "Inflation and Environmental Concern: Structural Change in the Process of Public Utility Price Regulation-" *Journal of Law and Economics (October):* 291-327.

Krauss, Ellis, and Bradford Simcock. 1980. "Citizens' Movements: The Growth and Impact of Environmental Protest in Japan." In Kurt Steiner, Ellis Krauss and Scott Flanagan, eds., *Political Opposition and Local Politics in Japan.* Princeton: Princeton University Press.

Kurihara, S., T. Kubokawa and S.R. Nakashima. 1982. "Japan's EIA Procedure for Nuclear Facilities." *EIA Review 3: 289-295.*

Ministry of International Trade and Industry. N.d. "Electricity Rate Regulation in Japan." Photocopy, Tokyo.

Lesbirel, Hayden. 1990. "Implementing Nuclear Energy Policy in Japan." *Energy Policy 4:* 267-282.

Marshall, John, and Peter Navarro. 1991. "Costs of Nuclear Power Plant Construction: Theory and Evidence." *RAND Journal of Economics 22:* 148-154.

McCubbins, Mathew D., and Frances McCall Roscnbluth. 1993. "Party Provision for Personal Politics: Dividing the Vote in Japan," in Cowhey, Peter, and Mathew D. McCubbins, eds. *Structure and Policy in Japan and the United States.* Cambridge: Cambridge University Press.

McKean, Margaret. *198* 1. *Environmental Protest and Citizen Politics in Japan.* Berkeley: University of California Press.

Montgomery, W., and J. Quirk. 1978. "Cost Escalation in Nuclear Power." Environmental Quality Laboratory Memo No. 2 1, California Institute of Technology.

Moraw, G., and A. Szeless. 1977. "Availability of Nuclear Power Plants in the World in 1976." Photocopy. Kernkraftwerke Planungsgeselschaft m.b.H., Vienna.

Navarro, Peter. 1988. "Comparative Energy Policy: The Economics of Nuclear Power in Japan and the United States." *Energy Journal 9:* l-l 5.

Navarro, Peter. 1989. "Creating and Destroying Comparative Advantage: The Role of Regulation in International Trade." *Journal of Comparative Economics 13 : 205-226.*

Ramseyer, J. Mark. 1985. "The Costs of the Consensual Myth: Anti-trust Enforcement and Institutional Barriers to Litigation in Japan." *Yale Law Journal 94: 604-645.*

Ramseyer, J. Mark. 1988. "Reluctant Litigant Revisited: Rationality and Disputes in Japan." *Journal of Japanese Studies* 14(1): 111-123.

Samuels, Richard. 1987. *The Business of the Japanese State: Energy Markets in Comparative and Historical Perspective.* Ithaca, N.Y.: Cornell University Press,

Suttmeier, Richard. 198 1. "The Japanese Nuclear Power Option: Technological Promise and Social Limitations." In Ronald Morse, ed., *The Politics of Japan's Energy Strategy.* Berkeley: Institute of East Asian Studies.

Tabusa, Keiko. 199 1. [title] Unpublished Ph.D. dissertation, Columbia University.

Trenkler, H. 1976. "Costs of Construction Time Extension in Nuclear Power Plants." Photocopy. Vereinignngen Deutscher Elektrizitatswerke, Frankfurt.

U.S. Department of Commerce, Bureau of the Census. 1991. *Statistical Abstract of the United States.* Washington.

U.S. Department of Energy, Energy Information Administration. *1980. Nuclear Power Regulation.* Energy Policy Study No. 10. Washington.

Upham, **Frank. 1987.** *Law and Social Change in Postwar Japan.* **Cambridge, Mass.: Harvard** University Press.

Weingast, Barry. 1980. "Congress, Regulation, and the Decline of Nuclear Power." *Public Policy 28: 23* l-255.

World Almanac and Book of Facts. 1992. New York: Pharos Books.

Young, Michael K. 1985. "Judicial Review of Administrative Guidance: Governmentally Encouraged Dispute Resolution in Japan." *Columbia Law Review 84: 923-983.*