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Government Credible Commitment to the French and American Nuclear Power Industries

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Abstract

Backlash against nuclear power, although widespread, affected nuclear power programs differently in the United States than in France owing to their differing institutional setups. This article uses a transaction costs economics approach to examine government credible commitment to the French and American nuclear power industries. Positive political theory sheds light on the comparative institutional environment in each industry. The American combination of fragmented power, little reliance on bureaucratic expertise, an independent judiciary, and opposing interest groups greatly undermines the ability of the U.S. government to credibly commit to the nuclear power industry. In France, despite substantial anti-nuclear interest groups, the impermeability of the institutional setup—no division of power, weak judiciary, and reliance on bureaucratic expertise—effectively prevents activists from influencing policy outcomes. © 2001 by the Association for Public Policy Analysis and Management.

INTRODUCTION

The American nuclear power industry declined rapidly beginning approximately in 1971 and culminating after the Three Mile Island (TMI) accident on 28 March 1979. What explains this turn of events? From the mid-1950s until the mid-1970s, the nuclear power industry in the United States built more nuclear power plants than any country in the world. U.S. utilities ordered 231 nuclear plants through 1974, but only 15 after that, and none at all after 1977 (Campbell, 1988; OTA, 1984); and, from 1970 to 1989, electric utilities canceled 134 nuclear units (CEA, 1994). These cancellations represent more than half the total previously ordered nuclear-generating capacity. In excess of \$15 billion had been spent on these units (Itteilag and Pavle, 1985). On the other hand, in France, whose nuclear power implementation has arguably been the most successful in the world, nuclear power has prospered for many years before and after TMI; only two French plants have ever been canceled. Nuclear power generates more than 75 percent of France's electricity, while it has never generated more than 20 percent of the United States'.

What accounts for this substantial variation? It is generally accepted that, between 1972 and 1982, high construction costs and declining electricity demand contributed

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to the decline of nuclear power in the United States (USDOE, 1983). But, are the decline in nuclear industry and the increase in costs to the industry also linked to the rise of anti-nuclear public opinion? How does public opinion interact with government structure to affect government's ability to credibly commit to certain industries? What, if any, aspects of the U.S. nuclear experience turned the tide against that industry, when similar opposition was present in many other countries—Japan, Sweden, France, the United Kingdom, Germany—which promoted nuclear power? Scholars (Hatch, 1986; Jasper, 1990; Joppke, 1993; Price, 1990; Schrader-Frechette, 1980) depict the importance of public opinion in impeding nuclear power, but with few exceptions (see Campbell, 1988, 1991), they offer scant explanation of the mechanics through which public opinion affects policy outcomes for industry. No attempt has been made to fit these outcomes into a systemic body of theory. While standard institutionalist treatment offers the important insight that institutional details matter, little in the way of coherent theory accompanies these observations (Barkenbus, 1984; Campbell, 1987, 1988; Rochlin and von Meier, 1994).

This paper asserts that licensing and construction costs in the nuclear industry may best be explained in terms of governments' ability to commit to industry.¹ The utility obtains the licenses to construct a nuclear power plant from regulatory bodies. Investment decisions that require huge sunk costs have to be made several years before starting the plant, and utilities are very sensitive to a regulatory body that can ease or complicate the process. In the United States, government's commitment was initially strong, but has been deteriorating over time, while in France, government's commitment has persisted over time.

What distinguishes the nuclear power industry from other industries? Why, for example, do the telecommunications or steel or consumer durables industries not experience similar problems? Nuclear power is highly controversial and provokes environmental activists and voters more than other issues (e.g., the specter of uncontrolled radiation).

The authors contend that an analysis of the differences in institutional environment attributes can further understanding of government's credible commitment to the industry. This paper begins that analysis by extending transaction costs economics (Williamson, 1985) to elucidate how differences between institutional environments induce changes in transaction costs. Positive political theory (PPT) is used to explain the differences in policy outcomes between France and the United States. While much of conventional analysis focuses on the "rules of the game," PPT explicitly moves that focus to the "game of the rules," the processes whereby policy is formed and changed (Bendor and Moe, 1985; Weingast, 1980). Weingast (1981) popularized PPT, a method that models rational political actors in a low- (often one-) dimensional space. The policy dimension examined here models the degree of preferences for or against nuclear energy.

MODELING CREDIBLE COMMITMENT

According to Williamson (1994) each national institutional environment originates shift parameters, changes that shift the comparative costs of governance of contractual relations. The focus here is on the uncertainty of government's behavior toward

¹ O. Williamson defined credible commitment as follows: "a contract in which a promisee is reliably compensated should the promisor prematurely terminate or otherwise alter the agreement. This should be contrasted with noncredible commitments, which are empty promises, and semicredibly commitments, in which there is a residual hazard. Credible commitments are pertinent to contracts in which one or both parties invest in specific assets" (Williamson, 1996, p. 377).

industry. In the case of nuclear power, a transaction is undertaken between a utility and a governmental regulatory body. This transaction should result in the utility eventually constructing and operating nuclear power plants under guidelines the regulatory body originated. For this discussion, the focus is mainly on transactions pertaining to construction and operating permit issuance in the nuclear power industry. The transaction between utility and regulator is highly asset-specific. Once the utility has decided to invest in a nuclear power plant it may not change to another regulatory body. Furthermore, a plant can neither be easily sold to another utility nor converted to another use. Operating licenses and construction permits are given to a utility, which has specific rights and responsibilities that may not be transferred to another company. Sunk costs comprise a large part of the total investment, specifically construction time (from 4 to 16 years) for a plant. During this period, regulatory changes can be sudden and retroactive. The credibility of a government's commitment to nuclear power projects is thus uncertain.

Credibility of government is vital to support non-redeployable investments. Uncertainty surrounding government credibility should increase transaction costs to the industry. Uncertainty affects the institutional environment's ability to credibly commit to industry (regulations change rapidly and unpredictably). The effects of this reverberate down to the level of the transaction by increasing industry transaction costs via construction delays and legal costs, among other problems.

Levy and Spiller (1994) highlight how the credibility and effectiveness of a regulatory framework—and hence its ability to facilitate private investment—vary with a country's political and social institutions. They submit that commitment is most credible in a democracy characterized by division of powers and an independent judiciary as opposed to a parliamentary system with a weak judiciary. Furthermore, the mechanisms of bureaucracy may operate in the service of stability and credibility. Conclusions of the research reported below differ for nuclear power because, in some cases, a weak judiciary and a lack of division of power may enhance credible government commitment to utilities.²

Figure 1 illustrates how Levy and Spiller's framework may be enhanced by considering opposed interest groups. Starting at the top of the figure, the differences between the United States and France are shown along Levy and Spiller's three critical dimensions:

- The division of power in France (a parliamentary system) is lacking compared with the United States (a constitutional system).
- Judicial independence in France is lacking (especially over nuclear power issues) compared with the United States (whose courts have a history of independence).
- In France, reliance on bureaucratic expertise in the technical issues of nuclear power is substantial. In the United States, input from multiple politically motivated sources is considered before technical decisions are made.

These facets of the institutional environment predict that credible commitment will be stronger in the United States than in France, which was true before the rise of activism in the United States. Before the 1970s, the U.S. system had the potential to let activists enter the game, however, the Levy and Spiller model does not explicitly

² The Levy and Spiller approach corresponds closely to North's framework (1990), wherein the institutional endowment of a nation can be described with five elements: legislative and executive institutions, judicial institutions, broadly accepted norms, the character of contending social interests within a society, and the administrative capabilities of the nation.

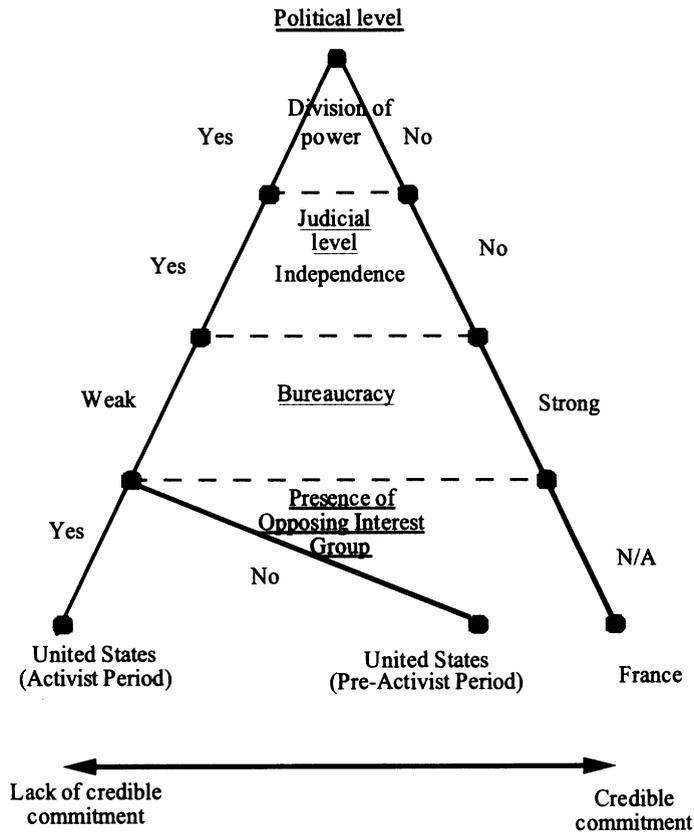


Figure 1. Institutional environment attributes, adapted from Levy and Spiller (1994).

treat the rise of activist voices in the United States. The adaptation in Figure 1 adds a branch that treats this contingency. The model now predicts credible commitment outcomes considering the influence of opposing interest groups. The American combination of strong division of power, weak bureaucracy, independent judiciary, and opposing interest groups greatly undermined the U.S. government’s ability to credibly commit to the nuclear power industry. In France, despite the substantial presence of anti-nuclear interest groups, the impermeability of the institutional setup (no division of power, weak judiciary, and strong bureaucracy) effectively prevented activists from influencing policy outcomes.

The model presented describes the situation in the United States and in France using the tools of PPT. PPT utilizes perfect information models to describe how political actors will behave given transaction costs and preference (utility) constraints (see Weingast, 1980). For the United States the model fuses two periods: pre-activist (pre-1971) and activist (post-1971). For France, the model remains constant over the two periods because the French situation remained unchanged over time (in particular the minimal access of interest groups to the judiciary persisted).

A Model for the United States³

The players identified in the model are: Congress (C), an Agency (A—the AEC [Atomic Energy Commission] and later the NRC [Nuclear Regulator Commission]), and a Judiciary (J). The U.S. legislative form has adopted a subcommittee structure that is quite open to changes in the composition of interest groups. In the United States, government moves with changes in the composition and importance of political demand-side elements. The U.S. version of representative government, compared with the French, is quite responsive. Consequently, across the two periods of the game, Congress changes its ideal point owing to changes in interest group composition (in the second period, activists enter as new players in addition to industry interest groups).

The model operates along a single dimension: degree of anti-nuclear policy outcomes.⁴ This model treats Congress as a unitary actor in order to avoid unnecessary complexity.⁵ The situations across the two time periods (pre-activist and activist) are shown in Figure 2. The order of play proceeds as follows:

1. The agency proposes a policy (A).
2. Congress oversees the agency and adjusts the policy to lie within its tolerable set of policies (surrounding Congress' ideal point, C).
3. Courts interpret compliance with congressional dictates and adjust the policy.
4. Congress reviews Court decisions.

In the first period, Congress' (pro-nuclear) ideal point C is surrounded by its set of

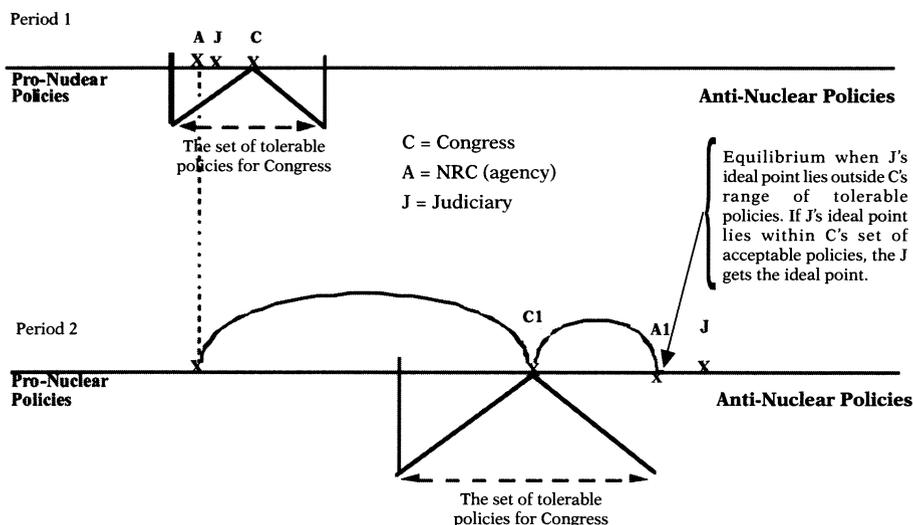


Figure 2. The game of the rules for nuclear power policy in the United States.

³ Our PPT model makes the following assumptions: actors seek to maximize their utility; preferences of actors in policy space are single-peaked; institutional setup and rules determine the order of play and which actors may exercise control over other actors' proposals for policy; preferences may be accurately modeled using a single dimension; and actors operate with constrained (finite) resources.

⁴ Policies toward the right of the spectrum are comparatively more anti-nuclear than those toward the left side.

⁵ Considering the Joint Committee on Atomic Energy (JCAE) and its power to propose legislation directly to the floor, this seems a reasonable approximation.

tolerable policies (Congress will not intervene in any policies falling within this set because its costs to do so are too high). The Agency has discretion within these limits set by Congress: It promotes nuclear power (initial agency position is A). The Judiciary, if its ideal point lies to the anti-nuclear side of C's preferred set, can move policy to the right edge of C's preferred set. J knows that Congress would overturn excessively anti-nuclear decisions. Structurally induced policy outcomes are possible within the limits set by Congress, but will occur at the right edge of C's policy set if J's ideal point is to the right of this point, or at J's ideal point if it lies within C's preferred set (shown). Policies are pro-nuclear: The industry prospers.

In the second period (activist), public opinion has shifted Congress toward a more anti-nuclear stand.⁶ Also, a previously unified Congress is now divided over the nuclear issue, resulting in wider court discretion (C's set of tolerable policies has expanded in width). Agency discretion is curtailed by its increased transaction costs. These costs are the result of increased congressional monitoring of the industry and the influx of information from anti-nuclear watchdog interest groups (who play a "fire-alarm" role). The agency cannot act to change policies within this new set of acceptable policies because these transaction costs are too high.

Existing policy (A—from the pre-activist period) no longer lies in the "oversight-proof" policy set of Congress. This results in policy being dragged to Congress' ideal point, C1. A liberalized Judiciary signals with some anti-nuclear decisions that its ideal point lies toward the anti-nuclear end of the policy space. Increased amounts of actionable legislation facilitate this. Interest groups respond aggressively to this invitation (precedential law acts in a signaling role for interest groups). If J's ideal point is outside the policy set acceptable to Congress, the policy outcome is forced to the right edge of C's policy set (A1—shown). If J's ideal point lies within C's set of acceptable policies, then J achieves its ideal point (not shown). Note that any policy outcome is more anti-nuclear than in the pre-activist period. J has free reign over policy within C's expanded and anti-nuclear-shifted policy set. Policies in the second period are comparatively anti-nuclear: the industry declines.

Taken together, increased numbers of rules and lawsuits increased transaction costs for the nuclear sector. This was precisely the strategic goal of the interest groups who brought suits to demand more and tighter regulation from an increasingly anti-nuclear Judiciary. From 1971 through 1979 (TMI) and the liberalization of the courts, the transaction costs of litigation for environmental groups went down. Simultaneously, uncertainty surrounding transaction costs incurred by industry to protect their large sunk investments rose precipitously. This was owing to opportunistic breach of prior regulatory commitment by regulators driven by Congress. Environmental groups were in a position to impose sufficient costs on industry (via the courts) such that the industry's economic viability became questionable. This uncertainty, in turn, raised the risk perceived by investors and substantially increased the cost of capital.

A Model for France

Turning to France, a different picture emerges (Figure 3): The order of play for France follows:

1. The President and ministries set policy.
2. Parliament "considers" the policy set in step 1.
3. The Judiciary reviews policy.
4. The President reviews policy for compliance with executive and ministerial objectives.

⁶ JCAE is dissolved and multiple committees bring nuclear issues under their jurisdiction.

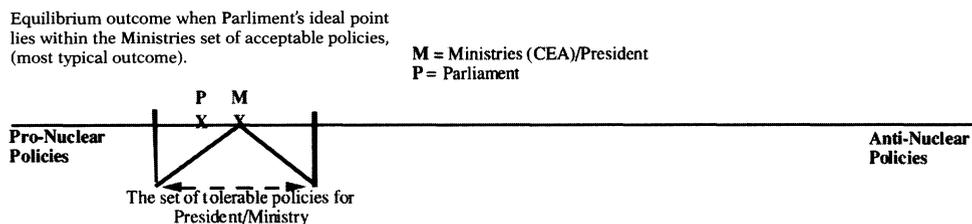


Figure 3. The game of the rules for nuclear power policy in France.

More specifically, the President gives general directions, such as “promote nuclear power aggressively,” and the Ministry sets and implements specific policy (the President and ministries are taken as a unitary actor owing to their same-party affiliations and the homogeneous backgrounds of members of both institutions). Parliament cooperatively passes legislation (often retroactive of policy implementation) that falls within the limits set by the Ministry; party discipline plays a key role in determining legislative behavior in France. Electoral rules in France are such that the high costs of getting elected or reelected are generally born by the party. Party discipline is usually strong across government branches and the Prime Minister may be considered as *de facto* working for the President. Strong party discipline in conjunction with the same parties in power in the executive and parliamentary branches suggests that conflict between the two branches is rare.

Policy outcomes lie within the acceptable policy set for the Ministry (M) if Parliament’s ideal point is in this set (Figure 3; Parliament achieves its ideal policy in this case). If Parliament’s ideal point lies outside the Ministry’s preferred set, then policy may be passed at the edge of the M’s preferred policy set. If members disregard warning signals and persist in passing policy outside the acceptable set for the Ministry/President, then the party can punish members for defection by withholding political rents (e.g., appointments, funding). Since members know this and wish to avoid party-imposed costs, they almost always cooperate with the Ministry/President. Parliament passes policies at an edge of M’s acceptable set when its views diverge from those of the President/Ministry.

Unlike in the United States, there is no access point to the Judiciary in France. This renders interest groups effectively powerless: The Judiciary is not a player in France. The model is thus static across the two periods despite the rise of anti-nuclear activism. The Judiciary (J) grants broad discretion to the Parliament because French courts cannot make laws, and if they did, the Parliament would overturn them (activists know this and few if any legal challenges are even begun). High judicial transaction costs enhance the discretion of other players. Thus, J cannot affect policy because the transaction costs are too high (e.g., rewriting the constitution to grant the courts unassailable independent authority).

The model portrays the American system as vulnerable to the rise of opposing interest groups, while the French system is comparatively impervious. This approach expands the applicability of the approach taken by Levy and Spiller (1994).

Evidence: The United States and France

Until the late 1970s, nuclear policy was largely a matter determined by governments mesmerized by the alchemy of nuclear innovation and the prospect of economic

prosperity based on technological progress. In the late 1970s the nuclear issue moved beyond its customary secretive decisionmaking into the sphere of open political conflict in most of the advanced nuclear countries. After the near-catastrophe at Three Mile Island in March 1979, it became clear that the nuclear industry was engaged in a struggle for survival. Concern about the risks to health and the environment were growing and spreading across the nuclear nations but in various forms. Although the date of TMI (March 1979) is a convenient marker to denote the demise of nuclear power in the United States, it is important to note that the decline of the nuclear industry actually began around 1971, when orders for plants fell off and environmental groups popularized the use of delaying tactics (a landmark lawsuit involved the Calvert Cliffs Nuclear Plant and the failure of its builders to consider the mandate of the National Environmental Policy Act (NEPA)).

By 1978, in the United States, 45 percent of the public opposed the construction of nuclear plants near their homes—an increase of 28 percent in 5 years (Rankin, Overcase, and Nealey, 1981). After the energy crisis, the U.S. anti-nuclear movement sharpened its political edge and went national. The best known of the groups are the Union of Concerned Scientists and the National Resources Defense Council. As Joppke (1993) observes, quoting Ralph Nader, “TMI brought an unparalleled mobilization peak for the U.S. anti-nuclear movement. Ralph Nader announced, in his typically strong words, that Three Mile Island would ‘be the beginning of the end of nuclear power in this country’” (p. 138) and called nuclear power “this country’s technological Vietnam” (Nader and Abbotts, 1977). The anti-nuclear movement sought to fully exploit the possibilities the American institutional context provided. Using the structures of federalism and the increasing involvement of the states in nuclear policy became a key strategy. Interest groups also employed the powerful strategy of directly attacking regulators by filing lawsuits for failure to ensure compliance (accusations of monitoring and policing lapses were common).

The French nuclear program has not gone without criticism. As in most other advanced industrialized democracies, by the early 1970s environmental concerns had begun to impinge on the French political agenda. Environmental groups had formed, such as the Friends of the Earth, Sociétés de Protection de la Nature, Comités de Defense de la Côte d’Azur, and Comités de Defense de Bretagne.⁷ By mid-1975, most important French newspapers, such as *Le Figaro*, had carried a series of articles discussing questions of radioactivity, the risk of nuclear accidents, the problems of nuclear waste, and the like. Protests sponsored by national, as well as local, anti-nuclear groups have multiplied since 1975. The largest and most violent was a demonstration against construction of the FBR Super-Phenix at Creys-Malville in June 1977. In France, support for nuclear power fell from 74 percent in 1974 to 47 percent in 1978 (Carmoy, 1982). France, despite protests at least as vehement as those in the United States and the existence of well-organized national interest groups, continued to experience growth in its use of nuclear power.

In the early 1980s, the United States abandoned pursuit of breeder reactor technology that uses a closed nuclear fuel cycle to burn waste into new fuel, while France completed a similar program and implemented a closed fuel cycle. The existence of such a fuel reprocessing capability may have mollified a skeptical French public and allayed its fears of waste-related accidents. Many thousands of people in France, however, indicated their extreme displeasure—100 injured and one killed—

⁷ Additionally, a group of university-based scientists, Groupement des Scientifiques pour l’Information sur l’Énergie Nucléaire (GSIEN), published materials between 1975 and 1977 discussing the dangers of nuclear power. Also, the pre-1981 Socialist party and two trade unions (notably CFDT—Confédération Française Démocratique du Travail—and CGT—Confédération Générale du Travail) were not favorably disposed to nuclear power plants owing primarily to questions about workers and safety.

during their protest against construction of a closed fuel cycle plant, the FBR Super-Phenix at Creys-Malville in June 1977. Possibly the perceived short-term, periodic threats to public safety represented by increased transport, handling, and processing which a closed cycle requires versus short-term storage, the U.S. alternative, were sufficient to concern many French citizens and activists. In fact the opposite occurs, so an explanation of policy outcomes should be sought elsewhere, namely the institutional setup.

Historical Context: The United States

The creation of the Atomic Energy Commission (AEC) as part of the Atomic Energy Act of 1954 represents the birth of U.S. efforts to commercially exploit nuclear power. The Defense Department had developed nuclear reactors for the Navy's fleet of nuclear submarines. Originally Congress' intent was to make nuclear power viable commercially by initially subsidizing basic research. The original Act failed to promulgate any interest in commercial power even in the mid-1950s because of the perception that an accident (and the accompanying unlimited liability of utilities) could financially ruin any firm responsible for the plant where the accident occurred (Weingast, 1980). In 1957 Congress addressed industry's resistance to participation in nuclear power by passing the Price-Anderson Act which limited utilities' liability to \$560 million, effectively transferring liability to the government (via taxpayers' wallets). This was the first and strongest indication of government credible commitment to the nuclear industry. The first commercially viable light water reactor (LWR), sold in 1963, signaled the beginning of commercial nuclear power in the United States. The AEC withdrew direct support of the industry in the late 1960s when it appeared that nuclear power was destined to become a major source of electricity for the foreseeable future. The 1954 Atomic Energy Act gave states control over economic aspects of nuclear power: land use, rate making, and demand assessment decisions. States later played an important role in providing access to policymaking for activists.

In the United States there were four major suppliers of nuclear steam supply systems (all private firms, e.g., General Electric), some dozen architect/engineering firms (e.g., Bechtel) designing plants, and 53 utilities involved in nuclear generating projects by 1982 (NRC, 1982). By 1994, 112 reactors in operation had been built by 55 utilities. Utilities placed orders for 20 plants in 1966 and 30 in 1967. For the 10 years preceding 1966, a total of 24 plants had been ordered (Weingast, 1980, p. 240).

Historical Context: France

In the early 1960s, based on a perceived shortage of enriched uranium, a need for weapons-grade materials, and the desire for energy independence from foreign states, France started exploration of a gas-cooled graphite-moderated reactor (GGR: gas-graphite reactor).⁸ Lacking other energy resource options, the goal of independence from other nations played a role in France's decision to promote nuclear power. This initial condition contrasts with the situation in the United States, where alternative energy sources allowed more flexibility. In 1955, three government organizations banded together to promote nuclear power; namely: Electricité de France (EDF—the state—

⁸ GGRs use natural uranium, not enriched uranium (as do LWRs). This allowed greater independence for France's nuclear power program because France at this time had no facilities for enriching uranium. Further, the need for plutonium for defense purposes was better met by the use of natural uranium in GGRs.

owned utility empowered by the Ministère de l'Industrie et des Finances), the Commissariat à l'Énergie Atomique (CEA—with a promotional mission parallel to America's AEC), and Production d'Électricité d'Origine Nucléaire (PEON—an advisory group to the CEA comprised of CEA, EDF, state, and industry representatives). The French nuclear industry is characterized by very few players and a high degree of state integration. Electricité de France (EDF) controls electricity production, electricity transmission, and end-user sales. The Commissariat à l'Énergie Atomique (CEA) administers research, controls all nuclear activities, and is 100 percent state owned. Cogema has a monopoly on fuel cycle processes and is 100 percent CEA owned. Framatome, the sole French manufacturer of nuclear steam supply systems, is state-owned.

Early GGR implementations manifested some serious technical flaws. By 1968, Westinghouse had moved into several European countries with its LWR technology, further reinforcing belief that GGRs were not exportable or even domestically exploitable (Jasper, 1990). Defense-related considerations had decreased in importance, and policy focused increasingly on meeting domestic energy needs. In 1969, French President Georges Pompidou announced the abandonment of GGRs in favor of LWRs. This was immediately followed by the announcement of licensing agreements between Compagnie Générale d'Électricité (CGE), a publicly owned French firm, and General Electric, as well as Framatome (a state-owned firm that in 1975 was awarded a monopoly over plant construction in France) and Westinghouse. The French nuclear strategy (Hatch, 1986, pp. 144–145) thus became one of co-optation of designs and know-how for a fixed period until independence from partners could be achieved.⁹ In 1975, EDF made a policy decision to focus solely on one reactor technology: pressurized water reactor (PWR).¹⁰ The French program is characterized by a high degree of central planning by the French government via six “contracts” (CP0, CP1, CP2, CP4, CP'4, and N4).¹¹ This French “fiat-like” approach to procurement contrasts with the American focus on market-based procurement and the resultant proliferation of multiple non-standard designs.

Fragmentation of Power in the United States

Before the 1970s and the rise of anti-nuclear activism, the American government was able to credibly commit to industry. Because of the division of powers and the independence of the judiciary, the U.S. institutional design guaranteed voice for a multiplicity of interests. The central problem of governance in the United States is related to the ability to pursue coherent and stable policies fashioned out of autonomous institutions (Chubb and Peterson, 1989). Within Congress, interest groups' access to legislators with differing policy preferences exacerbates the weak party discipline within this institution (Oleszek, 1984). Conflict and division of power at the federal level may invite opposing interest groups into the political forum. Additionally, the U.S. legislative form is characterized by a subcommittee structure

⁹ In the case of Framatome and Westinghouse, this occurred in 1982 when the license ran out and Westinghouse transferred its Framatome holdings back to the firm.

¹⁰ Subsequently the two BWR units at St. Laurent were canceled (the only reactor cancellations in the history of France's nuclear power program).

¹¹ In 1970, EDF authorized the construction of two PWR units, each of 900 MWe, at Fessenheim and four other units, each of 900 MWe, at Bugey (called the CP0 Contract). Taking into account the French trade deficit owing to the high price of oil, the French government decided in March 1974 to accelerate the nuclear equipment program. The first step was the launching of 18 units of 900 MWe between 1974 and 1975 (all came on line between 1980 and 1985—the CP1 contract).

open to competing interests, as well as vulnerable to changes in the composition of interest groups.

During the pre-activist period, power was concentrated in the hands of Congress, specifically, the Joint Committee on Atomic Energy (JCAE).¹² By 1977, the activist period, control over nuclear power policy had become highly fragmented:

[B]y the time the JCAE was officially disbanded in early 1977, more than a dozen committees in the House and Senate had gained some (oversight) over nuclear energy policy. Once the decentralization of authority had occurred, proposals to create a single House energy committee with concentrated authority were defeated. This proliferation of oversight is far more typical of the American political system than the centralized JCAE had been. (Jasper, 1990, pp. 191–192)

Policy formation was initially insulated and centralized within the Atomic Energy Commission (AEC) and the JCAE. Ambiguity as to who controlled nuclear power began in the 1970s when alternative interest groups from the political demand side began to affect the policy process. The rise of environmental groups brought changes in the relationship between Congress and the nuclear industry. First, the AEC was replaced by the NRC as the primary regulatory body. This was more than a change in name because Congress stripped the NRC of all promotional (pro-nuclear) responsibilities the AEC had previously held. Second, the congressional situation changed when the JCAE was abolished in 1977. In its place, two committees were given primary NRC oversight responsibilities—the Senate Environment and Public Works Committee and the House Interior and Insular Affairs Committee. In 1977, a variety of congressional committees contributed to regulatory policy not only by promulgating new legislation but also by controlling agency budgets (Barkenbus, 1984; Mitchell, 1981).

One might think that trouble at the federal level was sufficient to kill the nuclear industry in the United States. Power, however, was decentralized not just in Congress, but throughout the federal system, as state public utility commissions and legislatures nibbled away at federal authority. The states played a crucial role in bringing American nuclear energy to its knees. At the state and local level, the electoral system presented possibilities for engaging the nuclear policy process through referenda campaigns (Mitchell, 1981). Various states have, on their own initiative, taken measures to gain greater control over the deployment of nuclear power plants. Approximately half of the states now claim some authority over the siting of nuclear power reactors, and six states have adopted moratoria on further reactor development. A Supreme Court decision ruled that states can ban new power plants, provided the rationale is based on economic and not safety considerations (Barkenbus, 1984, p. 43). Given this power, the states acted. This tale shows how division of power (federalism in this case) interacts with the independent courts to cripple an industry.

Prudence and Independent Courts under Federalism

In the United States, the process of internal capital formation is strictly regulated by each state's public utility commission (PUC). Public utility regulation in the United States is designed to balance the costs to consumers on the one hand and the rate of

¹² Before 1975, JCAE acted as the sole overseer of nuclear regulatory activities. The President or the Executive Branch had relatively little effect upon nuclear regulatory policies in the 1960s because of the independence JCAE gave the AEC. The AEC was established by Congress as an "independent" regulatory agency, as opposed to a regulatory agency under the jurisdiction of the Executive.

return to shareholders on the other. A principal task of regulators is to set output prices that will achieve such a balance. The commission is responsible for establishing the price and, therefore, the profit rates for all electricity generated and sold by rival utilities within the state. The interests of public utilities and PUCs are in tension. But the main point is that the public is guaranteed access to the legal proceedings where these decisions are made, “a situation that often leads to heated political conflict among utilities, citizens, and regulators” (Campbell, 1985, p. 711). This situation has resulted in relatively small industry-retained earnings which are not sufficient to cover the construction of existing plants, let alone new plants.

Prudence reviews play a substantial role in PUC decisions regarding allowable rate structures. One of the most important rights granted to any electric utility is the right to pass on costs to the rate payer; prudence reviews have undermined these rights. In December 1992, the U.S. Supreme Court refused to review a finding by Louisiana Public Service Commission (LPSC) that a \$1.4 billion investment by Gulf State Utilities in its River Bend nuclear facility was imprudent.

The LPSC had found that Gulf States acted imprudently when it decided to restart construction at River Bend in February 1979 following the suspension of the project in 1977. The LPSC concluded that building a lignite (coal) plant represented a lower-cost option and that the company would have reached that conclusion if it had followed proper planning and forecasting procedures. (Studness, 1992, p. 28)

In addition to making clear the idea that establishing prudence was the obligation of the utility, one of the justifications given for the decision (upheld by the Louisiana Supreme Court) was that “Imprudence may be measured as the extent to which a utility fails to achieve optimality in retrospect, not on the extent to which it failed to exercise reasonable judgment” (p. 28). The discretion the courts afforded to PUCs in making policy that affects the ability of utilities to recover costs appears very wide. In one sense, the disallowance of cost recovery through prudence reviews may be interpreted as the PUCs “taking” of property (rights), a defense the courts seem unlikely to accept.¹³

More generally, less than 25 percent of investment capital was internally generated in 1972, down from 42 percent in 1965 (U.S. Senate, 1974, p. 462). Commissions began granting large rate increases in 1969, although at only about 60 percent of the amounts utilities requested (Gandara, 1977, p. 33). While commissioners recognized the utilities’ plight, they also worried that automatically increasing rates at a utility’s request would jeopardize their political legitimacy. The structure of the government system and protection of distributive payoffs (to rate-payers) appears to drive the states’ harsh attitudes toward nuclear power. The penetrability of the U.S. federalist system by public interest groups was largely responsible for the undoing of full-cost recovery rate-setting. The Nuclear Energy Agency (NEA, 1984, p. 13) remarks, “In the United States, the regulation of prices by the state Public Utility Commissions has discouraged large-scale capital investment and created the phenomenon of rate-shock by delaying capital cost recovery on new investments until the plants entered production.”

The Concentration of French Power

In parliamentary systems such as France, the Executive branch plays a comparatively greater role in the formulation of new legislation. Since the government controls the

¹³ This places utilities firmly at the mercy of state-level regulators, who are appointed by the governor of a given state. Governors have strong incentives to appoint public utilities commissioners who will act in the interests of voters’ wallets.

majority of legislative seats, policies originating in the Parliament must meet the approval of the leaders of the Executive branch, even if the policy does not begin as part of the government's agenda. This lack of division of power suggests that the Parliament and President may be treated as a unitary actor. How French Parliament plays the game is discussed by Hatch (1986, pp. 150, 152–154), who observes regarding policy in France:

[P]olicymaking was carried out by abdicating significant power to the bureaucracy.¹⁴ Policymaking among officials took place almost entirely among technocrats and the administration and managers of public enterprises. Parliament was hardly consulted except to approve plans...Throughout the 1970s, Parliament has remained far removed from the conduct of energy policy. The government's energy program wasn't even brought before the National Assembly until May 1975, where a perfunctory debate ensued...The regulatory arena is characterized by low visibility and the dominance of highly technical procedures, necessitating the involvement of experts and minimizing the role of lay citizens.

Hatch's description of the phenomenon of abdication of power by Parliament is on target, but his analysis does not take into account the explanatory power of party discipline. There is no individual member choice in the Parliament, and the deputies must obey party discipline or lose valuable resources needed to enhance their chances of re-election. Additionally, the use of presidential "*décrets*" points out the formal mechanisms by which, in French government, the Executive, acting in concert with the bureaucracy (ministries), by-passes Parliament. A decree, or *décret*, is a regulation decision from the government or the President, which may be issued without consulting Parliament.

Initial Strength, Subsequent Weakness: The U.S. Bureaucracy

Initially in the United States relationships among government actors were tight. The American institutional setup, however, allows changes the French setup does not. In the United States, nuclear policy in the 1960s was primarily the result of the interaction of three groups: the nuclear/electric industry, the AEC, and the congressional JCAE. The AEC was created with a dual mission. Congress directed the AEC not only to promote nuclear power, but also to promote the health and safety of the public. AEC was responding to the wishes of its key political overseer—Congress—and its desire to rapidly develop atomic energy for civilian purposes. Moreover, according to Senator Abraham Ribicoff, the development of the industry was controlled by the same groups that were chartered to regulate it. Just where the AEC began and industry left off was an open question (Walker, 1981). Nuclear power was typical of other highly technical and specialized issue areas where centralized policies were essentially the province of the regulators, the regulated industry, and JCAE. The policies emanating from this political environment fostered the growth of the nuclear industry and led to ambitious plans for the construction of nuclear power plants.

Enduring Bureaucratic Strength in France

In France, specialized expertise is considered a prerequisite to participate in policy discussions. The individuals involved in the consultation process often have years of experience consulting with each other. Interest groups lack the expertise and government experience to be credible sources of input for policymaking. The French

¹⁴ Using PPT "abdicating" power can be described as granting of policy discretion.

bureaucracy and the executive work so closely together that it is not unreasonable to treat them as a unitary actor. Practically, the only way that the citizens can influence a policy is through the election of members to Parliament, which is to say minimally. The President controls nuclear policy, partly for national security reasons. The basic enabling law for nuclear energy is the "Decree of 11 December 1963." On 19 February 1990, a décret reconfirmed the instructions regarding nuclear power plants. According to Dac (1994, pp. 31, 47–48):

The statute of the French civil nuclear law implies the evacuation of any legislative debate on the exact contours of the juridical regime of atomic energy development. Its origin is essentially executive and the rules are made under the quasi-monopoly of the executive on the three main domains of nuclear regulation: the definition of the main options of the nuclear politics, the evolution of the public energy sector with CEA and EDF, and the determination of sites for the nuclear power plants.... The French nuclear policy has been elaborated by the authority mode. Décrets, restraints ministers councils, and presidential declarations have engaged France, without any real discussion.

A centralized, insulated policy apparatus facilitated consistent nuclear policy formation in France from the outset of the 1940s. For policy formation, Commission Consultative pour la Production d'Electricité d'Origine Nucléaire (PEON) established reactor ordering goals, and coordinated all facets of nuclear policy. The committee reported to the Prime Minister and the members were drawn from the highest echelons of the administration, and industry; the government appointed them. EDF had a very influential role in PEON, especially for the choice of nuclear reactor type. Although PEON was disbanded in 1981 after the Socialists came into power, a small cadre of administrators retained control of nuclear policymaking. Citizens, environmentalists, and anti-nuclear groups had virtually no access to this policymaking forum.

The same has been true for policy implementation, particularly during licensing. The CEA was not required to publish safety studies for each proposed plan as the NRC was in the United States. Although the law mandated public inquiries during licensing, these did not involve hearings or other opportunities for critics, such as local officials, to present oral objections, ask questions, or request information. Instead, the federal government's local representative simply collected the public's written comments about the license application, reviewed them, and made licensing recommendations to the authorities. Because these "representatives" were bureaucratic appointees of the central government, not independent political actors, these officials did not challenge national nuclear policy (Barkenbus, 1984). It is not surprising, then, that the government never rejected a licensing request despite citizens' vigorous opposition.

The U.S. Judiciary: From Non-involvement to Facilitating Decline

In the United States, the rise of anti-nuclear interest groups was facilitated by the independent and highly accessible Judiciary. This exacerbated the decline of the U.S. nuclear power industry by undermining the feasibility of credible government commitment to industry. Industry players suddenly faced opponents made strong and viable via the courts, which can strike down agency rules and regulation. The Judiciary in the United States is independent and became liberalized in the middle of the 1970s. Increased amounts of actionable legislation effectively shifted the Judiciary toward an anti-nuclear policy. In addition to shifts in congressional preferences, the Judiciary was liberalized via 35 new liberal appellate court appointments Jimmy Carter made near the end of his term (in 1979).¹⁵ More liberal courts, as well as the increase in the number of available grounds on which to bring suit (starting with the National

¹⁵ Also, agency decisions were generally reviewed by the D.C. Circuit Court of Appeals, a reputedly liberal and hence anti-nuclear institution.

Environmental Policy Act of 1969), signaled activists that the door was open and they were being invited in.¹⁶ Given Congress' new skepticism regarding nuclear power, the invitation of activists into the regulatory arena may have served Congress as a series of "fire alarms," thus lowering their monitoring and policing costs.¹⁷

Table 1 illustrates the change in number of cases brought to the Judiciary over time, which suggests that environmentalists perceived this change across the time periods and acted to bring more lawsuits against the NRC. Additionally, the table shows the proliferation of rulemaking and other formal regulatory action, which provided additional "fodder" upon which activists might base legal (procedural) objections. The response of the NRC (and Congress) was to create more rules and regulations to avoid further lawsuits. This vicious cycle of legal challenge, promulgating regulations, legal challenge, etc., led to serious performance problems in the NRC (see Jasper, 1990, pp. 210–211).

Prior to 1975, the Atomic Energy Act of 1954, as amended, was the authoritative source of statutes governing nuclear energy. JCAE was the sole source of regulations and oversight for the AEC within Congress. In addition to the NRC, other administrative agencies exercising control over nuclear policy currently include the Environmental Protection Agency and the Departments of Energy, Justice, Transportation, and Defense. By 1991, activists had used more than 19 acts to affect the state of nuclear power in the United States (NEA, 1991, p. 131).¹⁸

Table 1. Caseloads and regulations in the United States.

<i>Year</i>	<i>Judicial Cases/year*</i>	<i>New Rules & Regulations—Cumulative**</i>
1975	15	20
1976	34	62
1977	41	127
1978	50	187
1979	57	240
1980	59	312
1981	70	392
1982	83	474
1983	21	535

Source: Nuclear Regulatory Commission Annual Reports, 1975–1983. *Suits brought against NRC, mostly for failing to follow procedural requirements regarding safety and siting decisions (NRC, 1975–1982). Includes pending cases. **Proposed rules are counted in these totals because the industry had to expend resources in evaluating and commenting on proposed rules.

¹⁶ The notion of structural change in the institution of the Judiciary is compatible with Kagan's (1988, p. 737) assertion regarding adversarial legalism and the tendency for the United States to be litigation-happy.

¹⁷ The activists absorbed policing costs somewhat, as they pursued legal action against utilities and agencies. This is a bonus for Congress in the form of usual decreasing of congressional monitoring or information costs when fire alarms are in place.

¹⁸ These include: National Environmental Policy Act of 1969, Resource Conservation Recovery Act (RCRA) of 1976, Toxic Substances Control Act, Clean Air Act of 1977, Uranium Mill Tailings Radiation Control Act of 1978, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, West Valley Demonstration Project Act of 1980, Nuclear Waste Policy Act of 1982, Low-Level Radioactive Waste Policy Amendments Act of 1985, Coastal Zone Management Act, Endangered Species Act, Federal Advisory Committee Act, Federal Water Pollution Control Act, Freedom of Information Act, Government in the Sunshine Act, Privacy Act, Wild and Scenic Rivers Act, Administrative Procedures Act, National Historic Preservation Act. Though not all acts mentioned nuclear power specifically (many did), subsequent judicial interpretations of acts and the use of acts to enhance access to the judicial system have expanded the scope of many of the acts mentioned above as pertaining in important ways to nuclear power. Consider the Freedom of Information Act, which, though very general in its scope, provided a tool for environmental activists to access previously unavailable information regarding safety assessments of particular nuclear sites. This information has subsequently been used in many lawsuits against NRC to mount procedural challenges under APA.

The institutional setup at the level of the states and the federal government provided opportunities for anti-nuclear groups to obstruct the policy process via the courts. Local safety and licensing boards operated by the AEC, courts, utility commissions, and generic rulemaking hearings at the national level all provided institutional points of access for citizens trying to influence nuclear policy. This exacerbated the licensing, regulatory, and plant cost problems by increasing the cost of capital, lost operating revenues, and direct production costs (of compliance with new and changed regulations).

NRC (1975–1982) describes no fewer than six formal access points that permit public participation in decisionmaking regarding nuclear power during the licensing and construction process. These are often in the form of hearings. After “interested parties” attend hearings, they are permitted to assert that despite their participation, their arguments have gone unheeded, which constitutes grounds for subsequent procedural lawsuits (not so in France). Any irregularity (perceived, real, or simply claimed) forms the basis of a legal challenge under the above-mentioned statutes. The activist strategy of fomenting delay to increase utility costs fits perfectly into this institutional arrangement.

The French Judiciary: Not a Relevant Player

The French system permits one point of public access early in the process of licensing for construction, at a hearing considering siting decisions, but “(i)n most cases inquiries are held even before the application for a license to set up an installation is filed” (NEA, 1991, p. 40). This permits the utility (EDF) to strategically search for multiple suitable sites, selecting on the basis of the least resistance encountered.¹⁹ According to Hatch (1986, pp. 158–159), public access to nuclear policy (particularly licensing decisions) is very limited:

[A]ttempts by anti-nuclear groups to appeal the granting of certain construction permits have proved uniformly unsuccessful. There have been only two instances of administrative courts suspending construction permits—Flamanville, where several irregularities in the licensing process were discovered, and Belleville-sur-Loire, where the environmental protection report was ruled unsatisfactory. The only avenue of appeal, however, leads directly to the Conseil d’Etat, which in both cases lifted the construction stops in three to six months.

Aside from purely regulatory processes, French national nuclear policy has seldom faced challenges either from the courts or prefectures (subnational government units). The French courts have not been sympathetic toward intervenor challenges, since the courts are seen as defenders of the state or nation, rather than protectors of individual rights (Nelkin and Pollak, 1981, pp. 155–156). France has a long history of eschewing judicial involvement in affairs of administrative policy. As Henry Abraham (1980, p. 272) states:

Fearful that the ordinary courts might interfere with the administrative or executive branch of government, the legislative bodies of France, dating all the way back to the days of the revolution, wrote into laws and constitutions specific provisions that expressly forbade judicial bodies to intervene.... That of August 16–24, 1790 spelled out the matter more clearly: “The judicial functions are and will remain forever separate from the administra-

¹⁹ Government-mandated procedures in the United States are too burdensome to permit simultaneous consideration of more than one site at a time. Utilities bet on the suitability of one site per plant, increasing the commitment necessary in early stages of planning.

tive functions. The judges will not be allowed, under penalty of forfeiture, to disturb in any manner whatsoever, the activities of the administrative corps, nor to summon before them administrators, concerning their functions."

Though procedural challenges are possible in France, in reality, ministries are given much leeway as to how best to implement policy, which greatly diminishes the ability of plaintiffs to pursue legal challenges. The inability of judges to create law based on precedents of other judges exacerbates this situation. In fact, judges are forbidden to make law at all: "The role of the courts is to solve disputes that are brought before them, not to make laws or regulations" (David, 1972, p. 180). In France, the ability of interest groups to challenge administrative action is severely limited to the point of virtual inaccessibility to the judiciary.

Norms

North (1990) and Levy and Spiller (1994) also discuss the importance of norms in determining the effect of institutions on policy. The values the individuals share in an institution have an important role in shaping the rules of the game. In France, most officials central to the formulation and implementation of energy policy (as in state-owned companies like EDF) come from the administrative elite. Made up exclusively of members from the *Grands Corps*, it is an elite group unified by a common educational background, career horizons, and corporate interests.²⁰ Out of this *milieu* has emerged a distinctive view of the state (Hatch, 1986, p. 10):

The higher civil servants see themselves as representing the general interest. The *hauts fonctionnaires* act for the State and the State acts for the general interest. If their conception of what the general interest demands happens to clash with the views of some other groups, their job is to act, if need be, over the objection of that group.

These interests when applied to energy policy have found expression in a strong commitment to national energy independence, with nuclear power assigned a vital role in its maintenance. The existence of members of the *Grands Corps* in all the administrative bodies of the French bureaucracy in charge of the nuclear question permits a certain esprit de corps to overcome potential conflict inside the government or between the government and the nuclear industry. They have been unified in their response to criticism and opposition from outside groups. The situation is reversed in the United States, as the elite is not so unified, and many other sources of energy were available. Bupp (1979) reflects that American political institutions are set up for conflict resolution and promotion of diverse interests, including minority interests; American institutions are not designed to foster efficient allocation of resources.

Transaction Costs

In the words of Weingast (1980, p. 241): "Lengthening the regulatory process increases the capital costs of the plant by pushing the revenue received from operation further into the future and by adding to the total interest payments on construction loans." Weingast (1981) estimates that the cost per kW for U.S. plants increased dramatically from 1965 to 1975. Although inflation and the competitive cost of coal are certainly partially responsible for the rise in costs of nuclear power, these elements do not

²⁰ Membership in the *Grands Corps* is restricted to the graduates of either the Ecole Polytechnique (Corps des Mines, Corps des Ponts et Chaussées) or ENA (Inspection des Finances, Cour des Comptes, Conseil d'Etat).

refelct the complete picture. Procedural delay (often purposely fomented by public interest groups) and increasing costs of compliance with safety and environmental standards (also fomented by interest groups) played a significant role in increasing costs associated with new plant construction.

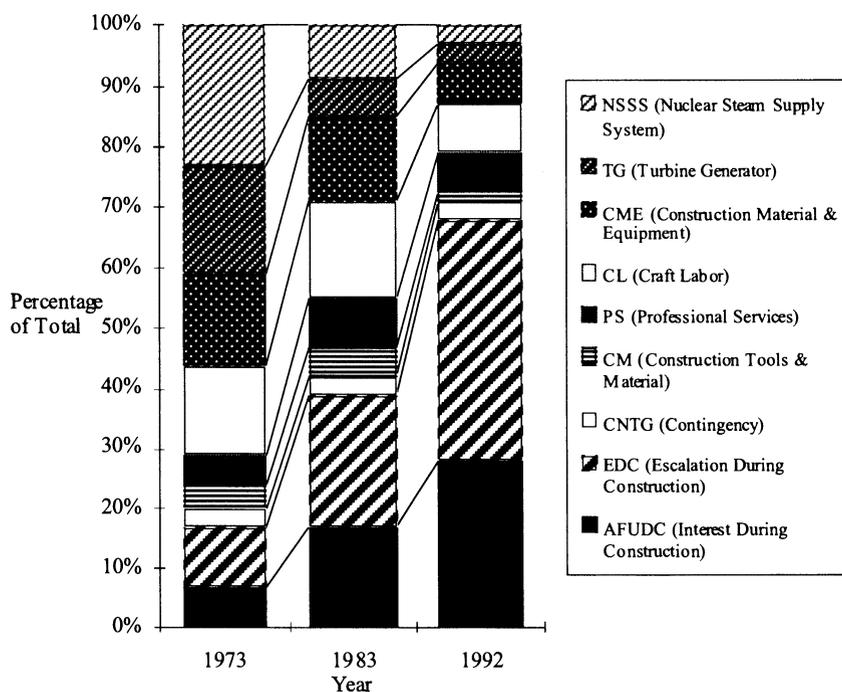
In the United States, from 1966 to 1970, the time required to complete the regulatory process rose from an average of 86 months to 122 months, an increase of 42 percent (Weingast, 1980). This early escalation of delays resulted in substantially higher costs for utilities in the form of the cost of capital. This trend was to continue well into the 1970s and become exacerbated by the effects of increased public doubt about the appropriateness of nuclear power. Campbell (1988, p. 158) gives a comparative look at average construction delays across a 10-year period, 1974 to 1984. During this period, the United States experienced average delays in plant construction of 33.9 months more than France did—the average French delay per plant was 5.5 months (calculated from Campbell, 1988, p. 41). From 1956 to 1979, in the United States, the average review time for construction permits grew by a factor of 4 (approximately), and the average review period for operating licenses (first issue: 1959) grew by a factor of roughly 4.5 (CEA, 1994). More comparatively, the average lead times for plants (from order to commercial operation) in both France and the United States increased from 1954 through 1979, from 2 to 6 years in France, and from just over 3 years to almost 13 years in the United States (CEA, 1994). The French program is characterized by more stability in lead times than that of the United States. For a similar period, regarding the time elapsed from the order of nuclear steam supply systems to the beginning of construction, CEA (1994) reports that delays in the United States increase over time while the French situation remains comparatively stable. Delays in France never exceeded 2 years, while delays in the United States ran as long as 4 years (in 1972).

The industry's heyday as the preeminent purchaser of regulation from Congress was clearly over; anti-nuclear groups were in the ascendancy. One possibility for industry salvation might have been consolidation and subsequent plant standardization. The utilities did not achieve sector integration because of a legal framework in the United States that mandated antitrust review. They tried, however, to reduce safety monitoring costs and to coordinate their knowledge through different associations. The Institute for Nuclear Power Operations (INPO), an association of all nuclear utilities and some suppliers, was formed to correct problems in utility management, construction, and quality-assurance practices. INPO formed a monitoring arrangement with the NRC, through a formal "memorandum of understanding" where they coordinated research efforts and exchanged information with each other (Campbell, 1991). This can be viewed as an industry attempt to self-regulate. The unfeasibility of adjusting governance of the industry under the U.S. institutional environment also played a role in the decline of the industry. Governance adaptation was effectively frozen between anti-trust law and activist court actions, which seemed to be sensitized to any action the industry might take to help foster a recovery.

Empirically, the evidence suggests that higher transaction costs for nuclear power are strongly correlated with the decline of the industry in the United States. Melicher and colleagues (1987) find evidence that total stock returns were lower in recent years for nuclear utilities than for non-nuclear utilities. Chen and colleagues (1987) find an association between U.S. nuclear power plant cancellations and positive share price reaction. NEA (1984, p. 46) gives the most direct estimate of transaction costs, asserting that in 1987, the cost in constant dollars per kWe in interest charges in the United States was \$296, while in France

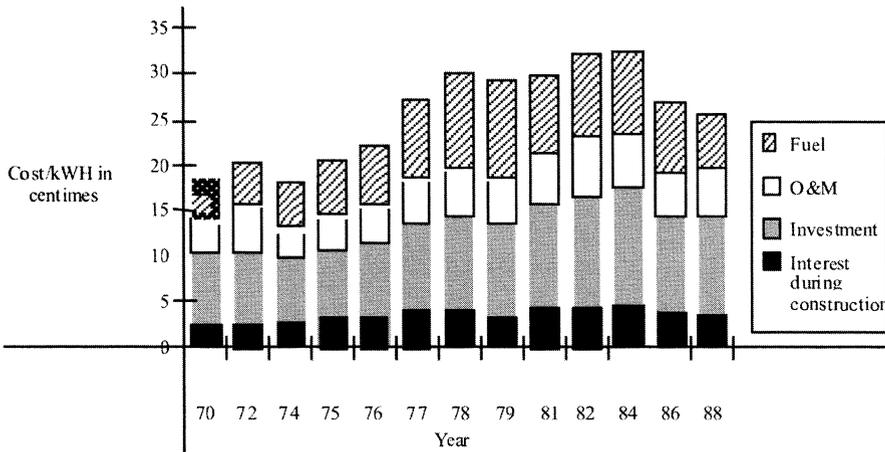
the same cost, at \$171, was 42 percent less. As shown in Figure 4, the interest during construction has been rising continuously in the United States, from less than 10 percent of the investment costs in 1973, to 30 percent in 1992. In France, on the contrary, interest during construction, as a fraction of entire investment has remained constant during 1970–1976 at less than 25 percent of the total investment cost and subsequently has even decreased (Figure 5). There is compelling evidence for the assertion that the French approach to capital provision is comparatively more efficient; EDF recently signed a deal with the French government to reduce its prices and reduce its debt, while investing 20 percent more in its distribution systems (Energy Market Report, 1993). In contrast, U.S. utilities have often raised prices and defaulted on debt.

Delay engendered by the open nature of the state and federal regulatory systems in the United States increased transaction costs by raising the amount of interest owed on borrowed capital, decreasing operating revenues, and increasing the costs of compliance with arrays of new rules and regulations. The U.S. nuclear industry has incurred huge indirect costs (costs avoided by France) in the area of legal expenses, including defending proposals and analyzing and commenting on new and proposed regulations.



Source: Nuclear Regulatory Commission Annual Reports, 1973, 1983, 1992.

Figure 4. Composition of nuclear power capital costs in the United States, 1973–1992.



Source : Capron, J-M., "Les coûts de référence de la production d'électricité," French Ministry of Industry, November 1993.

Figure 5. French reference nuclear costs during construction, 1970–1988.

DISCUSSION AND CONCLUSION

This paper presents arguments asserting that the effects of non-parametric uncertainty on an institutional environment may be felt at the level of transactions within particular industrial sectors of an economy, bearing out the general assertion that "institutional details matter." France, with its well-insulated governmental setup, has avoided the problems the United States encountered, is because the U.S. government setup best characterized as open to input from virtually all interested parties.

Taken as a whole, the effects of division of power, weak bureaucracy, and especially access to an independent Judiciary spelled trouble for the industry in America. U.S. utilities could not stem regulatory changes under the post-TMI regulatory institutional environment. The effect of unanticipated changes in uncertainty surrounding regulatory practice caused an escalation in costs and lead times unforeseen by utilities (Hewlett, 1994, p. 122). For example, for plants entering construction in the mid-1960s, forecast errors in interest costs were about 110 percent, which increased to about 170 percent for units entering construction 10 years later. Also, for an "average" plant at 25 percent of completion, managerial estimates of average lead times increased by 73 percent from 1967 to 1977 (Hewlett, 1994). The French institutional environment, on the other hand, is characterized by important protective attributes: concentrated power in the Executive and the ministries, a strong, expert bureaucracy, and no access for citizens to an independent Judiciary. The French political structure can carry out a long-term policy while ignoring the fluctuations of public opinion. The disadvantage of the French structure is the alienation that can result between the public and the government when a large segment of the population's concerns are not incorporated into policy. Powerless courts and the independent nature of bureaucracies, such as the Ministry of Industry, coupled with the power of the ruling party to enforce party preferences served to insulate French nuclear programs from the wrath of the people. Industry costs are thus expected to be comparatively more stable over time for France than for the United States.

When non-parametric uncertainty impinges on an industry, behavioral uncertainty is also affected, in turn affecting transaction costs. The sequence of the model is

Table 2. Comparative transaction costs.

	France	U.S.(pre-activist)	U.S. (activist)
<i>Facets of the institutional environment:</i>			
Division of power	Centralized: executive, bureaucracy (PEON and Ministry of Industry), utility (EDF)	Centralized: AEC, JCAE	Fragmented: Congress multiple committees, states (PUCs), judiciary
Strength of the bureaucracy	very strong	strong	weak
Judiciary	non-independent	independent, but not engaged by activists	independent and engaged by activists
Cultural norms	strong	weak	weak
Resulting access points to Foment Non-Parametric Uncertainty	few	few	many
Non-parametric uncertainty	low	low	high
<i>Transaction attributes:</i>			
Behavioral uncertainty resulting from exogenous nonparametric uncertainty	low	low	high
Asset specificity	high	high	high
Frequency	high	high	high
<i>Transaction costs :</i>			
capital, safety, monitoring, legal	low	low	high

presented in the context of France and the United States (in pre-activist and activist periods for the United States) in Table 2. Differences in governance efficacy are amplified by the effects of distorting behavioral uncertainty via non-parametric uncertainty. In this sense, PPT and TCE are shown to be compatible as PPT provides a method for explaining changes in the institutional environment (the game of the rules). By modeling the set of preferences of the players and the sequence of play, the PPT methodology proved useful to predict the set of changes in policy outcomes in France and in the United States in both periods (Figures 2 and 3). The contribution of this work lies not in the study of the effect of regulation on the organization of industries, but in the study of how uncertainty regarding regulatory changes is costly for industry. The use of TCE to disentangle transactions, complemented by PPT to

concretely characterize the institutional environment has facilitated a theory-based explanation of outcomes in an internationally comparative vein. This work is in broad agreement with Levy and Spiller's (1994), but adds the wrinkle that an independent Judiciary may (when opposing interest groups become significant players) reduce the prospects for credible government commitment to industry.

Note, however, that none of government structures discussed meet all the ostensible "goals" of a democratic system. In this sense, and speaking broadly, governance may be said to be "misaligned" with transaction attributes in both countries: French government fails to credibly commit to its constituents, the general public (who have no voice in nuclear policy), and U.S. government commitment to industry is similarly non-credible. The American system leads to nuclear industry decline and the French system seems impervious to public opinion. This paper does not advocate technocratic, antidemocratic forms of policy planning, nor does it make recommendations about whether the United States should try to revive the nuclear sector, and, how best to proceed in this endeavor. The authors have merely tried to point out the effects of outside influences (i.e., public access to review procedures and a credible, supportive environment for government investment in specific assets) on industry transaction costs.

In the United States, the TMI incident in 1979 accelerated the decline of the nuclear industry. What if an incident like TMI had happened in France? The model suggests that the public would never have been informed; the strong bureaucracy and unified Executive/Legislative branches may have kept the public ignorant. What then, if a Chernobyl were to happen in France? As the media would play its role, asymmetry of information between government officials and public opinion would be much lower. The model suggests that the system would collapse completely and rapidly, instead of incrementally as in the United States.

Evidence was presented that supports the idea that transaction costs are higher in the United States than France for nuclear power. This evidence, however, is not empirically unassailable. In particular, the main focus is on transaction costs associated with the construction of nuclear power plants. Further analysis should take into account the transaction costs associated with operation and decommissioning nuclear plants; these issues have also played an important role in the problems of the nuclear industry.²¹

Nuclear power in the United States today remains under similar (though currently dormant) pressure to that experienced during the 1970s and 1980s. The pressure does not seem so intense today because the anti-nuclear movement in the United States has apparently succeeded brilliantly with its "impose delay to impose transaction costs" strategy. Estimates, however, projecting the potential costs of nuclear energy in all participating countries for the future consistently fail to take transaction costs as a function of institutional environment into account. "Nuclear generation costs are conventionally split into three main components: capital investment, fuel and non-fuel operation and maintenance costs" (NEA, 1984, p. 45). These findings suggest that other regulated industries that experience significant controversy may be suitable for analysis using this approach.

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²¹ An analysis prepared by the Electric Power Research Institute shows that, from 1981 to 1988, operations and maintenance (O&M) costs increased by 80 percent (adjusted for inflation) and the average plant staff doubled. The EPRI study found that 30 to 60 percent of O&M costs were attributable to NRC requirements (Byus, 1990).

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